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<td>Class ElementDefaultClassLookup</td>
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</tr>
<tr>
<td>Class ElementNamespaceClassLookup</td>
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</tr>
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<td>Class Error</td>
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<tr>
<td>Class ErrorDomains</td>
<td>316</td>
</tr>
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<td>Class ErrorLevels</td>
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<td>Class ErrorTypes</td>
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</tr>
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<td>Class FallbackElementClassLookup</td>
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<td>Class HTMLParser</td>
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<tr>
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<td>Class LxmlSyntaxError</td>
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<tr>
<td>Class NamespaceRegistryError</td>
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</tr>
<tr>
<td>Class PIBase</td>
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</tr>
<tr>
<td>Class ParseError</td>
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</tr>
<tr>
<td>Class ParserBasedElementClassLookup</td>
<td>358</td>
</tr>
<tr>
<td>Class ParseErrorLog</td>
<td>360</td>
</tr>
<tr>
<td>Class PythonElementClassLookup</td>
<td>362</td>
</tr>
<tr>
<td>Class QName</td>
<td>363</td>
</tr>
<tr>
<td>Class RelaxNG</td>
<td>365</td>
</tr>
<tr>
<td>Class RelaxNG ParseError</td>
<td>370</td>
</tr>
<tr>
<td>Class RelaxNG ValidateError</td>
<td>371</td>
</tr>
<tr>
<td>Class Resolver</td>
<td>372</td>
</tr>
<tr>
<td>Class Schematron</td>
<td>373</td>
</tr>
<tr>
<td>Class Schematron ParseError</td>
<td>377</td>
</tr>
<tr>
<td>Class SchematronValidateError</td>
<td>378</td>
</tr>
<tr>
<td>Class SerialisationError</td>
<td>379</td>
</tr>
<tr>
<td>Class TreeBuilder</td>
<td>380</td>
</tr>
<tr>
<td>Class XInclude</td>
<td>381</td>
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<tr>
<td>Class XInclude Error</td>
<td>382</td>
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<tr>
<td>Class XMLParser</td>
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<td>Class XMLSchema</td>
<td>386</td>
</tr>
<tr>
<td>Class XMLSchema ParseError</td>
<td>387</td>
</tr>
<tr>
<td>Class XMLSchema ValidateError</td>
<td>388</td>
</tr>
<tr>
<td>Class XMLSyntaxError</td>
<td>389</td>
</tr>
<tr>
<td>Class XPath</td>
<td>390</td>
</tr>
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<td>Class ETCompatXMLParser</td>
<td>391</td>
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<tr>
<td>Class XPath DocumentEvaluator</td>
<td>394</td>
</tr>
<tr>
<td>Class XPath Error</td>
<td>395</td>
</tr>
<tr>
<td>Class XPath EvalError</td>
<td>397</td>
</tr>
<tr>
<td>Class</td>
<td>Page</td>
</tr>
<tr>
<td>---------------------</td>
<td>------</td>
</tr>
<tr>
<td>NoneElement</td>
<td>460</td>
</tr>
<tr>
<td>NumberElement</td>
<td>463</td>
</tr>
<tr>
<td>ObjectPath</td>
<td>469</td>
</tr>
<tr>
<td>ObjectifiedDataElement</td>
<td>470</td>
</tr>
<tr>
<td>ObjectifiedElement</td>
<td>472</td>
</tr>
<tr>
<td>ObjectifyElementClassLookup</td>
<td>475</td>
</tr>
<tr>
<td>PyType</td>
<td>476</td>
</tr>
<tr>
<td>StringElement</td>
<td>478</td>
</tr>
<tr>
<td>lxml.pyclasslookup</td>
<td>482</td>
</tr>
<tr>
<td>lxml.sax</td>
<td>483</td>
</tr>
<tr>
<td>lxml.usedoctest</td>
<td>490</td>
</tr>
</tbody>
</table>
Part I

lxml
Chapter 1

lxml

“lxml takes all the pain out of XML.”
Stephan Richter

lxml is the most feature-rich and easy-to-use library for processing XML and HTML in the Python language.

Introduction

The lxml XML toolkit is a Pythonic binding for the C libraries libxml2 and libxslt. It is unique in that it combines the speed and XML feature completeness of these libraries with the simplicity of a native Python API, mostly compatible but superior to the well-known ElementTree API. The latest release works with all CPython versions from 2.6 to 3.4. See the introduction for more information about background and goals of the lxml project. Some common questions are answered in the FAQ.

Documentation

The complete lxml documentation is available for download as PDF documentation. The HTML documentation from this web site is part of the normal source download.

- Tutorials:
  - the lxml.etree tutorial for XML processing
  - John Shipman’s tutorial on Python XML processing with lxml
  - Fredrik Lundh’s tutorial for ElementTree

- ElementTree:
  - ElementTree API
  - compatibility and differences of lxml.etree
  - ElementTree performance characteristics and comparison

- lxml.etree:
- lxml.etree specific API documentation
- the generated API documentation as a reference
- parsing and validating XML
- XPath and XSLT support
- Python XPath extension functions for XPath and XSLT
- custom XML element classes for custom XML APIs (see EuroPython 2008 talk)
- a SAX compliant API for interfacing with other XML tools
- a C-level API for interfacing with external C/Cython modules

lxml.objectify:

- lxml.objectify API documentation
- a brief comparison of objectify and etree

lxml.etree follows the ElementTree API as much as possible, building it on top of the native libxml2 tree. If you are new to ElementTree, start with the lxml.etree tutorial for XML processing. See also the ElementTree compatibility overview and the ElementTree performance page comparing lxml to the original ElementTree and cElementTree implementations.

Right after the lxml.etree tutorial for XML processing and the ElementTree documentation, the next place to look is the lxml.etree specific API documentation. It describes how lxml extends the ElementTree API to expose libxml2 and libxslt specific XML functionality, such as XPath, Relax NG, XML Schema, XSLT, and c14n. Python code can be called from XPath expressions and XSLT stylesheets through the use of XPath extension functions. lxml also offers a SAX compliant API, that works with the SAX support in the standard library.

There is a separate module lxml.objectify that implements a data-binding API on top of lxml.etree. See the objectify and etree FAQ entry for a comparison.

In addition to the ElementTree API, lxml also features a sophisticated API for custom XML element classes. This is a simple way to write arbitrary XML driven APIs on top of lxml. lxml.etree also has a C-level API that can be used to efficiently extend lxml.etree in external C modules, including fast custom element class support.

Download

The best way to download lxml is to visit lxml at the Python Package Index (PyPI). It has the source that compiles on various platforms. The source distribution is signed with this key.

The latest version is lxml 3.4.4, released 2015-04-25 (changes for 3.4.4). Older versions are listed below.

Please take a look at the installation instructions !

This complete web site (including the generated API documentation) is part of the source distribution, so if you want to download the documentation for offline use, take the source archive and copy the doc/html directory out of the source tree, or use the PDF documentation.

The latest installable developer sources should usually be available from the build server. It’s also possible to check out the latest development version of lxml from github directly, using a command like this (assuming you use hg and have hg-git installed):

```
hg clone git://github.com/lxml/lxml.git lxml
```
Alternatively, if you use git, this should work as well:

```bash
git clone git://github.com/lxml/lxml.git lxml
```

You can browse the source repository and its history through the web. Please read how to build lxml from source first. The latest CHANGES of the developer version are also accessible. You can check there if a bug you found has been fixed or a feature you want has been implemented in the latest trunk version.

**Mailing list**

Questions? Suggestions? Code to contribute? We have a mailing list.

You can search the archive with Gmane or Google.

**Bug tracker**

lxml uses the launchpad bug tracker. If you are sure you found a bug in lxml, please file a bug report there. If you are not sure whether some unexpected behaviour of lxml is a bug or not, please check the documentation and ask on the mailing list first. Do not forget to search the archive (e.g. with Gmane)!

**License**

The lxml library is shipped under a BSD license. libxml2 and libxslt2 itself are shipped under the MIT license. There should therefore be no obstacle to using lxml in your codebase.

**Old Versions**

See the web sites of lxml 1.3, 2.0, 2.1, 2.2, 2.3, 3.0, 3.1, 3.2, 3.3 and the latest in-development version.

- lxml 3.4.4, released 2015-04-25 (changes for 3.4.4)
- lxml 3.4.3, released 2015-04-15 (changes for 3.4.3)
- lxml 3.4.2, released 2015-02-07 (changes for 3.4.2)
- lxml 3.4.1, released 2014-11-20 (changes for 3.4.1)
- lxml 3.4.0, released 2014-09-10 (changes for 3.4.0)
- lxml 3.4.0beta1, released 2014-09-05 (changes for 3.4.0beta1)
- lxml 3.3.6, released 2014-08-28 (changes for 3.3.6)
- lxml 3.3.5, released 2014-04-18 (changes for 3.3.5)
- lxml 3.3.4, released 2014-04-03 (changes for 3.3.4)
- lxml 3.3.3, released 2014-03-04 (changes for 3.3.3)
- lxml 3.3.2, released 2014-02-26 (changes for 3.3.2)
- lxml 3.3.1, released 2014-02-12 (changes for 3.3.1)
• lxml 3.3.0, released 2014-01-26 (changes for 3.3.0)
• lxml 3.3.0beta5, released 2014-01-18 (changes for 3.3.0beta5)
• lxml 3.3.0beta4, released 2014-01-12 (changes for 3.3.0beta4)
• lxml 3.3.0beta3, released 2014-01-02 (changes for 3.3.0beta3)
• lxml 3.3.0beta2, released 2013-12-20 (changes for 3.3.0beta2)
• lxml 3.3.0beta1, released 2013-12-12 (changes for 3.3.0beta1)
• lxml 3.2.4, released 2013-11-07 (changes for 3.2.4)
• lxml 3.2.3, released 2013-07-28 (changes for 3.2.3)
• lxml 3.2.2, released 2013-07-28 (changes for 3.2.2)
• lxml 3.2.1, released 2013-05-11 (changes for 3.2.1)
• lxml 3.2.0, released 2013-04-28 (changes for 3.2.0)
• lxml 3.1.2, released 2013-04-12 (changes for 3.1.2)
• lxml 3.1.1, released 2013-03-29 (changes for 3.1.1)
• lxml 3.1.0, released 2013-02-10 (changes for 3.1.0)
• lxml 3.1beta1, released 2012-12-21 (changes for 3.1beta1)
• lxml 3.0.2, released 2012-12-14 (changes for 3.0.2)
• lxml 3.0.1, released 2012-10-14 (changes for 3.0.1)
• lxml 3.0, released 2012-10-08 (changes for 3.0)
• older releases
Chapter 2

Why lxml?

Motto

“the thrills without the strangeness”

To explain the motto:

“Programming with libxml2 is like the thrilling embrace of an exotic stranger. It seems to have the potential to fulfill your wildest dreams, but there’s a nagging voice somewhere in your head warning you that you’re about to get screwed in the worst way.” (a quote by Mark Pilgrim)

Mark Pilgrim was describing in particular the experience a Python programmer has when dealing with libxml2. The default Python bindings of libxml2 are fast, thrilling, powerful, and your code might fail in some horrible way that you really shouldn’t have to worry about when writing Python code. lxml combines the power of libxml2 with the ease of use of Python.

Aims

The C libraries libxml2 and libxslt have huge benefits:

- Standards-compliant XML support.
- Support for (broken) HTML.
- Full-featured.
- Actively maintained by XML experts.
- fast. fast! FAST!

These libraries already ship with Python bindings, but these Python bindings mimic the C-level interface. This yields a number of problems:

- very low level and C-ish (not Pythonic).
- underdocumented and huge, you get lost in them.
- UTF-8 in API, instead of Python unicode strings.
- Can easily cause segfaults from Python.
lxml is a new Python binding for libxml2 and libxslt, completely independent from these existing Python bindings. Its aims:

- Pythonic API.
- Documented.
- Use Python unicode strings in API.
- Safe (no segfaults).
- No manual memory management!

lxml aims to provide a Pythonic API by following as much as possible the ElementTree API. We’re trying to avoid inventing too many new APIs, or you having to learn new things -- XML is complicated enough.
Chapter 3

Installing lxml

Where to get it

lxml is generally distributed through PyPI.

Most Linux platforms come with some version of lxml readily packaged, usually named python-lxml for the Python 2.x version and python3-lxml for Python 3.x. If you can use that version, the quickest way to install lxml is to use the system package manager, e.g. `apt-get` on Debian/Ubuntu:

```bash
sudo apt-get install python3-lxml
```

For MacOS-X, a macport of lxml is available. Try something like

```bash
sudo port install py27-lxml
```

To install a newer version or to install lxml on other systems, see below.

Requirements

You need Python 2.6 or later.

Unless you are using a static binary distribution (e.g. from a Windows binary installer), lxml requires libxml2 and libxslt to be installed, in particular:

- **libxml2** version 2.7.0 or later.
  - We recommend libxml2 2.9.0 or a later version.
  - If you want to use the feed parser interface, especially when parsing from unicode strings, do not use libxml2 2.7.4 through 2.7.6.

- **libxslt** version 1.1.23 or later.
  - We recommend libxslt 1.1.26 or later. Version 1.1.25 will not work due to a missing library symbol.

Newer versions generally contain fewer bugs and are therefore recommended. XML Schema support is also still worked on in libxml2, so newer versions will give you better compliance with the W3C spec.

To install the required development packages of these dependencies on Linux systems, use your distribution specific installation tool, e.g. `apt-get` on Debian/Ubuntu:
Installation

For Debian based systems, it should be enough to install the known build dependencies of the provided lxml package, e.g.

```
sudo apt-get build-dep python3-lxml
```

Installation

If your system does not provide binary packages or you want to install a newer version, the best way is to get the pip package management tool (or use a virtualenv) and run the following:

```
pip install lxml
```

If you are not using pip in a virtualenv and want to install lxml globally instead, you have to run the above command as admin, e.g. on Linux:

```
sudo pip install lxml
```

To install a specific version, either download the distribution manually and let pip install that, or pass the desired version to pip:

```
pip install lxml==3.4.2
```

To speed up the build in test environments, e.g. on a continuous integration server, disable the C compiler optimisations by setting the CFLAGS environment variable:

```
CFLAGS="-O0" pip install lxml
```

(The option reads “minus Oh Zero”, i.e. zero optimisations.)

MS Windows

For MS Windows, recent lxml releases feature community donated binary distributions, although you might still want to take a look at the related FAQ entry. If you fail to build lxml on your MS Windows system from the signed and tested sources that we release, consider using the binary builds from PyPI or the unofficial Windows binaries that Christoph Gohlke generously provides.

Linux

On Linux (and most other well-behaved operating systems), pip will manage to build the source distribution as long as libxml2 and libxslt are properly installed, including development packages, i.e. header files, etc. See the requirements section above and use your system package management tool to look for packages like libxml2-dev or libxslt-devel. If the build fails, make sure they are installed.

Alternatively, setting STATIC_DEPS=true will download and build both libraries automatically in their latest version, e.g. STATIC_DEPS=true pip install lxml.

MacOS-X

On MacOS-X, use the following to build the source distribution, and make sure you have a working Internet connection, as this will download libxml2 and libxslt in order to build them:
Building lxml from dev sources

If you want to build lxml from the GitHub repository, you should read how to build lxml from source (or the file doc/build.txt in the source tree). Building from developer sources or from modified distribution sources requires Cython to translate the lxml sources into C code. The source distribution ships with pre-generated C source files, so you do not need Cython installed to build from release sources.

If you have read these instructions and still cannot manage to install lxml, you can check the archives of the mailing list to see if your problem is known or otherwise send a mail to the list.

Using lxml with python-libxml2

If you want to use lxml together with the official libxml2 Python bindings (maybe because one of your dependencies uses it), you must build lxml statically. Otherwise, the two packages will interfere in places where the libxml2 library requires global configuration, which can have any kind of effect from disappearing functionality to crashes in either of the two.

To get a static build, either pass the --static-deps option to the setup.py script, or run pip with the STATIC_DEPS or STATICBUILD environment variable set to true, i.e.

STATIC_DEPS=true pip install lxml

The STATICBUILD environment variable is handled equivalently to the STATIC_DEPS variable, but is used by some other extension packages, too.

Source builds on MS Windows

Most MS Windows systems lack the necessarily tools to build software, starting with a C compiler already. Microsoft leaves it to users to install and configure them, which is usually not trivial and means that distributors cannot rely on these dependencies being available on a given system. In a way, you get what you’ve paid for and make others pay for it.

Due to the additional lack of package management of this platform, it is best to link the library dependencies statically if you decide to build from sources, rather than using a binary installer. For that, lxml can use the binary distribution of libxml2 and libxslt, which it downloads automatically during the static build. It needs both libxml2 and libxslt, as well as iconv and zlib, which are available from the same download site. Further build instructions are in the source build documentation.

Source builds on MacOS-X

If you are not using macports or want to use a more recent lxml release, you have to build it yourself. While the pre-installed system libraries of libxml2 and libxslt are less outdated in recent MacOS-X versions than they used to be, so lxml should work them them out of the box, it is still recommended to use a static build with the most recent library versions.

Luckily, lxml's setup.py script has built-in support for building and integrating these libraries statically during the build. Please read the MacOS-X build instructions.
Chapter 4

Benchmarks and Speed

Author: Stefan Behnel

lxml.etree is a very fast XML library. Most of this is due to the speed of libxml2, e.g. the parser and serialiser, or the XPath engine. Other areas of lxml were specifically written for high performance in high-level operations, such as the tree iterators.

On the other hand, the simplicity of lxml sometimes hides internal operations that are more costly than the API suggests. If you are not aware of these cases, lxml may not always perform as you expect. A common example in the Python world is the Python list type. New users often expect it to be a linked list, while it actually is implemented as an array, which results in a completely different complexity for common operations.

Similarly, the tree model of libxml2 is more complex than what lxml’s ElementTree API projects into Python space, so some operations may show unexpected performance. Rest assured that most lxml users will not notice this in real life, as lxml is very fast in absolute numbers. It is definitely fast enough for most applications, so lxml is probably somewhere between ‘fast enough’ and ‘the best choice’ for yours. Read some messages from happy users to see what we mean.

This text describes where lxml.etree (abbreviated to 'lxe') excels, gives hints on some performance traps and compares the overall performance to the original ElementTree (ET) and cElementTree (cET) libraries by Fredrik Lundh. The cElementTree library is a fast C-implementation of the original ElementTree.

General notes

First thing to say: there is an overhead involved in having a DOM-like C library mimic the ElementTree API. As opposed to ElementTree, lxml has to generate Python representations of tree nodes on the fly when asked for them, and the internal tree structure of libxml2 results in a higher maintenance overhead than the simpler top-down structure of ElementTree. What this means is: the more of your code runs in Python, the less you can benefit from the speed of lxml and libxml2. Note, however, that this is true for most performance critical Python applications. No one would implement fourier transformations in pure Python when you can use NumPy.

The up side then is that lxml provides powerful tools like tree iterators, XPath and XSLT, that can handle complex operations at the speed of C. Their pythonic API in lxml makes them so flexible that most applications can easily benefit from them.
How to read the timings

The statements made here are backed by the (micro-)benchmark scripts bench_etree.py, bench_xpath.py and bench_objectify.py that come with the lxml source distribution. They are distributed under the same BSD license as lxml itself, and the lxml project would like to promote them as a general benchmarking suite for all ElementTree implementations. New benchmarks are very easy to add as tiny test methods, so if you write a performance test for a specific part of the API yourself, please consider sending it to the lxml mailing list.

The timings presented below compare lxml 3.1.1 (with libxml2 2.9.0) to the latest released versions of ElementTree (with cElementTree as accelerator module) in the standard library of CPython 3.3.0. They were run single-threaded on a 2.9GHz 64bit double core Intel i7 machine under Ubuntu Linux 12.10 (Quantal). The C libraries were compiled with the same platform specific optimisation flags. The Python interpreter was also manually compiled for the platform. Note that many of the following ElementTree timings are therefore better than what a normal Python installation with the standard library (c)ElementTree modules would yield. Note also that CPython 2.7 and 3.2+ come with a newer ElementTree version, so older Python installations will not perform as good for (c)ElementTree, and sometimes substantially worse.

The scripts run a number of simple tests on the different libraries, using different XML tree configurations: different tree sizes (T1-4), with or without attributes (-/A), with or without ASCII string or unicode text (-/S/U), and either against a tree or its serialised XML form (T/X). In the result extracts cited below, T1 refers to a 3-level tree with many children at the third level, T2 is swapped around to have many children below the root element, T3 is a deep tree with few children at each level and T4 is a small tree, slightly broader than deep. If repetition is involved, this usually means running the benchmark in a loop over all children of the tree root, otherwise, the operation is run on the root node (C/R).

As an example, the character code (SATR T1) states that the benchmark was running for tree T1, with plain string text (S) and attributes (A). It was run against the root element (R) in the tree structure of the data (T).

Note that very small operations are repeated in integer loops to make them measurable. It is therefore not always possible to compare the absolute timings of, say, a single access benchmark (which usually loops) and a ‘get all in one step’ benchmark, which already takes enough time to be measurable and is therefore measured as is. An example is the index access to a single child, which cannot be compared to the timings for getchildren(). Take a look at the concrete benchmarks in the scripts to understand how the numbers compare.

Parsing and Serialising

Serialisation is an area where lxml excels. The reason is that it executes entirely at the C level, without any interaction with Python code. The results are rather impressive, especially for UTF-8, which is native to libxml2. While 20 to 40 times faster than (c)ElementTree 1.2 (which was part of the standard library before Python 2.7/3.2), lxml is still more than 10 times as fast as the much improved ElementTree 1.3 in recent Python versions:

```
lxe: tostring_utf16 (S-TR T1) 7.9958 msec/pass
lxe: tostring_utf16 (UATR T1) 8.3222 msec/pass
lxe: tostring_utf8 (S-TR T2) 6.5677 msec/pass
lxe: tostring_utf8 (U-TR T3) 1.1952 msec/pass
```
The difference is somewhat smaller for plain text serialisation:

<table>
<thead>
<tr>
<th>Method</th>
<th>Time (msec/pass)</th>
</tr>
</thead>
<tbody>
<tr>
<td>lxe: tostring_text_ascii(S-TR T1)</td>
<td>2.7738</td>
</tr>
<tr>
<td>cET: tostring_text_ascii(S-TR T1)</td>
<td>4.7629</td>
</tr>
<tr>
<td>lxe: tostring_text_ascii(S-TR T3)</td>
<td>0.8273</td>
</tr>
<tr>
<td>cET: tostring_text_ascii(S-TR T3)</td>
<td>1.5273</td>
</tr>
<tr>
<td>lxe: tostring_text_utf16(S-TR T1)</td>
<td>2.7659</td>
</tr>
<tr>
<td>cET: tostring_text_utf16(S-TR T1)</td>
<td>10.5038</td>
</tr>
<tr>
<td>lxe: tostring_text_utf16(U-TR T1)</td>
<td>2.8017</td>
</tr>
<tr>
<td>cET: tostring_text_utf16(U-TR T1)</td>
<td>10.5207</td>
</tr>
<tr>
<td>lxe: tostring_text_unicode(S-TR T1)</td>
<td>2.6896</td>
</tr>
<tr>
<td>cET: tostring_text_unicode(S-TR T1)</td>
<td>1.0056</td>
</tr>
<tr>
<td>lxe: tostring_text_unicode(U-TR T1)</td>
<td>2.7366</td>
</tr>
<tr>
<td>cET: tostring_text_unicode(U-TR T1)</td>
<td>1.0154</td>
</tr>
<tr>
<td>lxe: tostring_text_unicode(S-TR T3)</td>
<td>0.7997</td>
</tr>
<tr>
<td>cET: tostring_text_unicode(S-TR T3)</td>
<td>0.3154</td>
</tr>
<tr>
<td>lxe: tostring_text_unicode(U-TR T4)</td>
<td>0.0048</td>
</tr>
<tr>
<td>cET: tostring_text_unicode(U-TR T4)</td>
<td>0.0160</td>
</tr>
</tbody>
</table>

The `tostring()` function also supports serialisation to a Python unicode string object, which is currently faster in ElementTree under CPython 3.3:

<table>
<thead>
<tr>
<th>Method</th>
<th>Time (msec/pass)</th>
</tr>
</thead>
<tbody>
<tr>
<td>lxe: tostring_text_unicode(S-TR T1)</td>
<td>2.6896</td>
</tr>
<tr>
<td>cET: tostring_text_unicode(S-TR T1)</td>
<td>1.0056</td>
</tr>
<tr>
<td>lxe: tostring_text_unicode(U-TR T1)</td>
<td>2.7366</td>
</tr>
<tr>
<td>cET: tostring_text_unicode(U-TR T1)</td>
<td>1.0154</td>
</tr>
<tr>
<td>lxe: tostring_text_unicode(S-TR T3)</td>
<td>0.7997</td>
</tr>
<tr>
<td>cET: tostring_text_unicode(S-TR T3)</td>
<td>0.3154</td>
</tr>
<tr>
<td>lxe: tostring_text_unicode(U-TR T4)</td>
<td>0.0048</td>
</tr>
<tr>
<td>cET: tostring_text_unicode(U-TR T4)</td>
<td>0.0160</td>
</tr>
</tbody>
</table>

For parsing, lxml.etree and cElementTree compete for the medal. Depending on the input, either of the two can be faster. The (c)ET libraries use a very thin layer on top of the expat parser, which is known to be very fast. Here are some timings from the benchmarking suite:

<table>
<thead>
<tr>
<th>Method</th>
<th>Time (msec/pass)</th>
</tr>
</thead>
<tbody>
<tr>
<td>lxe: parse_bytesIO (SAXR T1)</td>
<td>13.0246</td>
</tr>
<tr>
<td>cET: parse_bytesIO (SAXR T1)</td>
<td>8.2929</td>
</tr>
<tr>
<td>lxe: parse_bytesIO (S-XR T3)</td>
<td>1.3542</td>
</tr>
<tr>
<td>cET: parse_bytesIO (S-XR T3)</td>
<td>2.4023</td>
</tr>
<tr>
<td>lxe: parse_bytesIO (UAXR T3)</td>
<td>7.5610</td>
</tr>
<tr>
<td>cET: parse_bytesIO (UAXR T3)</td>
<td>11.2455</td>
</tr>
</tbody>
</table>

And another couple of timings from a benchmark that Fredrik Lundh used to promote cElementTree, comparing a number of different parsers. First, parsing a 274KB XML file containing Shakespeare’s Hamlet:

- xml.etree.ElementTree.parse done in 0.017 seconds
- xml.etree.cElementTree.parse done in 0.007 seconds
- xml.etree.cElementTree.XMLParser.feed(): 6636 nodes read in 0.007 seconds
- lxml.etree.parse done in 0.003 seconds
- drop_whitespace.parse done in 0.003 seconds
- minidom tree read in 0.080 seconds

And a 3.4MB XML file containing the Old Testament:

- xml.etree.ElementTree.parse done in 0.038 seconds
Here are the same benchmarks again, but including the memory usage of the process in KB before and after parsing (using os.fork() to make sure we start from a clean state each time). For the 274KB hamlet.xml file:

Memory usage: 7284
xml.etree.ElementTree.parse done in 0.017 seconds
Memory usage: 9432 (+2148)
xmI.etree.cElementTree.parse done in 0.007 seconds
Memory usage: 9432 (+2152)
xmI.etree.cElementTree.XMIParser.feed(): 6636 nodes read in 0.007 seconds
Memory usage: 9448 (+2164)
xmI.etree.parse done in 0.003 seconds
Memory usage: 11032 (+3748)
drop_whitespace.parse done in 0.003 seconds
Memory usage: 10224 (+2940)
xmI.etree.XMLParser.feed(): 6636 nodes read in 0.004 seconds
Memory usage: 11804 (+4520)
minidom tree read in 0.080 seconds
Memory usage: 12324 (+5040)

And for the 3.4MB Old Testament XML file:

Memory usage: 10420
xml.etree.ElementTree.parse done in 0.038 seconds
Memory usage: 20660 (+10240)
xmI.etree.cElementTree.parse done in 0.030 seconds
Memory usage: 20660 (+10240)
xmI.etree.cElementTree.XMIParser.feed(): 25317 nodes read in 0.030 seconds
Memory usage: 20844 (+10424)
xmI.etree.parse done in 0.016 seconds
Memory usage: 27624 (+17204)
drop_whitespace.parse done in 0.015 seconds
Memory usage: 24468 (+14052)
xmI.etree.XMLParser.feed(): 25317 nodes read in 0.022 seconds
Memory usage: 29844 (+19424)
minidom tree read in 0.288 seconds
Memory usage: 28788 (+18368)

As can be seen from the sizes, both lxml.etree and cElementTree are rather memory friendly compared to the pure Python libraries ElementTree and (especially) minidom. Comparing to older CPython versions, the memory footprint of the minidom library was considerably reduced in CPython 3.3, by about a factor of 4 in this case.

For plain parser performance, lxml.etree and cElementTree tend to stay rather close to each other, usually within a factor of two, with winners well distributed over both sides. Similar timings can be observed for the iterparse() function:

```python
lxe: iterparse_bytesIO (SAXR T1) 17.9198 msec/pass
cET: iterparse_bytesIO (SAXR T1) 14.4982 msec/pass
lxe: iterparse_bytesIO (UAXR T3) 8.8522 msec/pass
cET: iterparse_bytesIO (UAXR T3) 12.9857 msec/pass
```
However, if you benchmark the complete round-trip of a serialise-parse cycle, the numbers will look similar to these:

- **lxe: write_utf8_parse_bytesIO (S-TR T1)**: 19.8867 msec/pass
- **cET: write_utf8_parse_bytesIO (S-TR T1)**: 80.7259 msec/pass
- **lxe: write_utf8_parse_bytesIO (UATR T2)**: 23.7896 msec/pass
- **cET: write_utf8_parse_bytesIO (UATR T2)**: 98.0766 msec/pass
- **lxe: write_utf8_parse_bytesIO (S-TR T3)**: 3.0684 msec/pass
- **cET: write_utf8_parse_bytesIO (S-TR T3)**: 24.6122 msec/pass
- **lxe: write_utf8_parse_bytesIO (SATR T4)**: 0.3495 msec/pass
- **cET: write_utf8_parse_bytesIO (SATR T4)**: 1.9610 msec/pass

For applications that require a high parser throughput of large files, and that do little to no serialization, both cET and lxml.etree are a good choice. The cET library is particularly fast for iterparse applications that extract small amounts of data or aggregate information from large XML data sets that do not fit into memory. If it comes to round-trip performance, however, lxml is multiple times faster in total. So, whenever the input documents are not considerably larger than the output, lxml is the clear winner.

Regarding HTML parsing, Ian Bicking has done some benchmarking on lxml’s HTML parser, comparing it to a number of other famous HTML parser tools for Python. lxml wins this contest by quite a length. To give an idea, the numbers suggest that lxml.html can run a couple of parse-serialise cycles in the time that other tools need for parsing alone. The comparison even shows some very favourable results regarding memory consumption.

Liza Daly has written an article that presents a couple of tweaks to get the most out of lxml’s parser for very large XML documents. She quite favourably positions lxml.etree as a tool for high-performance XML parsing.

Finally, xml.com has a couple of publications about XML parser performance. Farwick and Hafner have written two interesting articles that compare the parser of libxml2 to some major Java based XML parsers. One deals with event-driven parser performance, the other one presents benchmark results comparing DOM parsers. Both comparisons suggest that libxml2’s parser performance is largely superior to all commonly used Java parsers in almost all cases. Note that the C parser benchmark results are based on xmlbench, which uses a simpler setup for libxml2 than lxml does.

### The ElementTree API

Since all three libraries implement the same API, their performance is easy to compare in this area. A major disadvantage for lxml’s performance is the different tree model that underlies libxml2. It allows lxml to provide parent pointers for elements and full XPath support, but also increases the overhead of tree building and restructuring. This can be seen from the tree setup times of the benchmark (given in seconds):

- **lxe:**
  - T1: 0.0299 0.0343 0.0344 0.0293 0.0345 0.0342
  - T2: 0.0368 0.0423 0.0418 0.0427 0.0474 0.0459
  - T3: 0.0088 0.0084 0.0086 0.0251 0.0258 0.0261
  - T4: 0.0002 0.0002 0.0002 0.0005 0.0006 0.0006
- **cET:**
  - T1: 0.0050 0.0045 0.0093 0.0044 0.0043 0.0043
  - T2: 0.0073 0.0075 0.0074 0.0201 0.0075 0.0074
  - T3: 0.0033 0.0213 0.0032 0.0034 0.0033 0.0035
  - T4: 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

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Child access

The timings are somewhat close to each other, although cET can be several times faster than lxml for larger trees. One of the reasons is that lxml must encode incoming string data and tag names into UTF-8, and additionally discard the created Python elements after their use, when they are no longer referenced. ElementTree represents the tree itself through these objects, which reduces the overhead in creating them.

Child access

The same tree overhead makes operations like collecting children as in list(element) more costly in lxml. Where cET can quickly create a shallow copy of their list of children, lxml has to create a Python object for each child and collect them in a list:

<table>
<thead>
<tr>
<th></th>
<th>Duration (msec/pass)</th>
</tr>
</thead>
<tbody>
<tr>
<td>lxe</td>
<td>root_list_children</td>
</tr>
<tr>
<td>cET</td>
<td>root_list_children</td>
</tr>
<tr>
<td>lxe</td>
<td>root_list_children</td>
</tr>
<tr>
<td>cET</td>
<td>root_list_children</td>
</tr>
</tbody>
</table>

This handicap is also visible when accessing single children:

<table>
<thead>
<tr>
<th></th>
<th>Duration (msec/pass)</th>
</tr>
</thead>
<tbody>
<tr>
<td>lxe</td>
<td>first_child</td>
</tr>
<tr>
<td>cET</td>
<td>first_child</td>
</tr>
<tr>
<td>lxe</td>
<td>last_child</td>
</tr>
<tr>
<td>cET</td>
<td>last_child</td>
</tr>
</tbody>
</table>

... unless you also add the time to find a child index in a bigger list. ET and cET use Python lists here, which are based on arrays. The data structure used by libxml2 is a linked tree, and thus, a linked list of children:

<table>
<thead>
<tr>
<th></th>
<th>Duration (msec/pass)</th>
</tr>
</thead>
<tbody>
<tr>
<td>lxe</td>
<td>middle_child</td>
</tr>
<tr>
<td>cET</td>
<td>middle_child</td>
</tr>
<tr>
<td>lxe</td>
<td>middle_child</td>
</tr>
<tr>
<td>cET</td>
<td>middle_child</td>
</tr>
</tbody>
</table>

Element creation

As opposed to ET, libxml2 has a notion of documents that each element must be in. This results in a major performance difference for creating independent Elements that end up in independently created documents:

<table>
<thead>
<tr>
<th></th>
<th>Duration (msec/pass)</th>
</tr>
</thead>
<tbody>
<tr>
<td>lxe</td>
<td>create_elements</td>
</tr>
<tr>
<td>cET</td>
<td>create_elements</td>
</tr>
</tbody>
</table>

Therefore, it is always preferable to create Elements for the document they are supposed to end up in, either as SubElements of an Element or using the explicit Element.makeelement() call:

<table>
<thead>
<tr>
<th></th>
<th>Duration (msec/pass)</th>
</tr>
</thead>
<tbody>
<tr>
<td>lxe</td>
<td>makeelement</td>
</tr>
<tr>
<td>cET</td>
<td>makeelement</td>
</tr>
<tr>
<td>lxe</td>
<td>create_subelements</td>
</tr>
<tr>
<td>cET</td>
<td>create_subelements</td>
</tr>
</tbody>
</table>

So, if the main performance bottleneck of an application is creating large XML trees in memory through calls to Element and SubElement, cET is the best choice. Note, however, that the serialisation performance may even out this advantage, especially for smaller trees and trees with many attributes.
Merging different sources

A critical action for lxml is moving elements between document contexts. It requires lxml to do recursive adaptations throughout the moved tree structure.

The following benchmark appends all root children of the second tree to the root of the first tree:

```
  lxe: append_from_document (--TR T1,T2)  1.0812 msec/pass
  cET: append_from_document (--TR T1,T2)  0.1104 msec/pass
  lxe: append_from_document (--TR T3,T4)  0.0155 msec/pass
  cET: append_from_document (--TR T3,T4)  0.0060 msec/pass
```

Although these are fairly small numbers compared to parsing, this easily shows the different performance classes for lxml and (c)ET. Where the latter do not have to care about parent pointers and tree structures, lxml has to deep traverse the appended tree. The performance difference therefore increases with the size of the tree that is moved.

This difference is not always as visible, but applies to most parts of the API, like inserting newly created elements:

```
  lxe: insert_from_document (--TR T1,T2)  3.9763 msec/pass
  cET: insert_from_document (--TR T1,T2)  0.1459 msec/pass
  lxe: replace_children_element (--TC T1)  0.0749 msec/pass
  cET: replace_children_element (--TC T1)  0.0081 msec/pass
```

or replacing the child slice by a newly created element:

```
  lxe: replace_children_element (--TC T1)  0.0052 msec/pass
  cET: replace_children_element (--TC T1)  0.0036 msec/pass
```

as opposed to replacing the slice with an existing element from the same document:

```
  lxe: replace_children (--TC T1)  0.0052 msec/pass
  cET: replace_children (--TC T1)  0.0036 msec/pass
```

While these numbers are too small to provide a major performance impact in practice, you should keep this difference in mind when you merge very large trees. Note that Elements have a `makeelement()` method that allows to create an Element within the same document, thus avoiding the merge overhead when inserting it into that tree.

**deepcopy**

Deep copying a tree is fast in lxml:

```
  lxe: deepcopy_all (--TR T1)  3.1650 msec/pass
  cET: deepcopy_all (--TR T1) 53.9973 msec/pass
  lxe: deepcopy_all (--ATR T2)  3.7365 msec/pass
  cET: deepcopy_all (--ATR T2) 61.6267 msec/pass
  lxe: deepcopy_all (S-TR T3)  0.7913 msec/pass
  cET: deepcopy_all (S-TR T3) 13.6220 msec/pass
```

So, for example, if you have a database-like scenario where you parse in a large tree and then search and copy independent subtrees from it for further processing, lxml is by far the best choice here.
Tree traversal

Another important area in XML processing is iteration for tree traversal. If your algorithms can benefit from step-by-step traversal of the XML tree and especially if few elements are of interest or the target element tag name is known, the .iter() method is a good choice:

Lxml:
- iter_all (--TR T1) 1.0529 msec/pass
- iter_slice (--TR T2) 0.0110 msec/pass
- iter_tag (--TR T2) 0.0079 msec/pass
- iter_tag_all (--TR T2) 0.1822 msec/pass

Chee's ET:
- iter_all (--TR T1) 0.2635 msec/pass
- iter_slice (--TR T2) 0.0050 msec/pass
- iter_tag (--TR T2) 0.0112 msec/pass
- iter_tag_all (--TR T2) 0.5343 msec/pass

This translates directly into similar timings for Element.findall():

Lxml:
- findall (--TR T2) 1.7176 msec/pass
- findall (--TR T3) 0.3967 msec/pass
- findall_tag (--TR T2) 0.2258 msec/pass
- findall_tag (...T3) 0.1085 msec/pass

Chee's ET:
- findall (--TR T2) 0.9973 msec/pass
- findall (--TR T3) 0.2525 msec/pass
- findall_tag (--TR T2) 0.5770 msec/pass
- findall_tag (...T3) 0.1919 msec/pass

Note that all three libraries currently use the same Python implementation for .findall(), except for their native tree iterator (Element.iter()). In general, Lxml is very fast for iteration, but looses ground against Chee's ET when many Elements are found and need to be instantiated. So, the more selective your search is, the faster Lxml will run.

XPath

The following timings are based on the benchmark script bench_xpath.py.

This part of Lxml does not have an equivalent in ElementTree. However, Lxml provides more than one way of accessing it and you should take care which part of the Lxml API you use. The most straight forward way is to call the xpath() method on an Element or ElementTree:

Lxml:
- xpath_method (--TC T1) 0.3982 msec/pass
- xpath_method (--TC T2) 0.3982 msec/pass
- xpath_method (--TC T3) 0.0477 msec/pass
- xpath_method (--TC T4) 0.3982 msec/pass

This is well suited for testing and when the XPath expressions are as diverse as the trees they are called on. However, if you have a single XPath expression that you want to apply to a larger number of different elements, the XPath class is the most efficient way to do it:

Lxml:
- xpath_class (--TC T1) 0.0713 msec/pass
Note that this still allows you to use variables in the expression, so you can parse it once and then adapt it through variables at call time. In other cases, where you have a fixed Element or ElementTree and want to run different expressions on it, you should consider the XPathEvaluator:

A longer example

... based on lxml 1.3.

A while ago, Uche Ogbuji posted a benchmark proposal that would read in a 3MB XML version of the Old Testament of the Bible and look for the word begat in all verses. Apparently, it is contained in 120 out of almost 24000 verses. This is easy to implement in ElementTree using findall(). However, the fastest and most memory friendly way to do this is obviously iterparse(), as most of the data is not of any interest.

Now, Uche’s original proposal was more or less the following:
def bench_ET():
    tree = ElementTree.parse("ot.xml")
    result = []
    for v in tree.findall("//v"):
        text = v.text
        if 'begat' in text:
            result.append(text)
    return len(result)

which takes about one second on my machine today. The faster iterparse() variant looks like this:

def bench_ET_iterparse():
    result = []
    for event, v in ElementTree.iterparse("ot.xml"):  
        if v.tag == 'v':
            text = v.text
            if 'begat' in text:
                result.append(text)
            v.clear()
    return len(result)

The improvement is about 10%. At the time I first tried (early 2006), lxml didn’t have iterparse() support,  
but the findall() variant was already faster than ElementTree. This changes immediately when you switch to  
cElementTree. The latter only needs 0.17 seconds to do the trick today and only some impressive 0.10 seconds  
when running the iterparse version. And even back then, it was quite a bit faster than what lxml could achieve.  

Since then, lxml has matured a lot and has gotten much faster. The iterparse variant now runs in 0.14 seconds, and  
if you remove the v.clear(), it is even a little faster (which isn’t the case for cElementTree).

One of the many great tools in lxml is XPath, a swiss army knife for finding things in XML documents. It is  
possible to move the whole thing to a pure XPath implementation, which looks like this:

def bench_lxml_xpath_all():
    tree = etree.parse("ot.xml")
    result = tree.xpath("//v[contains(., 'begat')]/text()")
    return len(result)

This runs in about 0.13 seconds and is about the shortest possible implementation (in lines of Python code) that I could come up with. Now, this is already a rather complex XPath expression compared to the simple "//v"  
ElementPath expression we started with. Since this is also valid XPath, let’s try this instead:

def bench_lxml_xpath():
    tree = etree.parse("ot.xml")
    result = []
    for v in tree.xpath("//v"):
        text = v.text
        if 'begat' in text:
            result.append(text)
    return len(result)

This gets us down to 0.12 seconds, thus showing that a generic XPath evaluation engine cannot always compete  
with a simpler, tailored solution. However, since this is not much different from the original findall variant, we  
can remove the complexity of the XPath call completely and just go with what we had in the beginning. Under  
lxml, this runs in the same 0.12 seconds.

But there is one thing left to try. We can replace the simple ElementPath expression with a native tree iterator:

def bench_lxml_getiterator():
    tree = etree.parse("ot.xml")
```python
result = []
for v in tree.getiterator("v"):
    text = v.text
    if 'begat' in text:
        result.append(text)
return len(result)
```

This implements the same thing, just without the overhead of parsing and evaluating a path expression. And this makes it another bit faster, down to 0.11 seconds. For comparison, cElementTree runs this version in 0.17 seconds.

So, what have we learned?

- Python code is not slow. The pure XPath solution was not even as fast as the first shot Python implementation. In general, a few more lines in Python make things more readable, which is much more important than the last 5% of performance.
- It’s important to know the available options - and it’s worth starting with the most simple one. In this case, a programmer would then probably have started with `getiterator("v")` or `iterparse()`. Either of them would already have been the most efficient, depending on which library is used.
- It’s important to know your tool. lxml and cElementTree are both very fast libraries, but they do not have the same performance characteristics. The fastest solution in one library can be comparatively slow in the other. If you optimise, optimise for the specific target platform.
- It’s not always worth optimising. After all that hassle we got from 0.12 seconds for the initial implementation to 0.11 seconds. Switching over to cElementTree and writing an `iterparse()` based version would have given us 0.10 seconds - not a big difference for 3MB of XML.
- Take care what operation is really dominating in your use case. If we split up the operations, we can see that lxml is slightly slower than cElementTree on `parse()` (both about 0.06 seconds), but more visibly slower on `iterparse()`: 0.07 versus 0.10 seconds. However, tree iteration in lxml is increadibly fast, so it can be better to parse the whole tree and then iterate over it rather than using `iterparse()` to do both in one step. Or, you can just wait for the lxml developers to optimise `iterparse` in one of the next releases...

### lxml.objectify

The following timings are based on the benchmark script `bench_objectify.py`.

Objectify is a data-binding API for XML based on lxml.etree, that was added in version 1.1. It uses standard Python attribute access to traverse the XML tree. It also features ObjectPath, a fast path language based on the same meme.

Just like lxml.etree, lxml.objectify creates Python representations of elements on the fly. To save memory, the normal Python garbage collection mechanisms will discard them when their last reference is gone. In cases where deeply nested elements are frequently accessed through the objectify API, the create-discard cycles can become a bottleneck, as elements have to be instantiated over and over again.

### ObjectPath

ObjectPath can be used to speed up the access to elements that are deep in the tree. It avoids step-by-step Python element instantiations along the path, which can substantially improve the access time:

```plaintext
lxe: attribute (--TR T1) 4.1828 msec/pass
lxe: attribute (--TR T2) 17.3802 msec/pass
lxe: attribute (--TR T4) 3.8657 msec/pass
```
Caching Elements

A way to improve the normal attribute access time is static instantiation of the Python objects, thus trading memory for speed. Just create a cache dictionary and run:

```
cache[root] = list(root.iter())
```

after parsing and:

```
del cache[root]
```

when you are done with the tree. This will keep the Python element representations of all elements alive and thus avoid the overhead of repeated Python object creation. You can also consider using filters or generator expressions to be more selective. By choosing the right trees (or even subtrees and elements) to cache, you can trade memory usage against access speed:

```
lxe: attribute_cached (--TR T1)  3.1357 msec/pass
lxe: attribute_cached (--TR T2) 15.8911 msec/pass
lxe: attribute_cached (--TR T4)  2.9194 msec/pass
lxe: attributes_deep_cached (--TR T1)  3.8984 msec/pass
lxe: attributes_deep_cached (--TR T2) 16.8300 msec/pass
lxe: attributes_deep_cached (--TR T4)  3.6936 msec/pass
```

Things to note: you cannot currently use `weakref.WeakKeyDictionary` objects for this as lxml’s element objects do not support weak references (which are costly in terms of memory). Also note that new element objects that you add to these trees will not turn up in the cache automatically and will therefore still be garbage collected when all their Python references are gone, so this is most effective for largely immutable trees. You should consider using a set instead of a list in this case and add new elements by hand.

Further optimisations

Here are some more things to try if optimisation is required:

- A lot of time is usually spent in tree traversal to find the addressed elements in the tree. If you often work in
Further optimisations

Further optimisations lxml.objectify

subtrees, do what you would also do with deep Python objects: assign the parent of the subtree to a variable or pass it into functions instead of starting at the root. This allows accessing its descendents more directly.

- Try assigning data values directly to attributes instead of passing them through DataElement.
- If you use custom data types that are costly to parse, try running `objectify.annotate()` over read-only trees to speed up the attribute type inference on read access.

Note that none of these measures is guaranteed to speed up your application. As usual, you should prefer readable code over premature optimisations and profile your expected use cases before bothering to apply optimisations at random.
Chapter 5
ElementTree compatibility of lxml.etree

A lot of care has been taken to ensure compatibility between etree and ElementTree. Nonetheless, some differences and incompatibilities exist:

- Importing etree is obviously different; etree uses a lower-case package name, while ElementTree uses a combination of upper-case and lower case in imports:

  ```python
  # etree
  from lxml.etree import Element
  
  # ElementTree
  from elementtree.ElementTree import Element
  from xml.etree.ElementTree import Element
  
  # ElementTree in the Python 2.5 standard library
  from elementtree.ElementTree import Element
  ```

  When switching over code from ElementTree to lxml.etree, and you’re using the package name prefix ‘ElementTree’, you can do the following:

  ```python
  # instead of
  from elementtree import ElementTree
  # use
  from lxml import etree as ElementTree
  ```

- lxml.etree offers a lot more functionality, such as XPath, XSLT, Relax NG, and XML Schema support, which (c)ElementTree does not offer.

- etree has a different idea about Python unicode strings than ElementTree. In most parts of the API, ElementTree uses plain strings and unicode strings as what they are. This includes Element.text, Element.tail and many other places. However, the ElementTree parsers assume by default that any string (str or unicode) contains ASCII data. They raise an exception if strings do not match the expected encoding.

  etree has the same idea about plain strings (str) as ElementTree. For unicode strings, however, etree assumes throughout the API that they are Python unicode encoded strings rather than byte data. This includes the parsers. It is therefore perfectly correct to pass XML unicode data into the etree parsers in form of Python unicode strings. It is an error, on the other hand, if unicode strings specify an encoding in their XML declaration, as this conflicts with the characteristic encoding of Python unicode strings.

- ElementTree allows you to place an Element in two different trees at the same time. Thus, this:

  ```python
  a = Element('a')
  b = SubElement(a, 'b')
  ```
c = Element('c')
c.append(b)

will result in the following tree a:

```xml
<a><b /></a>
```

and the following tree c:

```xml
<c><b /></c>
```

In lxml, this behavior is different, because lxml is built on top of a tree that maintains parent relationships for elements (like W3C DOM). This means an element can only exist in a single tree at the same time. Adding an element in some tree to another tree will cause this element to be moved.

So, for tree a we will get:

```xml
<a></a>
```

and for tree c we will get:

```xml
<c><b/></c>
```

Unfortunately this is a rather fundamental difference in behavior, which is hard to change. It won’t affect some applications, but if you want to port code you must unfortunately make sure that it doesn’t affect yours.

- etree allows navigation to the parent of a node by the `getparent()` method and to the siblings by calling `getnext()` and `getprevious()`. This is not possible in ElementTree as the underlying tree model does not have this information.

- When trying to set a subelement using `__setitem__` that is in fact not an Element but some other object, etree raises a `TypeError`, and ElementTree raises an `AssertionError`. This also applies to some other places of the API. In general, etree tries to avoid `AssertionErrors` in favour of being more specific about the reason for the exception.

- When parsing fails in `iterparse()`, ElementTree up to version 1.2.x raises a low-level `ExpatError` instead of a `SyntaxError` as the other parsers. Both lxml and ElementTree 1.3 raise a `ParseError` for parser errors.

- The `iterparse()` function in lxml is implemented based on the libxml2 parser and tree generator. This means that modifications of the document root or the ancestors of the current element during parsing can irritate the parser and even segfault. While this is not a problem in the Python object structure used by ElementTree, the C tree underlying lxml suffers from it. The golden rule for `iterparse()` on lxml therefore is: do not touch anything that will have to be touched again by the parser later on. See the lxml parser documentation on this.

- ElementTree ignores comments and processing instructions when parsing XML, while etree will read them in and treat them as Comment or ProcessingInstruction elements respectively. This is especially visible where comments are found inside text content, which is then split by the Comment element.

  You can disable this behaviour by passing the boolean `remove_comments` and/or `remove_pis` keyword arguments to the parser you use. For convenience and to support portable code, you can also use the `etree.ETCompatXMLParser` instead of the default `etree.XMLParser`. It tries to provide a default setup that is as close to the ElementTree parser as possible.

- The `TreeBuilder` class of lxml.etree uses a different signature for the `start()` method. It accepts an additional argument `nsmap` to propagate the namespace declarations of an element in addition to its own namespace. To assure compatibility with ElementTree (which does not support this argument), lxml checks if the method accepts 3 arguments before calling it, and otherwise drops the namespace mapping.
This should work with most existing ElementTree code, although there may still be conflicting cases.

- ElementTree 1.2 has a bug when serializing an empty Comment (no text argument given) to XML, etree serializes this successfully.

- ElementTree adds whitespace around comments on serialization, lxml does not. This means that a comment text "text" that ElementTree serializes as "<!-- text -->" will become "<!--text-->" in lxml.

- When the string ‘*’ is used as tag filter in the Element.getiterator() method, ElementTree returns all elements in the tree, including comments and processing instructions. lxml.etree only returns real Elements, i.e. tree nodes that have a string tag name. Without a filter, both libraries iterate over all nodes.

Note that currently only lxml.etree supports passing the Element factory function as a filter to select only Elements. Both libraries support passing the Comment and ProcessingInstruction factories to select the respective tree nodes.

- ElementTree merges the target of a processing instruction into PI.text, while lxml.etree puts it into the .target property and leaves it out of the .text property. The pi.text in ElementTree therefore corresponds to pi.target + " " + pi.text in lxml.etree.

- Because etree is built on top of libxml2, which is namespace prefix aware, etree preserves namespaces declarations and prefixes while ElementTree tends to come up with its own prefixes (ns0, ns1, etc). When no namespace prefix is given, however, etree creates ElementTree style prefixes as well.

- etree has a ‘prefix’ attribute (read-only) on elements giving the Element’s prefix, if this is known, and None otherwise (in case of no namespace at all, or default namespace).

- etree further allows passing an ‘nsmap’ dictionary to the Element and SubElement element factories to explicitly map namespace prefixes to namespace URIs. These will be translated into namespace declarations on that element. This means that in the probably rare case that you need to construct an attribute called ‘nsmap’, you need to be aware that unlike in ElementTree, you cannot pass it as a keyword argument to the Element and SubElement factories directly.

- ElementTree allows QName objects as attribute values and resolves their prefix on serialisation (e.g. an attribute value QName("{myns}myname") becomes “p:myname” if “p” is the namespace prefix of “myns”). lxml.etree also allows you to set attribute values from QName instances (and also .text values), but it resolves their prefix immediately and stores the plain text value. So, if prefixes are modified later on, e.g. by moving a subtree to a different tree (which reassigns the prefix mappings), the text values will not be updated and you might end up with an undefined prefix.

- etree elements can be copied using copy.deepcopy() and copy.copy(), just like ElementTree’s. However, copy.copy() does not create a shallow copy where elements are shared between trees, as this makes no sense in the context of libxml2 trees. Note that lxml can deep-copy trees considerably faster than ElementTree, so a deep copy might still be fast enough to replace a shallow copy in your case.
Chapter 6

lxml FAQ - Frequently Asked Questions

Frequently asked questions on lxml. See also the notes on compatibility to ElementTree.

General Questions

Is there a tutorial?

Read the lxml.etree Tutorial. While this is still work in progress (just as any good documentation), it provides an overview of the most important concepts in lxml.etree. If you want to help out, improving the tutorial is a very good place to start.

There is also a tutorial for ElementTree which works for lxml.etree. The documentation of the extended etree API also contains many examples for lxml.etree. Fredrik Lundh’s element library contains a lot of nice recipes that show how to solve common tasks in ElementTree and lxml.etree. To learn using lxml.objectify, read the objectify documentation.

John Shipman has written another tutorial called Python XML processing with lxml that contains lots of examples. Liza Daly wrote a nice article about high-performance aspects when parsing large files with lxml.

Where can I find more documentation about lxml?

There is a lot of documentation on the web and also in the Python standard library documentation, as lxml implements the well-known ElementTree API and tries to follow its documentation as closely as possible. The recipes in Fredrik Lundh’s element library are generally worth taking a look at. There are a couple of issues where lxml cannot keep up compatibility. They are described in the compatibility documentation.

The lxml specific extensions to the API are described by individual files in the doc directory of the source distribution and on the web page.

The generated API documentation is a comprehensive API reference for the lxml package.

What standards does lxml implement?

The compliance to XML Standards depends on the support in libxml2 and libxslt. Here is a quote from http://xmlsoft.org/:
In most cases libxml2 tries to implement the specifications in a relatively strictly compliant way. As of release 2.4.16, libxml2 passed all 1800+ tests from the OASIS XML Tests Suite.

lxml currently supports libxml2 2.6.20 or later, which has even better support for various XML standards. The important ones are:

- XML 1.0
- HTML 4
- XML namespaces
- XML Schema 1.0
- XPath 1.0
- XInclude 1.0
- XSLT 1.0
- EXSLT
- XML catalogs
- canonical XML
- RelaxNG
- xml:id
- xml:base

Support for XML Schema is currently not 100% complete in libxml2, but is definitely very close to compliance. Schematron is supported in two ways, the best being the original ISO Schematron reference implementation via XSLT. Libxml2 also supports loading documents through HTTP and FTP.

For RelaxNG Compact Syntax support, there is a tool called mc2rng, written by David Mertz, which you might be able to use from Python. Failing that, trang is the ‘official’ command line tool (written in Java) to do the conversion.

**Who uses lxml?**

As an XML library, lxml is often used under the hood of in-house server applications, such as web servers or applications that facilitate some kind of content management. Many people who deploy Zope, Plone or Django use it together with lxml in the background, without speaking publicly about it. Therefore, it is hard to get an idea of who uses it, and the following list of ‘users and projects we know of’ is very far from a complete list of lxml’s users.

Also note that the compatibility to the ElementTree library does not require projects to set a hard dependency on lxml - as long as they do not take advantage of lxml’s enhanced feature set.

- cssutils, a CSS parser and toolkit, can be used with lxml.cssselect
- Deliverance, a content theming tool
- Enfold Proxy 4, a web server accelerator with on-the-fly XSLT processing
- Inteproxy, a secure HTTP proxy
- Iwebstring, an XML template engine
What is the difference between lxml.etree and lxml.objectify?

The two modules provide different ways of handling XML. However, objectify builds on top of lxml.etree and therefore inherits most of its capabilities and a large portion of its API.

- lxml.etree is a generic API for XML and HTML handling. It aims for ElementTree compatibility and supports the entire XML infoset. It is well suited for both mixed content and data centric XML. Its generality makes it the best choice for most applications.

- lxml.objectify is a specialized API for XML data handling in a Python object syntax. It provides a very natural way to deal with data fields stored in a structurally well defined XML format. Data is automatically converted to Python data types and can be manipulated with normal Python operators. Look at the examples in the objectify documentation to see what it feels like to use it.

Objectify is not well suited for mixed contents or HTML documents. As it is built on top of lxml.etree, however, it inherits the normal support for XPath, XSLT or validation.

How can I make my application run faster?

lxml.etree is a very fast library for processing XML. There are, however, a few caveats involved in the mapping of the powerful libxml2 library to the simple and convenient ElementTree API. Not all operations are as fast as the simplicity of the API might suggest, while some use cases can heavily benefit from finding the right way of doing them. The benchmark page has a comparison to other ElementTree implementations and a number of tips for performance tweaking. As with any Python application, the rule of thumb is: the more of your processing runs in C, the faster your application gets. See also the section on threading.
What about that trailing text on serialised Elements?

The ElementTree tree model defines an Element as a container with a tag name, contained text, child Elements and a tail text. This means that whenever you serialise an Element, you will get all parts of that Element:

```python
>>> root = etree.XML("<root><tag>text<child/></tag>tail</root>")
>>> print(etree.tostring(root[0]))
<tag>text<child/></tag>tail
```

Here is an example that shows why not serialising the tail would be even more surprising from an object point of view:

```python
>>> root = etree.Element("test")
>>> root.text = "TEXT"
>>> print(etree.tostring(root))
<test>TEXT</test>
>>> root.tail = "TAIL"
>>> print(etree.tostring(root))
<test>TEXT</test>TAIL
>>> root.tail = None
>>> print(etree.tostring(root))
<test>TEXT</test>
```

Just imagine a Python list where you append an item and it doesn’t show up when you look at the list.

The `.tail` property is a huge simplification for the tree model as it avoids text nodes to appear in the list of children and makes access to them quick and simple. So this is a benefit in most applications and simplifies many, many XML tree algorithms.

However, in document-like XML (and especially HTML), the above result can be unexpected to new users and can sometimes require a bit more overhead. A good way to deal with this is to use helper functions that copy the Element without its tail. The lxml.html package also deals with this in a couple of places, as most HTML algorithms benefit from a tail-free behaviour.

How can I find out if an Element is a comment or PI?

```python
>>> root = etree.XML("<?my PI?><root><!-- empty --></root>")
>>> root.tag
'root'
>>> root.getprevious().tag is etree.PI
True
>>> root[0].tag is etree.Comment
True
```

How can I map an XML tree into a dict of dicts?

I’m glad you asked.

```python
def recursive_dict(element):
    return element.tag,
    dict(map(recursive_dict, element)) or element.text
```

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Why does lxml sometimes return ‘str’ values for text in Python 2?

In Python 2, lxml’s API returns byte strings for plain ASCII text values, be it for tag names or text in Element content. This is the same behaviour as known from ElementTree. The reasoning is that ASCII encoded byte strings are compatible with Unicode strings in Python 2, but consume less memory (usually by a factor of 2 or 4) and are faster to create because they do not require decoding. Plain ASCII string values are very common in XML, so this optimisation is generally worth it.

In Python 3, lxml always returns Unicode strings for text and names, as does ElementTree. Since Python 3.3, Unicode strings containing only characters that can be encoded in ASCII or Latin-1 are generally as efficient as byte strings. In older versions of Python 3, the above mentioned drawbacks apply.

Installation

Which version of libxml2 and libxslt should I use or require?

It really depends on your application, but the rule of thumb is: more recent versions contain less bugs and provide more features.

- Do not use libxml2 2.6.27 if you want to use XPath (including XSLT). You will get crashes when XPath errors occur during the evaluation (e.g. for unknown functions). This happens inside the evaluation call to libxml2, so there is nothing that lxml can do about it.

- Try to use versions of both libraries that were released together. At least the libxml2 version should not be older than the libxslt version.

- If you use XML Schema or Schematron which are still under development, the most recent version of libxml2 is usually a good bet.

- The same applies to XPath, where a substantial number of bugs and memory leaks were fixed over time. If you encounter crashes or memory leaks in XPath applications, try a more recent version of libxml2.

- For parsing and fixing broken HTML, lxml requires at least libxml2 2.6.21.

- For the normal tree handling, however, any libxml2 version starting with 2.6.20 should do.

Read the release notes of libxml2 and the release notes of libxslt to see when (or if) a specific bug has been fixed.

Where are the binary builds?

Binary builds are most often requested by users of Microsoft Windows. Two of the major design issues of this operating system make it non-trivial for its users to build lxml: the lack of a pre-installed standard compiler and the missing package management.

For recent lxml releases, PyPI provides community donated Windows binaries. Besides that, Christoph Gohlke generously provides unofficial lxml binary builds for Windows that are usually very up to date. Consider using them if you prefer a binary build over a signed official source release.

Why do I get errors about missing UCS4 symbols when installing lxml?

You are using a Python installation that was configured for a different internal Unicode representation than the lxml package you are trying to install. CPython versions before 3.3 allowed to switch between two types at build
Contributing time: the 32 bit encoding UCS4 and the 16 bit encoding UCS2. Sadly, both are not compatible, so eggs and other
binary distributions can only support the one they were compiled with.

This means that you have to compile lxml from sources for your system. Note that you do not need Cython for
this, the lxml source distribution is directly compilable on both platform types. See the build instructions on how
to do this.

Contributing

Why is lxml not written in Python?

It almost is.

lxml is not written in plain Python, because it interfaces with two C libraries: libxml2 and libxslt. Accessing them
at the C-level is required for performance reasons.

However, to avoid writing plain C-code and caring too much about the details of built-in types and reference
counting, lxml is written in Cython, a superset of the Python language that translates to C-code. Chances are that
if you know Python, you can write code that Cython accepts. Again, the C-ish style used in the lxml code is just for
performance optimisations. If you want to contribute, don’t bother with the details, a Python implementation of
your contribution is better than none. And keep in mind that lxml’s flexible API often favours an implementation
of features in pure Python, without bothering with C-code at all. For example, the lxml.html package is written
entirely in Python.

Please contact the mailing list if you need any help.

How can I contribute?

If you find something that you would like lxml to do (or do better), then please tell us about it on the mailing list.
Patches are always appreciated, especially when accompanied by unit tests and documentation (doctests would be
great). See the tests subdirectories in the lxml source tree (below the src directory) and the ReST text files in
the doc directory.

We also have a list of missing features that we would like to implement but didn’t due to lack if time. If you find
the time, patches are very welcome.

Besides enhancing the code, there are a lot of places where you can help the project and its user base. You can

• spread the word and write about lxml. Many users (especially new Python users) have not yet heared
  about lxml, although our user base is constantly growing. If you write your own blog and feel like saying
  something about lxml, go ahead and do so. If we think your contribution or criticism is valuable to other
users, we may even put a link or a quote on the project page.

• provide code examples for the general usage of lxml or specific problems solved with lxml. Readable code
  is a very good way of showing how a library can be used and what great things you can do with it. Again,
if we hear about it, we can set a link on the project page.

• work on the documentation. The web page is generated from a set of ReST text files. It is meant both as
  a representative project page for lxml and as a site for documenting lxml’s API and usage. If you have
questions or an idea how to make it more readable and accessible while you are reading it, please send a
comment to the mailing list.

• enhance the web site. We put some work into making the web site usable, understandable and also easy
  to find, but there’s always things that can be done better. You may notice that we are not top-ranked when
searching the web for “Python and XML”, so maybe you have an idea how to improve that.

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• help with the tutorial. A tutorial is the most important stating point for new users, so it is important for us to provide an easy to understand guide into lxml. As all documentation, the tutorial is work in progress, so we appreciate every helping hand.

• improve the docstrings. lxml uses docstrings to support Python’s integrated online help() function. However, sometimes these are not sufficient to grasp the details of the function in question. If you find such a place, you can try to write up a better description and send it to the mailing list.

Bugs

My application crashes!

One of the goals of lxml is “no segfaults”, so if there is no clear warning in the documentation that you were doing something potentially harmful, you have found a bug and we would like to hear about it. Please report this bug to the mailing list. See the section on bug reporting to learn how to do that.

If your application (or e.g. your web container) uses threads, please see the FAQ section on threading to check if you touch on one of the potential pitfalls.

In any case, try to reproduce the problem with the latest versions of libxml2 and libxslt. From time to time, bugs and race conditions are found in these libraries, so a more recent version might already contain a fix for your problem.

Remember: even if you see lxml appear in a crash stack trace, it is not necessarily lxml that caused the crash.

My application crashes on MacOS-X!

This was a common problem up to lxml 2.1.x. Since lxml 2.2, the only officially supported way to use it on this platform is through a static build against freshly downloaded versions of libxml2 and libxslt. See the build instructions for MacOS-X.

I think I have found a bug in lxml. What should I do?

First, you should look at the current developer changelog to see if this is a known problem that has already been fixed in the master branch since the release you are using.

Also, the ‘crash’ section above has a few good advices what to try to see if the problem is really in lxml - and not in your setup. Believe it or not, that happens more often than you might think, especially when old libraries or even multiple library versions are installed.

You should always try to reproduce the problem with the latest versions of libxml2 and libxslt - and make sure they are used. lxml.etree can tell you what it runs with:

```python
import sys
from lxml import etree

print("%-20s: %s" % ('Python', sys.version_info))
print("%-20s: %s" % ('lxml.etree', etree.LXML_VERSION))
print("%-20s: %s" % ('libxml used', etree.LIBXML_VERSION))
print("%-20s: %s" % ('libxml compiled', etree.LIBXML_COMPILLED_VERSION))
print("%-20s: %s" % ('libxslt used', etree.LIBXSLT_VERSION))
print("%-20s: %s" % ('libxslt compiled', etree.LIBXSLT_COMPILED_VERSION))
```
**How do I know a bug is really in lxml and not in libxml2?**

If you can figure that the problem is not in lxml but in the underlying libxml2 or libxslt, you can ask right on the respective mailing lists, which may considerably reduce the time to find a fix or work-around. See the next question for some hints on how to do that.

Otherwise, we would really like to hear about it. Please report it to the bug tracker or to the mailing list so that we can fix it. It is very helpful in this case if you can come up with a short code snippet that demonstrates your problem. If others can reproduce and see the problem, it is much easier for them to fix it - and maybe even easier for you to describe it and get people convinced that it really is a problem to fix.

It is important that you always report the version of lxml, libxml2 and libxslt that you get from the code snippet above. If we do not know the library versions you are using, we will ask back, so it will take longer for you to get a helpful answer.

Since as a user of lxml you are likely a programmer, you might find this article on bug reports an interesting read.

**How do I know a bug is really in lxml and not in libxml2?**

A large part of lxml’s functionality is implemented by libxml2 and libxslt, so problems that you encounter may be in one or the other. Knowing the right place to ask will reduce the time it takes to fix the problem, or to find a work-around.

Both libxml2 and libxslt come with their own command line frontends, namely `xmllint` and `xsltproc`. If you encounter problems with XSLT processing for specific stylesheets or with validation for specific schemas, try to run the XSLT with `xsltproc` or the validation with `xmllint` respectively to find out if it fails there as well. If it does, please report directly to the mailing lists of the respective project, namely:

- libxml2 mailing list
- libxslt mailing list

On the other hand, everything that seems to be related to Python code, including custom resolvers, custom XPath functions, etc. is likely outside of the scope of libxml2/libxslt. If you encounter problems here or you are not sure where there the problem may come from, please ask on the lxml mailing list first.

In any case, a good explanation of the problem including some simple test code and some input data will help us (or the libxml2 developers) see and understand the problem, which largely increases your chance of getting help. See the question above for a few hints on what is helpful here.

**Threading**

**Can I use threads to concurrently access the lxml API?**

Short answer: yes, if you use lxml 2.2 and later.

Since version 1.1, lxml frees the GIL (Python’s global interpreter lock) internally when parsing from disk and memory, as long as you use either the default parser (which is replicated for each thread) or create a parser for each thread yourself. lxml also allows concurrency during validation (RelaxNG and XMLSchema) and XSL transformation. You can share RelaxNG, XMLSchema and XSLT objects between threads.

While you can also share parsers between threads, this will serialize the access to each of them, so it is better to use the default parser or to just use the default parser if you do not need any special configuration. The same applies to the XPath evaluators, which use an internal lock to protect their prepared evaluation contexts. It is therefore best to use separate evaluator instances in threads.

Warning: Before lxml 2.2, and especially before 2.1, there were various issues when moving subtrees between
Does my program run faster if I use threads?

Threading

different threads, or when applying XSLT objects from one thread to trees parsed or modified in another. If you need code to run with older versions, you should generally avoid modifying trees in other threads than the one it was generated in. Although this should work in many cases, there are certain scenarios where the termination of a thread that parsed a tree can crash the application if subtrees of this tree were moved to other documents. You should be on the safe side when passing trees between threads if you either

- do not modify these trees and do not move their elements to other trees, or
- do not terminate threads while the trees they parsed are still in use (e.g. by using a fixed size thread-pool or long-running threads in processing chains)

Since lxml 2.2, even multi-thread pipelines are supported. However, note that it is more efficient to do all tree work inside one thread, than to let multiple threads work on a tree one after the other. This is because trees inherit state from the thread that created them, which must be maintained when the tree is modified inside another thread.

Does my program run faster if I use threads?

Depends. The best way to answer this is timing and profiling.

The global interpreter lock (GIL) in Python serializes access to the interpreter, so if the majority of your processing is done in Python code (walking trees, modifying elements, etc.), your gain will be close to zero. The more of your XML processing moves into lxml, however, the higher your gain. If your application is bound by XML parsing and serialisation, or by very selective XPath expressions and complex XSLTs, your speedup on multi-processor machines can be substantial.

See the question above to learn which operations free the GIL to support multi-threading.

Would my single-threaded program run faster if I turned off threading?

Possibly, yes. You can see for yourself by compiling lxml entirely without threading support. Pass the --without-threading option to setup.py when building lxml from source. You can also build libxml2 without pthread support (--without-pthreads option), which may add another bit of performance. Note that this will leave internal data structures entirely without thread protection, so make sure you really do not use lxml outside of the main application thread in this case.

Why can’t I reuse XSLT stylesheets in other threads?

Since later lxml 2.0 versions, you can do this. There is some overhead involved as the result document needs an additional cleanup traversal when the input document and/or the stylesheet were created in other threads. However, on a multi-processor machine, the gain of freeing the GIL easily covers this drawback.

If you need even the last bit of performance, consider keeping (a copy of) the stylesheet in thread-local storage, and try creating the input document(s) in the same thread. And do not forget to benchmark your code to see if the increased code complexity is really worth it.

My program crashes when run with mod_python/Pyro/Zope/Plone/...

These environments can use threads in a way that may not make it obvious when threads are created and what happens in which thread. This makes it hard to ensure lxml’s threading support is used in a reliable way. Sadly, if problems arise, they are as diverse as the applications, so it is difficult to provide any generally applicable solution. Also, these environments are so complex that problems become hard to debug and even harder to reproduce in a
predictable way. If you encounter crashes in one of these systems, but your code runs perfectly when started by hand, the following gives you a few hints for possible approaches to solve your specific problem:

- make sure you use recent versions of libxml2, libxslt and lxml. The libxml2 developers keep fixing bugs in each release, and lxml also tries to become more robust against possible pitfalls. So newer versions might already fix your problem in a reliable way. Version 2.2 of lxml contains many improvements.

- make sure the library versions you installed are really used. Do not rely on what your operating system tells you! Print the version constants in `lxml.etree` from within your runtime environment to make sure it is the case. This is especially a problem under MacOS-X when newer library versions were installed in addition to the outdated system libraries. Please read the bugs section regarding MacOS-X in this FAQ.

- if you use `mod_python`, try setting this option:

  ```
  PythonInterpreter main_interpreter
  ```

  There was a discussion on the mailing list about this problem:

  ```
  http://comments.gmane.org/gmane.comp.python.lxml.devel/2942
  ```

- in a threaded environment, try to initially import `lxml.etree` from the main application thread instead of doing first-time imports separately in each spawned worker thread. If you cannot control the thread spawning of your web/application server, an import of `lxml.etree` in `sitecustomize.py` or `usercustomize.py` may still do the trick.

- compile lxml without threading support by running `setup.py` with the `--without-threading` option. While this might be slower in certain scenarios on multi-processor systems, it might also keep your application from crashing, which should be worth more to you than peak performance. Remember that lxml is fast anyway, so concurrency may not even be worth it.

- look out for fancy XSLT stuff like foreign document access or passing in subtrees trough XSLT variables. This might or might not work, depending on your specific usage. Again, later versions of lxml and libxslt provide safer support here.

- try copying trees at suspicious places in your code and working with those instead of a tree shared between threads. Note that the copying must happen inside the target thread to be effective, not in the thread that created the tree. Serialising in one thread and parsing in another is also a simple (and fast) way of separating thread contexts.

- try keeping thread-local copies of XSLT stylesheets, i.e. one per thread, instead of sharing one. Also see the question above.

- you can try to serialise suspicious parts of your code with explicit thread locks, thus disabling the concurrency of the runtime system.

- report back on the mailing list to see if there are other ways to work around your specific problems. Do not forget to report the version numbers of lxml, libxml2 and libxslt you are using (see the question on reporting a bug).

Note that most of these options will degrade performance and/or your code quality. If you are unsure what to do, please ask on the mailing list.
Why doesn’t the pretty_print option reformat my XML output?

Pretty printing (or formatting) an XML document means adding white space to the content. These modifications are harmless if they only impact elements in the document that do not carry (text) data. They corrupt your data if they impact elements that contain data. If lxml cannot distinguish between whitespace and data, it will not alter your data. Whitespace is therefore only added between nodes that do not contain data. This is always the case for trees constructed element-by-element, so no problems should be expected here. For parsed trees, a good way to assure that no conflicting whitespace is left in the tree is the remove_blank_text option:

```python
>>> parser = etree.XMLParser(remove_blank_text=True)
>>> tree = etree.parse(filename, parser)
```

This will allow the parser to drop blank text nodes when constructing the tree. If you now call a serialization function to pretty print this tree, lxml can add fresh whitespace to the XML tree to indent it.

Note that the remove_blank_text option also uses a heuristic if it has no definite knowledge about the document’s ignorable whitespace. It will keep blank text nodes that appear after non-blank text nodes at the same level. This is to prevent document-style XML from loosing content.

The HTMLParser has this structural knowledge built-in, which means that most whitespace that appears between tags in HTML documents will not be removed by this option, except in places where it is truly ignorable, e.g. in the page header, between table structure tags, etc. Therefore, it is also safe to use this option with the HTMLParser, as it will keep content like the following intact (i.e. it will not remove the space that separates the two words):

```html
<p><b>some</b> <em>text</em></p>
```

If you want to be sure all blank text is removed from an XML document (or just more blank text than the parser does by itself), you have to use either a DTD to tell the parser which whitespace it can safely ignore, or remove the ignorable whitespace manually after parsing, e.g. by setting all tail text to None:

```python
for element in root.iter():
    element.tail = None
```

Fredrik Lundh also has a Python-level function for indenting XML by appending whitespace to tags. It can be found on his element library recipe page.

Why can’t lxml parse my XML from unicode strings?

First of all, XML is explicitly defined as a stream of bytes. It’s not Unicode text. Take a look at the XML specification, it’s all about byte sequences and how to map them to text and structure. That leads to rule number one: do not decode your XML data yourself. That’s a part of the work of an XML parser, and it does it very well. Just pass it your data as a plain byte stream, it will always do the right thing, by specification.

This also includes not opening XML files in text mode. Make sure you always use binary mode, or, even better, pass the file path into lxml’s `parse()` function to let it do the file opening, reading and closing itself. This is the most simple and most efficient way to do it.

That being said, lxml can read Python unicode strings and even tries to support them if libxml2 does not. This is because there is one valid use case for parsing XML from text strings: literal XML fragments in source code.

However, if the unicode string declares an XML encoding internally (`<?xml encoding="..."?>`), parsing is bound to fail, as this encoding is almost certainly not the real encoding used in Python unicode. The same is true for HTML unicode strings that contain charset meta tags, although the problems may be more subtle here. The libxml2 HTML parser may not be able to parse the meta tags in broken HTML and may end up ignoring them, so
even if parsing succeeds, later handling may still fail with character encoding errors. Therefore, parsing HTML from unicode strings is a much saner thing to do than parsing XML from unicode strings.

Note that Python uses different encodings for unicode on different platforms, so even specifying the real internal unicode encoding is not portable between Python interpreters. Don’t do it.

Python unicode strings with XML data that carry encoding information are broken. lxml will not parse them. You must provide parsable data in a valid encoding.

Can lxml parse from file objects opened in unicode/text mode?

Technically, yes. However, you likely do not want to do that, because it is extremely inefficient. The text encoding that libxml2 uses internally is UTF-8, so parsing from a Unicode file means that Python first reads a chunk of data from the file, then decodes it into a new buffer, and then copies it into a new unicode string object, just to let libxml2 make yet another copy while encoding it down into UTF-8 in order to parse it. It’s clear that this involves a lot more recoding and copying than when parsing straight from the bytes that the file contains.

If you really know the encoding better than the parser (e.g. when parsing HTML that lacks a content declaration), then instead of passing an encoding parameter into the file object when opening it, create a new instance of an XMLParser or HTMLParser and pass the encoding into its constructor. Afterwards, use that parser for parsing, e.g. by passing it into the etree.parse(file, parser) function. Remember to open the file in binary mode (mode="rb"), or, if possible, prefer passing the file path directly into parse() instead of an opened Python file object.

What is the difference between str(xslt(doc)) and xslt(doc).write()?

The str() implementation of the XSLTResultTree class (a subclass of the ElementTree class) knows about the output method chosen in the stylesheet (xsl:output), write() doesn’t. If you call write(), the result will be a normal XML tree serialization in the requested encoding. Calling this method may also fail for XSLT results that are not XML trees (e.g. string results). If you call str(), it will return the serialized result as specified by the XSL transform. This correctly serializes string results to encoded Python strings and honours xsl:output options like indent. This almost certainly does what you want, so you should only use write() if you are sure that the XSLT result is an XML tree and you want to override the encoding and indentation options requested by the stylesheet.

Why can’t I just delete parents or clear the root node in iterparse()?

The iterparse() implementation is based on the libxml2 parser. It requires the tree to be intact to finish parsing. If you delete or modify parents of the current node, chances are you modify the structure in a way that breaks the parser. Normally, this will result in a segfault. Please refer to the iterparse section of the lxml API documentation to find out what you can do and what you can’t do.

How do I output null characters in XML text?

Don’t. What you would produce is not well-formed XML. XML parsers will refuse to parse a document that contains null characters. The right way to embed binary data in XML is using a text encoding such as uuencode or base64.
Is lxml vulnerable to XML bombs?

This has nothing to do with lxml itself, only with the parser of libxml2. Since libxml2 version 2.7, the parser imposes hard security limits on input documents to prevent DoS attacks with forged input data. Since lxml 2.2.1, you can disable these limits with the `huge_tree` parser option if you need to parse really large, trusted documents. All lxml versions will leave these restrictions enabled by default.

Note that libxml2 versions of the 2.6 series do not restrict their parser and are therefore vulnerable to DoS attacks.

Note also that these “hard limits” may still be high enough to allow for excessive resource usage in a given use case. They are compile time modifiable, so building your own library versions will allow you to change the limits to your own needs. Also see the next question.

How do I use lxml safely as a web-service endpoint?

XML based web-service endpoints are generally subject to several types of attacks if they allow some kind of untrusted input. From the point of view of the underlying XML tool, the most obvious attacks try to send a relatively small amount of data that induces a comparatively large resource consumption on the receiver side.

First of all, make sure network access is not enabled for the XML parser that you use for parsing untrusted content and that it is not configured to load external DTDs. Otherwise, attackers can try to trick the parser into an attempt to load external resources that are overly slow or impossible to retrieve, thus wasting time and other valuable resources on your server such as socket connections. Note that you can register your own document loader in lxml, which allows for fine-grained control over any read access to resources.

Some of the most famous excessive content expansion attacks use XML entity references. Luckily, entity expansion is mostly useless for the data commonly sent through web services and can simply be disabled, which rules out several types of denial of service attacks at once. This also involves an attack that reads local files from the server, as XML entities can be defined to expand into their content. Consequently, version 1.2 of the SOAP standard explicitly disallows entity references in the XML stream.

To disable entity expansion, use an XML parser that is configured with the option `resolve_entities=False`. Then, after (or while) parsing the document, use `root.iter(etree.Entity)` to recursively search for entity references. If it contains any, reject the entire input document with a suitable error response. In lxml 3.x, you can also use the new DTD introspection API to apply your own restrictions on input documents.

Another attack to consider is compression bombs. If you allow compressed input into your web service, attackers can try to send well forged highly repetitive and thus very well compressing input that unpacks into a very large XML document in your server’s main memory, potentially a thousand times larger than the compressed input data.

As a counter measure, either disable compressed input for your web server, at least for untrusted sources, or use incremental parsing with `iterparse()` instead of parsing the whole input document into memory in one shot. That allows you to enforce suitable limits on the input by applying semantic checks that detect and prevent an illegitimate use of your service. If possible, you can also use this to reduce the amount of data that you need to keep in memory while parsing the document, thus further reducing the possibility of an attacker to trick your system into excessive resource usage.

Finally, please be aware that XPath suffers from the same vulnerability as SQL when it comes to content injection. The obvious fix is to not build any XPath expressions via string formatting or concatenation when the parameters may come from untrusted sources, and instead use XPath variables, which safely expose their values to the evaluation engine.

The `defusedxml` package comes with an example setup and a wrapper API for lxml that applies certain counter measures internally.
XPath and Document Traversal

What are the `findall()` and `xpath()` methods on `Element(Tree)`?

`findall()` is part of the original `ElementTree` API. It supports a simple subset of the XPath language, without predicates, conditions and other advanced features. It is very handy for finding specific tags in a tree. Another important difference is namespace handling, which uses the `{namespace}tagname` notation. This is not supported by XPath. The `findall`, `find` and `findtext` methods are compatible with other `ElementTree` implementations and allow writing portable code that runs on `ElementTree`, `cElementTree` and `lxml.etree`.

`xpath()`, on the other hand, supports the complete power of the XPath language, including predicates, XPath functions and Python extension functions. The syntax is defined by the XPath specification. If you need the expressiveness and selectivity of XPath, the `xpath()` method, the `XPath` class and the `XPathEvaluator` are the best choice.

Why doesn’t `findall()` support full XPath expressions?

It was decided that it is more important to keep compatibility with `ElementTree` to simplify code migration between the libraries. The main difference compared to XPath is the `{namespace}tagname` notation used in `findall()`, which is not valid XPath.

`ElementTree` and `lxml.etree` use the same implementation, which assures 100% compatibility. Note that `findall()` is so fast in `lxml` that a native implementation would not bring any performance benefits.

How can I find out which namespace prefixes are used in a document?

You can traverse the document (`root.iter()`) and collect the prefix attributes from all `Elements` into a set. However, it is unlikely that you really want to do that. You do not need these prefixes, honestly. You only need the namespace URIs. All namespace comparisons use these, so feel free to make up your own prefixes when you use XPath expressions or extension functions.

The only place where you might consider specifying prefixes is the serialization of `Elements` that were created through the API. Here, you can specify a prefix mapping through the `nsmap` argument when creating the root `Element`. Its children will then inherit this prefix for serialization.

How can I specify a default namespace for XPath expressions?

You can’t. In XPath, there is no such thing as a default namespace. Just use an arbitrary prefix and let the namespace dictionary of the XPath evaluators map it to your namespace. See also the question above.
Part II

Developing with lxml
Chapter 7

The lxml.etree Tutorial

Author: Stefan Behnel

This is a tutorial on XML processing with lxml.etree. It briefly overviews the main concepts of the ElementTree API, and some simple enhancements that make your life as a programmer easier.

For a complete reference of the API, see the generated API documentation.

A common way to import lxml.etree is as follows:

```python
>>> from lxml import etree
```

If your code only uses the ElementTree API and does not rely on any functionality that is specific to lxml.etree, you can also use (any part of) the following import chain as a fall-back to the original ElementTree:

```python
try:
    from lxml import etree
    print("running with lxml.etree")
except ImportError:
    try:
        # Python 2.5
        import xml.etree.cElementTree as etree
        print("running with cElementTree on Python 2.5+")
    except ImportError:
        try:
            # Python 2.5
            import xml.etree.ElementTree as etree
            print("running with ElementTree on Python 2.5+")
        except ImportError:
            try:
                # normal cElementTree install
                import cElementTree as etree
                print("running with cElementTree")
            except ImportError:
                try:
                    # normal ElementTree install
                    import elementtree.ElementTree as etree
                    print("running with ElementTree")
                except ImportError:
                    print("Failed to import ElementTree from any known place")
```
To aid in writing portable code, this tutorial makes it clear in the examples which part of the presented API is an extension of lxml.etree over the original ElementTree API, as defined by Fredrik Lundh’s ElementTree library.

The Element class

An Element is the main container object for the ElementTree API. Most of the XML tree functionality is accessed through this class. Elements are easily created through the Element factory:

```python
>>> root = etree.Element("root")
```

The XML tag name of elements is accessed through the tag property:

```python
>>> print(root.tag)
root
```

Elements are organised in an XML tree structure. To create child elements and add them to a parent element, you can use the append() method:

```python
>>> root.append( etree.Element("child1") )
```

However, this is so common that there is a shorter and much more efficient way to do this: the SubElement factory. It accepts the same arguments as the Element factory, but additionally requires the parent as first argument:

```python
>>> child2 = etree.SubElement(root, "child2")
>>> child3 = etree.SubElement(root, "child3")
```

To see that this is really XML, you can serialise the tree you have created:

```python
>>> print(etree.tostring(root, pretty_print=True))
<root>
  <child1/>
  <child2/>
  <child3/>
</root>
```

Elements are lists

To make the access to these subelements easy and straightforward, elements mimic the behaviour of normal Python lists as closely as possible:

```python
>>> child = root[0]
>>> print(child.tag)
child1

>>> print(len(root))
3

>>> root.index(root[1])  # lxml.etree only!
1

>>> children = list(root)

>>> for child in root:
```
Elements are lists

```python
...     print(child.tag)
child1
cchild2
cchild3

>>> root.insert(0, etree.Element("child0"))
>>> start = root[:1]
>>> end = root[-1:]

>>> print(start[0].tag)
cchild0
>>> print(end[0].tag)
cchild3

Prior to ElementTree 1.3 and lxml 2.0, you could also check the truth value of an Element to see if it has children,
i.e. if the list of children is empty:

```if` root:  # this no longer works!
    print("The root element has children")
```This is no longer supported as people tend to expect that a “something” evaluates to True and expect Elements to
be “something”, may they have children or not. So, many users find it surprising that any Element would evaluate
to False in an if-statement like the above. Instead, use `len(element)`, which is both more explicit and less
error prone.

```python
>>> print(etree.iselement(root))  # test if it’s some kind of Element
True
>>> if len(root):  # test if it has children
...     print("The root element has children")
The root element has children
```

There is another important case where the behaviour of Elements in lxml (in 2.0 and later) deviates from that of
lists and from that of the original ElementTree (prior to version 1.3 or Python 2.7/3.2):

```python
>>> for child in root:
...     print(child.tag)
child0
child1
child2
child3
```

```python
>>> root[0] = root[-1]  # this moves the element in lxml.etree!
```

```python
>>> for child in root:
...     print(child.tag)
child3
child1
child2
```

In this example, the last element is moved to a different position, instead of being copied, i.e. it is automatically
removed from its previous position when it is put in a different place. In lists, objects can appear in multiple
positions at the same time, and the above assignment would just copy the item reference into the first position, so
that both contain the exact same item:

```python
>>> l = [0, 1, 2, 3]
>>> l[0] = l[-1]
>>> l
[3, 1, 2, 3]
```
Elements carry attributes as a dict

Note that in the original ElementTree, a single Element object can sit in any number of places in any number of trees, which allows for the same copy operation as with lists. The obvious drawback is that modifications to such an Element will apply to all places where it appears in a tree, which may or may not be intended.

The upside of this difference is that an Element in lxml.etree always has exactly one parent, which can be queried through the getparent() method. This is not supported in the original ElementTree.

```python
>>> root is root[0].getparent()  # lxml.etree only!
True
```

If you want to copy an element to a different position in lxml.etree, consider creating an independent deep copy using the copy module from Python’s standard library:

```python
>>> from copy import deepcopy
>>> element = etree.Element("neu")
>>> element.append( deepcopy(root[1]) )
```

The siblings (or neighbours) of an element are accessed as next and previous elements:

```python
>>> root[0] is root[1].getprevious()  # lxml.etree only!
True
>>> root[1] is root[0].getnext()      # lxml.etree only!
True
```

Elements carry attributes as a dict

XML elements support attributes. You can create them directly in the Element factory:

```python
>>> root = etree.Element("root", interesting="totally")
>>> etree.tostring(root)
b'\<root interesting="totally"/>'
```

Attributes are just unordered name-value pairs, so a very convenient way of dealing with them is through the dictionary-like interface of Elements:

```python
>>> print(root.get("interesting"))
totally
>>> print(root.get("hello"))
None
>>> root.set("hello", "Huhu")
>>> print(root.get("hello"))
Huhu
```

```python
>>> etree.tostring(root)
b'\<root interesting="totally" hello="Huhu"/>'
```

```python
>>> sorted(root.keys())
['hello', 'interesting']
```

```python
>>> for name, value in sorted(root.items()):
```

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Elements contain text

...    print('%s = %r' % (name, value))
hello = 'Huhu'
interesting = 'totally'

For the cases where you want to do item lookup or have other reasons for getting a ‘real’ dictionary-like object, e.g. for passing it around, you can use the attrib property:

```python
>>> attributes = root.attrib
>>> print(attributes['interesting'])
totally
>>> print(attributes.get('no-such-attribute'))
None
```

```python
def print(attributes['hello']) = "Guten Tag"
>>> attributes['hello'] = "Guten Tag"
>>> print(attributes['hello'])
Guten Tag
```

Note that attrib is a dict-like object backed by the Element itself. This means that any changes to the Element are reflected in attrib and vice versa. It also means that the XML tree stays alive in memory as long as the attrib of one of its Elements is in use. To get an independent snapshot of the attributes that does not depend on the XML tree, copy it into a dict:

```python
>>> d = dict(root.attrib)
```

```python
>>> sorted(d.items())
[('hello', 'Guten Tag'), ('interesting', 'totally')]
```

Elements contain text

Elements can contain text:

```python
>>> root = etree.Element("root")
>>> root.text = "TEXT"
```

```python
>>> print(root.text)
TEXT
```

```python
>>> etree.tostring(root)
b'<root>TEXT</root>'
```

In many XML documents (data-centric documents), this is the only place where text can be found. It is encapsulated by a leaf tag at the very bottom of the tree hierarchy.

However, if XML is used for tagged text documents such as (X)HTML, text can also appear between different elements, right in the middle of the tree:

```html
<html><body>Hello<br/>World</body></html>
```

Here, the `<br/>` tag is surrounded by text. This is often referred to as document-style or mixed-content XML. Elements support this through their tail property. It contains the text that directly follows the element, up to the next element in the XML tree:

```python
>>> html = etree.Element("html")
>>> body = etree.SubElement(html, "body")
>>> body.text = "TEXT"
```
Using XPath to find text

Another way to extract the text content of a tree is XPath, which also allows you to extract the separate text chunks into a list:

```python
>>> print (html.xpath("string()"))  # lxml.etree only!
TEXTTAIL
>>> print (html.xpath("//text()"))  # lxml.etree only!
[‘TEXT’, ‘TAIL’]
```

If you want to use this more often, you can wrap it in a function:

```python
>>> build_text_list = etree.XPath("//text()")  # lxml.etree only!
>>> print (build_text_list(html))
[‘TEXT’, ‘TAIL’]
```

Note that a string result returned by XPath is a special 'smart' object that knows about its origins. You can ask it where it came from through its getparent() method, just as you would with Elements:

```python
>>> texts = build_text_list(html)
>>> print (texts[0])
TEXT
>>> parent = texts[0].getparent()
>>> print (parent.tag)
body
```
Tree iteration

```python
>>> print(texts[1])
TAIL
>>> print(texts[1].getparent().tag)
br

You can also find out if it’s normal text content or tail text:

```python
>>> print(texts[0].is_text)
True
>>> print(texts[1].is_text)
False
>>> print(texts[1].is_tail)
True
```

While this works for the results of the `text()` function, lxml will not tell you the origin of a string value that was constructed by the XPath functions `string()` or `concat()`:

```python
>>> stringify = etree.XPath("string()")
>>> print(stringify(html))
TEXTTAIL
>>> print(stringify(html).getparent())
None
```

Tree iteration

For problems like the above, where you want to recursively traverse the tree and do something with its elements, tree iteration is a very convenient solution. Elements provide a tree iterator for this purpose. It yields elements in document order, i.e. in the order their tags would appear if you serialised the tree to XML:

```python
>>> root = etree.Element("root")
>>> etree.SubElement(root, "child").text = "Child 1"
>>> etree.SubElement(root, "child").text = "Child 2"
>>> etree.SubElement(root, "another").text = "Child 3"
```

```python
>>> print(etree.tostring(root, pretty_print=True))
<root>
  <child>Child 1</child>
  <child>Child 2</child>
  <another>Child 3</another>
</root>
```

```python
>>> for element in root.iter():
...    print("%s - %s" % (element.tag, element.text))
root - None
child - Child 1
child - Child 2
another - Child 3
```

If you know you are only interested in a single tag, you can pass its name to `iter()` to have it filter for you. Starting with lxml 3.0, you can also pass more than one tag to intercept on multiple tags during iteration.

```python
>>> for element in root.iter("child"):
...    print("%s - %s" % (element.tag, element.text))
child - Child 1
child - Child 2
```
Serialisation

Serialisation commonly uses the tostring() function that returns a string, or the ElementTree.write() method that writes to a file, a file-like object, or a URL (via FTP PUT or HTTP POST). Both calls accept the same keyword arguments like pretty_print for formatted output or encoding to select a specific output encoding other than plain ASCII:

```python
>>> root = etree.XML('<root><a><b/></a></root>')</n
>>> etree.tostring(root)
'b'<'root'>a'='b'/'</a></root>'

>>> print(etree.tostring(root, xml_declaration=True))
<?xml version='1.0' encoding='ASCII'?><root><a><b/></a></root>
```

By default, iteration yields all nodes in the tree, including ProcessingInstructions, Comments and Entity instances. If you want to make sure only Element objects are returned, you can pass the Element factory as tag parameter:

```python
>>> root.append(etree.Entity("#234"))
>>> root.append(etree.Comment("some comment"))

>>> for element in root.iter():
... if isinstance(element.tag, basestring):
...     print("%s - %s" % (element.tag, element.text))
... else:
...     print("SPECIAL: %s - %s" % (element, element.text))
root - None
child - Child 1
child - Child 2
another - Child 3
SPECIAL: &#234; - &amp;#234;
SPECIAL: <!--some comment--> - some comment

>>> for element in root.iter(tag=etree.Element):
...     print("%s - %s" % (element.tag, element.text))
root - None
child - Child 1
child - Child 2
another - Child 3

>>> for element in root.iter(tag=etree.Entity):
...     print(element.text)
&#234;
```

Note that passing a wildcard "*" tag name will also yield all Element nodes (and only elements).

In lxml.etree, elements provide further iterators for all directions in the tree: children, parents (or rather ancestors) and siblings.

Serialisation

Serialisation commonly uses the tostring() function that returns a string, or the ElementTree.write() method that writes to a file, a file-like object, or a URL (via FTP PUT or HTTP POST). Both calls accept the same keyword arguments like pretty_print for formatted output or encoding to select a specific output encoding other than plain ASCII:
Serialisation

>>> print(etree.tostring(root, encoding='iso-8859-1'))
<?xml version='1.0' encoding='iso-8859-1'?><root><a><b/></a></root>

>>> print(etree.tostring(root, pretty_print=True))
<root>
  <a>
    <b/>
  </a>
</root>

Note that pretty printing appends a newline at the end.

In lxml 2.0 and later (as well as ElementTree 1.3), the serialisation functions can do more than XML serialisation. You can serialise to HTML or extract the text content by passing the method keyword:

```python
>>> root = etree.XML(...
  '<html><head/><body><p>Hello<br/>World</p></body></html>')

>>> etree.tostring(root)  # default: method = 'xml'
b'<html><head/><body><p>Hello<br/>World</p></body></html>'

>>> etree.tostring(root, method='xml')  # same as above
b'<html><head/><body><p>Hello<br/>World</p></body></html>'

>>> etree.tostring(root, method='html')
'b'<html><head/><body><p>Hello<br/>World</p></body></html>'

>>> print(etree.tostring(root, method='html', pretty_print=True))
<html>
  <head></head>
  <body><p>Hello<br/>World</p></body>
</html>

>>> etree.tostring(root, method='text')
b'HelloWorld'

As for XML serialisation, the default encoding for plain text serialisation is ASCII:

```python
>>> br = next(root.iter('br'))  # get first result of iteration
>>> br.tail = u'World'

>>> etree.tostring(root, encoding='utf-8', method='text')  # doctest: +ELLIPSIS
b'HelloWorld\xc3\xa4'```

Here, serialising to a Python unicode string instead of a byte string might become handy. Just pass the name ‘unicode’ as encoding:

```python
>>> etree.tostring(root, encoding='unicode', method='text')
u'HelloWorld'```

The W3C has a good article about the Unicode character set and character encodings.

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The ElementTree class

An ElementTree is mainly a document wrapper around a tree with a root node. It provides a couple of methods for serialisation and general document handling.

```python
>>> root = etree.XML(''
...   ...   ...   ...   ...   ...   ...   ...   ...   ...   ...   ...   ...   ...   ...   ...   ''
...   ...   ...   ...   ...   ...   ...   ...   ...   ...   ...   ...   ...   ...   ...   ...   ''
...   ...   ...   ...   ...   ...   ...   ...   ...   ...   ...   ...   ...   ...   ...   ...   ''
...   ...   ...   ...   ...   ...   ...   ...   ...   ...   ...   ...   ...   ...   ...   ...   ''
...   ...   ...   ...   ...   ...   ...   ...   ...   ...   ...   ...   ...   ...   ...   ...   ''

>>> tree = etree.ElementTree(root)

>>> print (tree.docinfo.xml_version)
1.0

>>> print (tree.docinfo.doctype)
<!DOCTYPE root SYSTEM "test">
```

An ElementTree is also what you get back when you call the parse() function to parse files or file-like objects (see the parsing section below).

One of the important differences is that the ElementTree class serialises as a complete document, as opposed to a single Element. This includes top-level processing instructions and comments, as well as a DOCTYPE and other DTD content in the document:

```python
>>> print (etree.tostring(tree))  # lxml 1.3.4 and later
<!DOCTYPE root SYSTEM "test" [  
     <!ENTITY tasty "parsnips">  ]>
    <root>
     <a>parsnips</a>
   </root>
```

In the original xml.etree.ElementTree implementation and in lxml up to 1.3.3, the output looks the same as when serialising only the root Element:

```python
>>> print (etree.tostring(tree.getroot()))
<root>
   <a>parsnips</a>
</root>
```

This serialisation behaviour has changed in lxml 1.3.4. Before, the tree was serialised without DTD content, which made lxml lose DTD information in an input-output cycle.

Parsing from strings and files

lxml.etree supports parsing XML in a number of ways and from all important sources, namely strings, files, URLs (http/ftp) and file-like objects. The main parse functions are fromstring() and parse(), both called with the source as first argument. By default, they use the standard parser, but you can always pass a different parser as second argument.
The fromstring() function

The fromstring() function is the easiest way to parse a string:

```python
>>> some_xml_data = "<root>data</root>"

>>> root = etree.fromstring(some_xml_data)
>>> print(root.tag)
root
>>> etree.tostring(root)
b'<root>data</root>'
```

The XML() function

The XML() function behaves like the fromstring() function, but is commonly used to write XML literals right into the source:

```python
>>> root = etree.XML("<root>data</root>")
>>> print(root.tag)
root
>>> etree.tostring(root)
b'<root>data</root>'
```

There is also a corresponding function HTML() for HTML literals.

The parse() function

The parse() function is used to parse from files and file-like objects.

As an example of such a file-like object, the following code uses the BytesIO class for reading from a string instead of an external file. That class comes from the io module in Python 2.6 and later. In older Python versions, you will have to use the StringIO class from the StringIO module. However, in real life, you would obviously avoid doing this all together and use the string parsing functions above.

```python
>>> some_file_like_object = BytesIO("<root>data</root>")

>>> tree = etree.parse(some_file_like_object)

>>> etree.tostring(tree)
b'<root>data</root>'
```

Note that parse() returns an ElementTree object, not an Element object as the string parser functions:

```python
>>> root = tree.getroot()
>>> print(root.tag)
root
>>> etree.tostring(root)
b'<root>data</root>'
```

The reasoning behind this difference is that parse() returns a complete document from a file, while the string parsing functions are commonly used to parse XML fragments.

The parse() function supports any of the following sources:

- an open file object (make sure to open it in binary mode)
• a file-like object that has a .read(byte_count) method returning a byte string on each call
• a filename string
• an HTTP or FTP URL string

Note that passing a filename or URL is usually faster than passing an open file or file-like object. However, the HTTP/FTP client in libxml2 is rather simple, so things like HTTP authentication require a dedicated URL request library, e.g. urllib2 or request. These libraries usually provide a file-like object for the result that you can parse from while the response is streaming in.

Parser objects

By default, lxml.etree uses a standard parser with a default setup. If you want to configure the parser, you can create a you instance:

```python
>>> parser = etree.XMLParser(remove_blank_text=True)  # lxml.etree only!
```

This creates a parser that removes empty text between tags while parsing, which can reduce the size of the tree and avoid dangling tail text if you know that whitespace-only content is not meaningful for your data. An example:

```python
>>> root = etree.XML("<root> <a/> <b> </b> </root>", parser)
```

```python
>>> etree.tostring(root)
b'<root><a/><b/></root>'
```

Note that the whitespace content inside the <b> tag was not removed, as content at leaf elements tends to be data content (even if blank). You can easily remove it in an additional step by traversing the tree:

```python
>>> for element in root.iter("*"):
...    if element.text is not None and not element.text.strip():
...        element.text = None

>>> etree.tostring(root)
b'<root><a/> </b></root>'
```

See help(etree.XMLParser) to find out about the available parser options.

Incremental parsing

lxml.etree provides two ways for incremental step-by-step parsing. One is through file-like objects, where it calls the read() method repeatedly. This is best used where the data arrives from a source like urllib or any other file-like object that can provide data on request. Note that the parser will block and wait until data becomes available in this case:

```python
>>> class DataSource:
...     data = [ b"<roo", b"t><", b"a/", b"""" ]
...     def read(self, requested_size):
...         try:
...             return self.data.pop(0)
...         except IndexError:
...             return b''

>>> tree = etree.parse(DataSource())
```

```python
>>> etree.tostring(tree)
```

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The second way is through a feed parser interface, given by the `feed(data)` and `close()` methods:

```python
>>> parser = etree.XMLParser()

>>> parser.feed("<root>")
>>> parser.feed("t">
>>> parser.feed("a/")
>>> parser.feed(">")
>>> parser.feed("/root>")

>>> root = parser.close()

>>> etree.tostring(root)
b'<root><a/></root>'
```

Here, you can interrupt the parsing process at any time and continue it later on with another call to the `feed()` method. This comes in handy if you want to avoid blocking calls to the parser, e.g. in frameworks like Twisted, or whenever data comes in slowly or in chunks and you want to do other things while waiting for the next chunk.

After calling the `close()` method (or when an exception was raised by the parser), you can reuse the parser by calling its `feed()` method again:

```python
>>> parser.feed("<root/>")
>>> root = parser.close()
>>> etree.tostring(root)
b'<root/>'
```

### Event-driven parsing

Sometimes, all you need from a document is a small fraction somewhere deep inside the tree, so parsing the whole tree into memory, traversing it and dropping it can be too much overhead. `lxml.etree` supports this use case with two event-driven parser interfaces, one that generates parser events while building the tree (`iterparse`), and one that does not build the tree at all, and instead calls feedback methods on a target object in a SAX-like fashion.

Here is a simple `iterparse()` example:

```python
>>> some_file_like = BytesIO("<root><a>data</a></root>"

>>> for event, element in etree.iterparse(some_file_like, events=("start", "end")):
...    print("%s, %3s, %s" % (event, element.tag, element.text))
end, a, data
end, root, None
```

By default, `iterparse()` only generates events when it is done parsing an element, but you can control this through the `events` keyword argument:

```python
>>> some_file_like = BytesIO("<root><a>data</a></root>"

>>> for event, element in etree.iterparse(some_file_like,
...    events=(*"start", *"end")):
...    print("%s, %3s, %s" % (event, element.tag, element.text))
start, start, None
start, a, data
end, a, data
```
Event-driven parsing

Note that the text, tail, and children of an Element are not necessarily present yet when receiving the `start` event. Only the `end` event guarantees that the Element has been parsed completely.

It also allows you to `.clear()` or modify the content of an Element to save memory. So if you parse a large tree and you want to keep memory usage small, you should clean up parts of the tree that you no longer need:

```python
>>> some_file_like = BytesIO("<root><a><b>data</b></a><a><b/></a></root>")

>>> for event, element in etree.iterparse(some_file_like):
...     if element.tag == 'b':
...         print(element.text)
...     elif element.tag == 'a':
...         print("** cleaning up the subtree")
...         element.clear()
** cleaning up the subtree
None
** cleaning up the subtree
```

A very important use case for `iterparse()` is parsing large generated XML files, e.g. database dumps. Most often, these XML formats only have one main data item element that hangs directly below the root node and that is repeated thousands of times. In this case, it is best practice to let `lxml.etree` do the tree building and only to intercept on exactly this one Element, using the normal tree API for data extraction.

```python
>>> xml_file = BytesIO('''
<root>
<a><b>ABC</b><c>abc</c></a>
<a><b>MORE DATA</b><c>more data</c></a>
<a><b>XYZ</b><c>xyz</c></a>
</root>''')

>>> for _, element in etree.iterparse(xml_file, tag='a'):
...     print('%s -- %s' % (element.findtext('b'), element[1].text))
ABC -- abc
MORE DATA -- more data
XYZ -- xyz
```

If, for some reason, building the tree is not desired at all, the target parser interface of `lxml.etree` can be used. It creates SAX-like events by calling the methods of a target object. By implementing some or all of these methods, you can control which events are generated:

```python
>>> class ParserTarget:
...     events = []
...     close_count = 0
...     def start(self, tag, attrib):
...         self.events.append(('start', tag, attrib))
...     def close(self):
...         if self.events:
...             self.events, self.events = self.events, []
...             self.close_count += 1
...             return self.events

>>> parser_target = ParserTarget()

>>> parser = etree.XMLParser(target=parser_target)
```

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Namespaces

>>> events = etree.fromstring('<root test="true"/>', parser)

>>> print(parser_target.close_count)
1

>>> for event in events:
...     print('event: %s - tag: %s' % (event[0], event[1]))
...     for attr, value in event[2].items():
...         print(' * %s = %s' % (attr, value))
event: start - tag: root
 * test = true

You can reuse the parser and its target as often as you like, so you should take care that the .close() method really resets the target to a usable state (also in the case of an error!).

>>> events = etree.fromstring('<root test="true"/>', parser)
>>> print(parser_target.close_count)
2

>>> events = etree.fromstring('<root test="true"/>', parser)
>>> print(parser_target.close_count)
3

>>> events = etree.fromstring('<root test="true"/>', parser)
>>> print(parser_target.close_count)
4

>>> for event in events:
...     print('event: %s - tag: %s' % (event[0], event[1]))
...     for attr, value in event[2].items():
...         print(' * %s = %s' % (attr, value))
event: start - tag: root
 * test = true

Namespaces

The ElementTree API avoids namespace prefixes wherever possible and deploys the real namespace (the URI) instead:

>>> xhtml = etree.Element("{http://www.w3.org/1999/xhtml}html")
>>> body = etree.SubElement(xhtml, "{http://www.w3.org/1999/xhtml}body")
>>> body.text = "Hello World"

>>> print(etree.tostring(xhtml, pretty_print=True))
<html xmlns="http://www.w3.org/1999/xhtml" xml:lang="en">
  <html:body>Hello World</html:body>
</html:

The notation that ElementTree uses was originally brought up by James Clark. It has the major advantage of providing a universally qualified name for a tag, regardless of any prefixes that may or may not have been used or defined in a document. By moving the indirection of prefixes out of the way, it makes namespace aware code much clearer and easier to get right.

As you can see from the example, prefixes only become important when you serialise the result. However, the above code looks somewhat verbose due to the lengthy namespace names. And retyping or copying a string over and over again is error prone. It is therefore common practice to store a namespace URI in a global variable. To adapt the namespace prefixes for serialisation, you can also pass a mapping to the Element factory function, e.g.
to define the default namespace:

```python
>>> XHTML_NAMESPACE = "http://www.w3.org/1999/xhtml"
>>> XHTML = "{%s}" % XHTML_NAMESPACE

>>> NSMAP = {None : XHTML_NAMESPACE}  # the default namespace (no prefix)

>>> xhtml = etree.Element(XHTML + "html", nsmap=NSMAP)  # lxml only!
>>> body = etree.SubElement(xhtml, XHTML + "body")
>>> body.text = "Hello World"

>>> print(etree.tostring(xhtml, pretty_print=True))
<html xmlns="http://www.w3.org/1999/xhtml">
  <body>Hello World</body>
</html>
```

You can also use the QName helper class to build or split qualified tag names:

```python
>>> tag = etree.QName('http://www.w3.org/1999/xhtml', 'html')
>>> print(tag.localname)
html
>>> print(tag.namespace)
http://www.w3.org/1999/xhtml
>>> print(tag.text)
{http://www.w3.org/1999/xhtml}html

>>> tag = etree.QName('{http://www.w3.org/1999/xhtml}html')
>>> print(tag.localname)
html
>>> print(tag.namespace)
http://www.w3.org/1999/xhtml

>>> root = etree.Element('{http://www.w3.org/1999/xhtml}html')

>>> tag = etree.QName(root)
>>> print(tag.localname)
html

>>> tag = etree.QName(root, 'script')
>>> print(tag.text)
{http://www.w3.org/1999/xhtml}script

>>> tag = etree.QName('{http://www.w3.org/1999/xhtml}html', 'script')
>>> print(tag.text)
{http://www.w3.org/1999/xhtml}script
```

lxml.etree allows you to look up the current namespaces defined for a node through the .nsmap property:

```python
>>> xhtml.nsmap
{None: 'http://www.w3.org/1999/xhtml'}
```

Note, however, that this includes all prefixes known in the context of an Element, not only those that it defines itself.

```python
>>> root = etree.Element('root', nsmap={'a': 'http://a.b/c'})
>>> child = etree.SubElement(root, 'child',
...                            nsmap={'b': 'http://b.c/d'})

>>> len(root.nsmap)
1
>>> len(child.nsmap)
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```
Namespaces

Therefore, modifying the returned dict cannot have any meaningful impact on the Element. Any changes to it are ignored.

Namespaces on attributes work alike, but as of version 2.3, lxml.etree will ensure that the attribute uses a pre-fixed namespace declaration. This is because unprefixed attribute names are not considered being in a namespace by the XML namespace specification (section 6.2), so they may end up loosing their namespace on a serialise-parse roundtrip, even if they appear in a namespaced element.

```python
>>> body.set(XHTML + "bgcolor", ":CCFFAA")
>>> print(etree.tostring(xhtml, pretty_print=True))
<html xmlns="http://www.w3.org/1999/xhtml">Hello World</body>
</html>
```

```python
>>> print(body.get("bgcolor"))
None
```

```python
>>> body.get(XHTML + "bgcolor")
'#:CCFFAA'
```

You can also use XPath with fully qualified names:

```python
>>> find_xhtml_body = etree.ETXPath("://{s}body" % XHTML_NAMESPACE)
>>> results = find_xhtml_body(xhtml)
```

```python
>>> print(results[0].tag)
{http://www.w3.org/1999/xhtml}body
```

For convenience, you can use "*" wildcards in all iterators of lxml.etree, both for tag names and namespaces:

```python
>>> for el in xhtml.iter('*'): print(el.tag) # any element
{http://www.w3.org/1999/xhtml}html
{http://www.w3.org/1999/xhtml}body
```

To look for elements that do not have a namespace, either use the plain tag name or provide the empty namespace explicitly:

```python
>>> [ el.tag for el in xhtml.iter('{http://www.w3.org/1999/xhtml}body') ]
['{http://www.w3.org/1999/xhtml}body']
```

```python
>>> for el in xhtml.iter('{}*'):
...     print(el.tag)
```

```python
>>> [ el.tag for el in xhtml.iter('{}body') ]
[]
```

```python
>>> [ el.tag for el in xhtml.iter('{}*)') ]
[]
```
The E-factory

The E-factory provides a simple and compact syntax for generating XML and HTML:

```python
>>> from lxml.builder import E

>>> def CLASS(*args): # class is a reserved word in Python
...     return {'class': ' '.join(args)}

>>> html = page = (
...     E.html( # create an Element called "html"
...         E.head( # html
...             E.title("This is a sample document")
...         ),
...         E.body( # page
...             E.h1("Hello!", CLASS("title")),
...             E.p("This is a paragraph with ", E.b("bold"), ", text in it!"),
...             E.p("This is another paragraph, with a ", E.a("link", href="http://www.python.org"), ",
...             E.p("Here are some reserved characters: <spam&egg>."),
...             etree.XML("<p>And finally an embedded XHTML fragment.</p>")),
...         )
...     )

>>> print(etree.tostring(page, pretty_print=True))
<html>
<head>
<title>This is a sample document</title>
</head>
<body>
<h1 class="title">Hello!</h1>
<p>This is a paragraph with <b>bold</b> text in it!</p>
<p>This is another paragraph, with a <a href="http://www.python.org">link</a>.</p>
<p>Here are some reserved characters: &lt;spam&amp;egg&gt;.</p>
<p>And finally an embedded XHTML fragment.</p>
</body>
</html>
```

Element creation based on attribute access makes it easy to build up a simple vocabulary for an XML language:

```python
>>> from lxml.builder import ElementMaker # lxml only!

>>> E = ElementMaker(namespace="http://my.de/fault/namespace",
...                   nsmap={'p': "http://my.de/fault/namespace"})

>>> DOC = E.doc
>>> TITLE = E.title
>>> SECTION = E.section
>>> PAR = E.par

>>> my_doc = DOC(
...     TITLE("The dog and the hog"),
...     SECTION(
...         TITLE("The dog"),
...     ))
```
One such example is the module `lxml.html.builder`, which provides a vocabulary for HTML. When dealing with multiple namespaces, it is good practice to define one ElementMaker for each namespace URI. Again, note how the above example predefines the tag builders in named constants. That makes it easy to put all tag declarations of a namespace into one Python module and to import/use the tag name constants from there. This avoids pitfalls like typos or accidentally missing namespaces.

**ElementPath**

The `ElementTree` library comes with a simple XPath-like path language called `ElementPath`. The main difference is that you can use the `{namespace}tag` notation in `ElementPath` expressions. However, advanced features like value comparison and functions are not available.

In addition to a full XPath implementation, `lxml.etree` supports the `ElementPath` language in the same way `ElementTree` does, even using (almost) the same implementation. The API provides four methods here that you can find on Elements and ElementTrees:

- `iterfind()` iterates over all Elements that match the path expression
- `findall()` returns a list of matching Elements
- `find()` efficiently returns only the first match
- `findtext()` returns the `.text` content of the first match

Here are some examples:

```python
>>> root = etree.XML("<root><a x='123'>aText</b><c/>b/></a></root>")
```

Find a child of an Element:

```python
>>> print(root.find("b"))
None
>>> print(root.find("a").tag)
```
Find an Element anywhere in the tree:

```python
>>> print(root.find("./b").tag)
b
>>> [b.tag for b in root.iterfind("./b")]  
['b', 'b']
```

Find Elements with a certain attribute:

```python
>>> print(root.findall("./a[@x]")[0].tag)
a
>>> print(root.findall("./a[@y]"))
[]
```

In lxml 3.4, there is a new helper to generate a structural ElementPath expression for an Element:

```python
>>> tree = etree.ElementTree(root)
>>> a = root[0]
>>> print(tree.getelementpath(a[0]))
a/b[1]
>>> print(tree.getelementpath(a[1]))
a/c
>>> print(tree.getelementpath(a[2]))
a/b[2]
```

As long as the tree is not modified, this path expression represents an identifier for a given element that can be used to `find()` it in the same tree later. Compared to XPath, ElementPath expressions have the advantage of being self-contained even for documents that use namespaces.

The `.iter()` method is a special case that only finds specific tags in the tree by their name, not based on a path. That means that the following commands are equivalent in the success case:

```python
>>> print(root.find("./b").tag)
b
>>> print(next(root.iterfind("./b")).tag)
b
>>> print(next(root.iter("b"))).tag)
b
```

Note that the `.find()` method simply returns `None` if no match is found, whereas the other two examples would raise a `StopIteration` exception.
Chapter 8

APIs specific to lxml.etree

lxml.etree tries to follow established APIs wherever possible. Sometimes, however, the need to expose a feature in an easy way led to the invention of a new API. This page describes the major differences and a few additions to the main ElementTree API.

For a complete reference of the API, see the generated API documentation.

Separate pages describe the support for parsing XML, executing XPath and XSLT, validating XML and interfacing with other XML tools through the SAX-API.

lxml is extremely extensible through XPath functions in Python, custom Python element classes, custom URL resolvers and even at the C-level.

lxml.etree

lxml.etree tries to follow the ElementTree API wherever it can. There are however some incompatibilities (see compatibility). The extensions are documented here.

If you need to know which version of lxml is installed, you can access the lxml.etree.LXML_VERSION attribute to retrieve a version tuple. Note, however, that it did not exist before version 1.0, so you will get an AttributeError in older versions. The versions of libxml2 and libxslt are available through the attributes LIBXML_VERSION and LIBXSLT_VERSION.

The following examples usually assume this to be executed first:

```python
>>> from lxml import etree
```

Other Element APIs

While lxml.etree itself uses the ElementTree API, it is possible to replace the Element implementation by custom element subclasses. This has been used to implement well-known XML APIs on top of lxml. For example, lxml ships with a data-binding implementation called objectify, which is similar to the Amara bindery tool.

lxml.etree comes with a number of different lookup schemes to customize the mapping between libxml2 nodes and the Element classes used by lxml.etree.
Trees and Documents

Compared to the original ElementTree API, lxml.etree has an extended tree model. It knows about parents and siblings of elements:

```python
>>> root = etree.Element("root")
>>> a = etree.SubElement(root, "a")
>>> b = etree.SubElement(root, "b")
>>> c = etree.SubElement(root, "c")
>>> d = etree.SubElement(root, "d")
>>> e = etree.SubElement(d, "e")
>>> b.getparent() == root
True
>>> print(b.getnext().tag)
c
>>> print(c.getprevious().tag)
b
```

Elements always live within a document context in lxml. This implies that there is also a notion of an absolute document root. You can retrieve an ElementTree for the root node of a document from any of its elements.

```python
>>> tree = d.getroottree()
>>> print(tree.getroot().tag)
root
```

Note that this is different from wrapping an Element in an ElementTree. You can use ElementTrees to create XML trees with an explicit root node:

```python
>>> tree = etree.ElementTree(d)
>>> print(tree.getroot().tag)
d
>>> etree.tostring(tree)
b'<d><e/></d>'
```

ElementTree objects are serialised as complete documents, including preceding or trailing processing instructions and comments.

All operations that you run on such an ElementTree (like XPath, XSLT, etc.) will understand the explicitly chosen root as root node of a document. They will not see any elements outside the ElementTree. However, ElementTrees do not modify their Elements:

```python
>>> element = tree.getroot()
>>> print(element.tag)
d
>>> print(element.getparent().tag)
root
>>> print(element.getroottree().getroot().tag)
root
```

The rule is that all operations that are applied to Elements use either the Element itself as reference point, or the absolute root of the document that contains this Element (e.g. for absolute XPath expressions). All operations on an ElementTree use its explicit root node as reference.
Iteration

The ElementTree API makes Elements iterable to supports iteration over their children. Using the tree defined above, we get:

```python
>>> [ child.tag for child in root ]
['a', 'b', 'c', 'd']
```

To iterate in the opposite direction, use the built-in `reversed()` function that exists in Python 2.4 and later.

Tree traversal should use the `element.iter()` method:

```python
>>> [ el.tag for el in root.iter() ]
['root', 'a', 'b', 'c', 'd', 'e']
```

lxml.etree also supports this, but additionally features an extended API for iteration over the children, following/preceding siblings, ancestors and descendants of an element, as defined by the respective XPath axis:

```python
>>> [ child.tag for child in root.iterchildren() ]
['a', 'b', 'c', 'd']
```
```python
>>> [ child.tag for child in root.iterchildren(reversed=True) ]
['d', 'c', 'b', 'a']
```
```python
>>> [ sibling.tag for sibling in b.itersiblings() ]
['c', 'd']
```
```python
>>> [ sibling.tag for sibling in c.itersiblings(preceding=True) ]
['b', 'a']
```
```python
>>> [ ancestor.tag for ancestor in e.iterancestors() ]
['d', 'root']
```
```python
>>> [ el.tag for el in root.iterdescendants() ]
['a', 'b', 'c', 'd', 'e']
```
```python
>>> [ el.tag for el in root.iter('d') ]
['d']
```
```python
>>> [ el.tag for el in root.iter('d', 'a') ]
['a', 'd']
```

Note how `element.iterdescendants()` does not include the element itself, as opposed to `element.iter()`. The latter effectively implements the 'descendant-or-self' axis in XPath.

All of these iterators support one (or more, since lxml 3.0) additional arguments that filter the generated elements by tag name:

```python
>>> [ child.tag for child in root.iterchildren('a') ]
['a']
```
```python
>>> [ child.tag for child in d.iterchildren('a') ]
[]
```
```python
>>> [ el.tag for el in root.iterdescendants('d') ]
['d']
```
```python
>>> [ el.tag for el in root.iter('d', 'a') ]
['a', 'd']
```

Note that the order of the elements is determined by the iteration order, which is the document order in most cases (except for preceding siblings and ancestors, where it is the reversed document order). The order of the tag selection arguments is irrelevant, as you can see in the last example.

The most common way to traverse an XML tree is depth-first, which traverses the tree in document order. This is implemented by the `.iter()` method. While there is no dedicated method for breadth-first traversal, it is almost as simple if you use the `collections.deque` type that is available in Python 2.4 and later.

```python
>>> root = etree.XML('<root><a><b/><c/></a><d><e/></d></root>')</n```
Error handling on exceptions

Libxml2 provides error messages for failures, be it during parsing, XPath evaluation or schema validation. The preferred way of accessing them is through the local `error_log` property of the respective evaluator or transformer object. See their documentation for details.

However, lxml also keeps a global error log of all errors that occurred at the application level. Whenever an exception is raised, you can retrieve the errors that occured and “might have” lead to the problem from the error log copy attached to the exception:

```python
>>> etree.clear_error_log()
>>> broken_xml = '''
... <root>
... <a>
... </a>
... '</root>
... '''
>>> try:
...     etree.parse(StringIO(broken_xml))
... except etree.XMLSyntaxError, e:
...     pass # just put the exception into e
```

Once you have caught this exception, you can access its `error_log` property to retrieve the log entries or filter them by a specific type, error domain or error level:

```python
>>> log = e.error_log.filter_from_level(etree.ErrorLevels.FATAL)
>>> print(log)
<string>:4:8:FATAL:PARSER:ERR_TAG_NAME_MISMATCH: Opening and ending tag mismatch: a line 3 and root
<string>:5:1:FATAL:PARSER:ERR_TAG_NOT_FINISHED: Premature end of data in tag root line 2
```

This might look a little cryptic at first, but it is the information that libxml2 gives you. At least the message at the end should give you a hint what went wrong and you can see that the fatal errors (FATAL) happened during
parsing (PARSER) lines 4, column 8 and line 5, column 1 of a string (string), or the filename if available). Here, PARSER is the so-called error domain, see lxml.etree.ErrorDomains for that. You can get it from a log entry like this:

```python
>>> entry = log[0]
>>> print(entry.domain_name)
PARSER
>>> print(entry.type_name)
ERR_TAG_NAME_MISMATCH
>>> print(entry.filename)
<string>
```

There is also a convenience attribute last_error that returns the last error or fatal error that occurred:

```python
>>> entry = e.error_log.last_error
>>> print(entry.domain_name)
PARSER
>>> print(entry.type_name)
ERR_TAG_NOT_FINISHED
>>> print(entry.filename)
<string>
```

**Error logging**

lxml.etree supports logging libxml2 messages to the Python stdlib logging module. This is done through the etree.PyErrorLog class. It disables the error reporting from exceptions and forwards log messages to a Python logger. To use it, see the descriptions of the function etree.useGlobalPythonLog and the class etree.PyErrorLog for help. Note that this does not affect the local error logs of XSLT, XMLSchema, etc.

**Serialisation**

lxml.etree has direct support for pretty printing XML output. Functions like ElementTree.write() and tostring() support it through a keyword argument:

```python
>>> root = etree.XML("<root><test/></root>")
>>> etree.tostring(root)
b'<root><test/></root>'

>>> print(etree.tostring(root, pretty_print=True))
<root>
 <test/>
</root>
```

Note the newline that is appended at the end when pretty printing the output. It was added in lxml 2.0.

By default, lxml (just as ElementTree) outputs the XML declaration only if it is required by the standard:

```python
>>> unicode_root = etree.Element( u"t\u3120st" )
>>> unicode_root.text = u"t\u0A0ast"
>>> etree.tostring(unicode_root, encoding="utf-8")
b'\xe3\x84\xa0st\xe0\xa8\x8ast\xe3\x84\xa0st'"\nx8ast</t\xe3\x84\xa0st>'

>>> print(etree.tostring(unicode_root, encoding="iso-8859-1"))
```
Incremental XML generation

Also see the general remarks on Unicode support.

You can enable or disable the declaration explicitly by passing another keyword argument for the serialisation:

```python
>>> print(etree.tostring(root, xml_declaration=True))
<?xml version='1.0' encoding='ASCII'?>
<root><test/></root>
```

```python
>>> unicode_root.clear()
>>> etree.tostring(unicode_root, encoding="UTF-16LE",
...                  xml_declaration=False)
b'\x00t\x00 1s\x00t\x00/\x00>
```

Note that a standard compliant XML parser will not consider the last line well-formed XML if the encoding is not explicitly provided somehow, e.g. in an underlying transport protocol:

```python
>>> notxml = etree.tostring(unicode_root, encoding="UTF-16LE",
...                           xml_declaration=False)
>>> root = etree.XML(notxml)
#doctest: +ELLIPSIS
Traceback (most recent call last):
...
lxml.etree.XMLSyntaxError: ...
```

Since version 2.3, the serialisation can override the internal subset of the document with a user provided DOCTYPE:

```python
>>> xml = '<!DOCTYPE root>
<root/>
' >>> print(etree.tostring(tree))
<!DOCTYPE root>  <root/>
```

```python
>>> print(etree.tostring(tree,
...                        doctype='<!DOCTYPE root SYSTEM "/tmp/test.dtd">'))
<!DOCTYPE root SYSTEM "/tmp/test.dtd">  <root/>
```

The content will be encoded, but otherwise copied verbatimly into the output stream. It is therefore left to the user to take care for a correct doctype format, including the name of the root node.

### Incremental XML generation

Since version 3.1, lxml provides an xmlfile API for incrementally generating XML using the with statement. It's main purpose is to freely and safely mix surrounding elements with pre-built in-memory trees, e.g. to write out large documents that consist mostly of repetitive subtrees (like database dumps). But it can be useful in many cases where memory consumption matters or where XML is naturally generated in sequential steps. Since lxml 3.4.1, there is an equivalent context manager for HTML serialisation called htmlfile.

The API can serialise to real files (given as file path or file object), as well as file-like objects, e.g. `io.BytesIO()`.

Here is a simple example:

```python
>>> f = BytesIO()
```
Incremental XML generation

```python
>>> with etree.xmlfile(f) as xf:
...     with xf.element('abc'):
...         xf.write('text')

>>> print(f.getvalue().decode('utf-8'))
<abc>text</abc>
```

`xmlfile()` accepts a file path as first argument, or a file(-like) object, as in the example above. In the first case, it takes care to open and close the file itself, whereas file(-like) objects are not closed by default. This is left to the code that opened them. Since lxml 3.4, however, you can pass the argument `close=True` to make lxml call the object's `.close()` method when exiting the `xmlfile` context manager.

To insert pre-constructed Elements and subtrees, just pass them into `write()`:

```python
>>> f = BytesIO()
>>> with etree.xmlfile(f) as xf:
...     with xf.element('abc'):
...         with xf.element('in'):
...             for value in '123':
...                 # construct a really complex XML tree
...                 el = etree.Element('xyz', attr=value)
...                 xf.write(el)
...             # no longer needed, discard it right away!
...             el = None

>>> print(f.getvalue().decode('utf-8'))
<abc><in><xyz attr="1"/><xyz attr="2"/><xyz attr="3"/></in></abc>
```

It is a common pattern to have one or more nested `element()` blocks, and then build in-memory XML subtrees in a loop (using the ElementTree API, the builder API, XSLT, or whatever) and write them out into the XML file one after the other. That way, they can be removed from memory right after their construction, which can largely reduce the memory footprint of an application, while keeping the overall XML generation easy, safe and correct.

Together with Python coroutines, this can be used to generate XML in an asynchronous, non-blocking fashion, e.g. for a stream protocol like the instant messaging protocol XMPP:

```python
def writer(out_stream):
    with xmlfile(out_stream) as xf:
        with xf.element('{http://etherx.jabber.org/streams}stream'):
            try:
                while True:
                    el = (yield)
                    xf.write(el)
                    xf.flush()
            except GeneratorExit:
                pass

w = writer(stream)
nex(w) # start writing (run up to 'yield')
```

Then, whenever XML elements are available for writing, call

```python
w.send(element)
```

And when done:
w.close()

Note the additional `xf.flush()` call in the example above, which is available since lxml 3.4. Normally, the output stream is buffered to avoid excessive I/O calls. Whenever the internal buffer fills up, its content is written out. In the case above, however, we want to make sure that each message that we write (i.e. each element subtree) is written out immediately, so we flush the content explicitly at the right point.

Alternatively, if buffering is not desired at all, it can be disabled by passing the flag `buffered=False` into `xmlfile()` (also since lxml 3.4).

### CDATA

By default, lxml’s parser will strip CDATA sections from the tree and replace them by their plain text content. As real applications for CDATA are rare, this is the best way to deal with this issue.

However, in some cases, keeping CDATA sections or creating them in a document is required to adhere to existing XML language definitions. For these special cases, you can instruct the parser to leave CDATA sections in the document:

```python
>>> parser = etree.XMLParser(strip_cdata=False)
>>> root = etree.XML('  

  ...

  <root><![CDATA[test]]></root>', parser)
```

```python
>>> root.text
'test'
```

```python
>>> etree.tostring(root)
b'<root><![CDATA[test]]></root>'
```

Note how the `.text` property does not give any indication that the text content is wrapped by a CDATA section. If you want to make sure your data is wrapped by a CDATA block, you can use the `CDATA()` text wrapper:

```python
>>> root.text = 'test'
```

```python
>>> root.text
'test'
```

```python
>>> etree.tostring(root)
b'<root>test</root>'
```

```python
>>> root.text = etree.CDATA(root.text)
```

```python
>>> root.text
'test'
```

```python
>>> etree.tostring(root)
b'<root><![CDATA[test]]></root>'
```

### XInclude and ElementInclude

You can let lxml process xinclude statements in a document by calling the `xinclude()` method on a tree:

```python
>>> data = StringIO('  

  ...

  <doc xmlns:xi="http://www.w3.org/2001/XInclude">
  ...
  <foo/>
  ...
  <xi:include href="doc/test.xml" />
  ...
  </doc>''
```

---

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Note that the ElementTree compatible ElementInclude module is also supported as lxml.ElementInclude. It has the additional advantage of supporting custom URL resolvers at the Python level. The normal XInclude mechanism cannot deploy these. If you need ElementTree compatibility or custom resolvers, you have to stick to the external Python module.

**write_c14n on ElementTree**

The lxml.etree.ElementTree class has a method write_c14n, which takes a file object as argument. This file object will receive an UTF-8 representation of the canonicalized form of the XML, following the W3C C14N recommendation. For example:

```python
>>> f = StringIO('<a><b/></a>')
>>> tree = etree.parse(f)
>>> f2 = StringIO()
>>> tree.write_c14n(f2)
>>> print(f2.getvalue().decode("utf-8"))
<a><b/></b></a>
```
Chapter 9

Parsing XML and HTML with lxml

lxml provides a very simple and powerful API for parsing XML and HTML. It supports one-step parsing as well as step-by-step parsing using an event-driven API (currently only for XML).

The usual setup procedure:

```python
>>> from lxml import etree
```

The following examples also use StringIO or BytesIO to show how to parse from files and file-like objects. Both are available in the io module:

```python
from io import StringIO, BytesIO
```

**Parsers**

Parsers are represented by parser objects. There is support for parsing both XML and (broken) HTML. Note that XHTML is best parsed as XML, parsing it with the HTML parser can lead to unexpected results. Here is a simple example for parsing XML from an in-memory string:

```python
>>> xml = '<a xmlns="test"><b xmlns="test"/></a>'
```

```python
>>> root = etree.fromstring(xml)
```

```python
>>> etree.tostring(root)
```

To read from a file or file-like object, you can use the `parse()` function, which returns an `ElementTree` object:

```python
>>> tree = etree.parse(StringIO(xml))
```

```python
>>> etree.tostring(tree.getroot())
```

Note how the `parse()` function reads from a file-like object here. If parsing is done from a real file, it is more common (and also somewhat more efficient) to pass a filename:

```python
>>> tree = etree.parse("doc/test.xml")
```

lxml can parse from a local file, an HTTP URL or an FTP URL. It also auto-detects and reads gzip-compressed XML files (.gz).
If you want to parse from memory and still provide a base URL for the document (e.g. to support relative paths in an XInclude), you can pass the base_url keyword argument:

```python
>>> root = etree.fromstring(xml, base_url="http://where.it/is/from.xml")
```

**Parser options**

The parsers accept a number of setup options as keyword arguments. The above example is easily extended to clean up namespaces during parsing:

```python
>>> parser = etree.XMLParser(ns_clean=True)
>>> tree = etree.parse(StringIO(xml), parser)
>>> etree.tostring(tree.getroot())
b'<a xmlns="test"><b/></a>'
```

The keyword arguments in the constructor are mainly based on the libxml2 parser configuration. A DTD will also be loaded if validation or attribute default values are requested.

Available boolean keyword arguments:

- attribute_defaults - read the DTD (if referenced by the document) and add the default attributes from it
- dtd_validation - validate while parsing (if a DTD was referenced)
- load_dtd - load and parse the DTD while parsing (no validation is performed)
- no_network - prevent network access when looking up external documents (on by default)
- ns_clean - try to clean up redundant namespace declarations
- recover - try hard to parse through broken XML
- remove_blank_text - discard blank text nodes between tags, also known as ignorable whitespace. This is best used together with a DTD or schema (which tells data and noise apart), otherwise a heuristic will be applied.
- remove_comments - discard comments
- remove_pis - discard processing instructions
- strip_cdata - replace CDATA sections by normal text content (on by default)
- resolve_entities - replace entities by their text value (on by default)
- huge_tree - disable security restrictions and support very deep trees and very long text content (only affects libxml2 2.7+)
- compact - use compact storage for short text content (on by default)
- collect_ids - collect XML IDs in a hash table while parsing (on by default). Disabling this can substantially speed up parsing of documents with many different IDs if the hash lookup is not used afterwards.

Other keyword arguments:

- encoding - override the document encoding
- target - a parser target object that will receive the parse events (see The target parser interface)
- schema - an XMLSchema to validate against (see validation)
Error log

Parsers have an `error_log` property that lists the errors and warnings of the last parser run:

```python
>>> parser = etree.XMLParser()
>>> print(len(parser.error_log))
0

>>> tree = etree.XML("<root>

</b>", parser)
Traceback (most recent call last):
  ...  
lxml.etree.XMLSyntaxError: Opening and ending tag mismatch: root line 1 and b, line 2, column 5

>>> print(len(parser.error_log))
1

>>> error = parser.error_log[0]
>>> print(error.message)
Opening and ending tag mismatch: root line 1 and b
>>> print(error.line)
2
>>> print(error.column)
5
```

Each entry in the log has the following properties:

- `message`: the message text
- `domain`: the domain ID (see the `lxml.etree.ErrorDomains` class)
- `type`: the message type ID (see the `lxml.etree.ErrorTypes` class)
- `level`: the log level ID (see the `lxml.etree.ErrorLevels` class)
- `line`: the line at which the message originated (if applicable)
- `column`: the character column at which the message originated (if applicable)
- `filename`: the name of the file in which the message originated (if applicable)

For convenience, there are also three properties that provide readable names for the ID values:

- `domain_name`
- `type_name`
- `level_name`

To filter for a specific kind of message, use the different `filter_*()` methods on the error log (see the `lxml.etree._ListErrorLog` class).

Parsing HTML

HTML parsing is similarly simple. The parsers have a `recover` keyword argument that the `HTMLParser` sets by default. It lets libxml2 try its best to return a valid HTML tree with all content it can manage to parse. It will not raise an exception on parser errors. You should use libxml2 version 2.6.21 or newer to take advantage of this feature.
Doctype information

```python
>>> broken_html = "<html><head><title>test</title><body><h1>page title</h1>"
>>> parser = etree.HTMLParser()
>>> tree = etree.parse(StringIO(broken_html), parser)
>>> result = etree.tostring(tree.getroot(),
...    pretty_print=True, method="html")
>>> print(result)
<html>
  <head>
    <title>test</title>
  </head>
  <body>
    <h1>page title</h1>
  </body>
</html>
```

Lxml has an HTML function, similar to the XML shortcut known from ElementTree:

```python
>>> html = etree.HTML(broken_html)
>>> result = etree.tostring(html, pretty_print=True, method="html")
>>> print(result)
<html>
  <head>
    <title>test</title>
  </head>
  <body>
    <h1>page title</h1>
  </body>
</html>
```

The support for parsing broken HTML depends entirely on libxml2’s recovery algorithm. It is not the fault of lxml if you find documents that are so heavily broken that the parser cannot handle them. There is also no guarantee that the resulting tree will contain all data from the original document. The parser may have to drop seriously broken parts when struggling to keep parsing. Especially misplaced meta tags can suffer from this, which may lead to encoding problems.

Note that the result is a valid HTML tree, but it may not be a well-formed XML tree. For example, XML forbids double hyphens in comments, which the HTML parser will happily accept in recovery mode. Therefore, if your goal is to serialise an HTML document as an XML/XHTML document after parsing, you may have to apply some manual preprocessing first.

Also note that the HTML parser is meant to parse HTML documents. For XHTML documents, use the XML parser, which is namespace aware.

Doctype information

The use of the libxml2 parsers makes some additional information available at the API level. Currently, ElementTree objects can access the DOCTYPE information provided by a parsed document, as well as the XML version and the original encoding:

```python
>>> pub_id = "-//W3C//DTD XHTML 1.0 Transitional//EN"
>>> sys_url = "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd"
>>> doctype_string = '<?!DOCTYPE html PUBLIC "%s" "%s"'> % (pub_id, sys_url)
>>> xml_header = '<?xml version="1.0" encoding="ascii"?>'
>>> xhtml = xml_header + doctype_string + '<?html><body></body><?html>'
```
The target parser interface

As in ElementTree, and similar to a SAX event handler, you can pass a target object to the parser:

```python
>>> class EchoTarget(object):
...     def start(self, tag, attrib):
...         print("start %s %r" % (tag, dict(attrib)))
...     def end(self, tag):
...         print("end %s" % tag)
...     def data(self, data):
...         print("data %r" % data)
...     def comment(self, text):
...         print("comment %s" % text)
...     def close(self):
...         return "closed!"

>>> parser = etree.XMLParser(target = EchoTarget())

>>> result = etree.XML("<element>some<!--comment-->text</element>",
...                     parser)
start element {}
data u'some'
comment comment
data u'text'
end element
close

>>> print(result)
closed!
```

It is important for the `.close()` method to reset the parser target to a usable state, so that you can reuse the parser as often as you like:

```python
>>> result = etree.XML("<element>some<!--comment-->text</element>",
...                     parser)
start element {}
data u'some'
comment comment
```
data u’text’
end element
close

>>> print(result)
closed!

Starting with lxml 2.3, the .close() method will also be called in the error case. This diverges from the behaviour of ElementTree, but allows target objects to clean up their state in all situations, so that the parser can reuse them afterwards.

>>> class CollectorTarget(object):
...     def __init__(self):
...         self.events = []
...     def start(self, tag, attrib):
...         self.events.append("start \%s %r \" % (tag, dict(attrib)))
...     def end(self, tag):
...         self.events.append("end %s \" % tag)
...     def data(self, data):
...         self.events.append("data %r \" % data)
...     def comment(self, text):
...         self.events.append("comment %s \" % text)
...     def close(self):
...         self.events.append("close")
...         return "closed!"

>>> parser = etree.XMLParser(target = CollectorTarget())

>>> result = etree.XML("<element>some</error>\",
...     parser)  # doctest: +ELLIPSIS
lxml.etree.XMLSyntaxError: Opening and ending tag mismatch...

>>> for event in parser.target.events:
...     print(event)

start element {}
data u’some’
close

Note that the parser does not build a tree when using a parser target. The result of the parser run is whatever the target object returns from its .close() method. If you want to return an XML tree here, you have to create it programmatically in the target object. An example for a parser target that builds a tree is the TreeBuilder:

>>> parser = etree.XMLParser(target = etree.TreeBuilder())

>>> result = etree.XML("<element>some<!--comment-->text</element>\",
...     parser)

>>> print(result.tag)
element

>>> print(result[0].text)
comment
The feed parser interface

Since lxml 2.0, the parsers have a feed parser interface that is compatible to the ElementTree parsers. You can use it to feed data into the parser in a controlled step-by-step way.

In lxml.etree, you can use both interfaces to a parser at the same time: the parse() or XML() functions, and the feed parser interface. Both are independent and will not conflict (except if used in conjunction with a parser target object as described above).

To start parsing with a feed parser, just call its feed() method to feed it some data.

```python
>>> parser = etree.XMLParser()
>>> for data in '<?xml version="1.0"?>', '<root><a/></root>':
...     parser.feed(data)
```

When you are done parsing, you must call the close() method to retrieve the root Element of the parse result document, and to unlock the parser:

```python
>>> root = parser.close()
```

```python
>>> print(root.tag)
root
>>> print(root[0].tag)
a
```

If you do not call close(), the parser will stay locked and subsequent feeds will keep appending data, usually resulting in a non well-formed document and an unexpected parser error. So make sure you always close the parser after use, also in the exception case.

Another way of achieving the same step-by-step parsing is by writing your own file-like object that returns a chunk of data on each read() call. Where the feed parser interface allows you to actively pass data chunks into the parser, a file-like object passively responds to read() requests of the parser itself. Depending on the data source, either way may be more natural.

Note that the feed parser has its own error log called feed_error_log. Errors in the feed parser do not show up in the normal error_log and vice versa.

You can also combine the feed parser interface with the target parser:

```python
>>> parser = etree.XMLParser(target = EchoTarget())
>>> parser.feed("<element>
>>> parser.feed("<some text" /></element>
```

```python
start element {}
```

```python
data u'some text'
```

```python
>>> parser.feed("</element>
```

```python
end element
```

```python
>>> result = parser.close()
```

```python
closed!
```

Again, this prevents the automatic creation of an XML tree and leaves all the event handling to the target object. The close() method of the parser forwards the return value of the target’s close() method.
Incremental event parsing

In Python 3.4, the xml.etree.ElementTree package gained an extension to the feed parser interface that is implemented by the XMLPullParser class. It additionally allows processing parse events after each incremental parsing step, by calling the .read_events() method and iterating over the result. This is most useful for non-blocking execution environments where data chunks arrive one after the other and should be processed as far as possible in each step.

The same feature is available in lxml 3.3. The basic usage is as follows:

```python
>>> parser = etree.XMLPullParser(events=('start', 'end'))

... def print_events(parser):
...     for action, element in parser.read_events():
...         print('%s: %s' % (action, element.tag))

>>> parser.feed('<root>some text')
>>> print_events(parser)  # well, no more events, as before ...

>>> parser.feed('<child><a />')
>>> print_events(parser)
start: child
start: a
end: a

>>> parser.feed('</child></root>')
>>> print_events(parser)
end: child
>>> parser.feed('t>')
>>> print_events(parser)
end: root
```

Just like the normal feed parser, the XMLPullParser builds a tree in memory (and you should always call the .close() method when done with parsing):

```python
>>> root = parser.close()
>>> etree.tostring(root)
b'\<root>some text\<child>\<a/>\</child></root>''
```

However, since the parser provides incremental access to that tree, you can explicitly delete content that you no longer need once you have processed it. Read the section on Modifying the tree below to see what you can do here and what kind of modifications you should avoid.

In lxml, it is enough to call the .read_events() method once as the iterator it returns can be reused when new events are available.

Also, as known from other iterators in lxml, you can pass a tag argument that selects which parse events are returned by the .read_events() iterator.

### Event types

The parse events are tuples (event-type, object). The event types supported by ElementTree and lxml.etree are the strings 'start', 'end', 'start-ns' and 'end-ns'. The 'start' and 'end' events represent opening and closing elements. They are accompanied by the respective Element instance. By default, only 'end' events are generated,
whereas the example above requested the generation of both 'start' and 'end' events.

The 'start-ns' and 'end-ns' events notify about namespace declarations. They do not come with Elements. Instead, the value of the 'start-ns' event is a tuple \((\text{prefix}, \text{namespaceURI})\) that designates the beginning of a prefix-namespace mapping. The corresponding end-ns event does not have a value (None). It is common practice to use a list as namespace stack and pop the last entry on the 'end-ns' event.

```python
>>> def print_events(events):
...     for action, obj in events:
...         if action in ('start', 'end'):
...             print("%s: %s" % (action, obj.tag))
...         elif action == 'start-ns':
...             print("%s: %s" % (action, obj))
...         else:
...             print(action)
```

```python
>>> event_types = ("start", "end", "start-ns", "end-ns")
>>> parser = etree.XMLPullParser(event_types)
>>> events = parser.read_events()
>>> parser.feed('<root><element>')</n" data-bbox="5 841 991 884" data-element-type="code" data-line-index="8":

```python
>>> parser.feed('text</element><element>text</element>')</n" data-bbox="5 884 991 927" data-element-type="code" data-line-index="9":

```python
>>> parser.feed('<empty-element xmlns="http://testns/" />')</n" data-bbox="5 927 991 971" data-element-type="code" data-line-index="10":

```python
>>> parser.feed('</root>')</n" data-bbox="5 971 991 999" data-element-type="code" data-line-index="11":

```python
Modifying the tree

You can modify the element and its descendants when handling the 'end' event. To save memory, for example, you can remove subtrees that are no longer needed:

```python
>>> parser = etree.XMLPullParser()
>>> events = parser.read_events()
>>> parser.feed('<root><element key="value">text</element>')</n" data-bbox="5 999 991 1042" data-element-type="code" data-line-index="12":

```python
>>> parser.feed('<element><child /></element>')</n" data-bbox="5 1042 991 1085" data-element-type="code" data-line-index="13":

```python
>>> for action, elem in events:
...     print('%s: %d' % (elem.tag, len(elem))) # processing
...     if elem.tag == 'element':
...         elem.clear() # delete children
```
Selective tag events

As an extension over ElementTree, lxml.etree accepts a tag keyword argument just like `element.iter(tag)`. This restricts events to a specific tag or namespace:

```python
>>> parser = etree.XMLPullParser(tag="element")
>>> parser.feed("<root><element key="value">text</element>"/
>>> parser.feed("<element><child /></element>"
>>> parser.feed("<empty-element xmlns="http://testns/" /></root>"
```
Comments and PIs

As an extension over ElementTree, the XMLPullParser in lxml.etree also supports the event types ‘comment’ and ‘pi’ for the respective XML structures.

```python
>>> event_types = ('start', 'end', 'comment', 'pi')
>>> parser = etree.XMLPullParser(event_types)

>>> parser.feed('<?some pi ?><!-- a comment --><root>')</n
>>> parser.feed('<element key="value">text</element>')</n
>>> parser.feed('<!-- another comment -->')</n
>>> parser.feed('<element>text</element>tail')</n
>>> parser.feed('<empty-element xmlns="http://testns/" />')</n
>>> parser.feed('</root>')</n
>>> for action, elem in parser.read_events():
...     if action in ('start', 'end'):
...         print("%s: %s" % (action, elem.tag))
...     elif action == 'pi':
...         print("%s: -%s=%s-" % (action, elem.target, elem.text))
...     else:
...         # 'comment'
...         print("%s: -%s-" % (action, elem.text))
```

```
pi: -some=pi -
comment: - a comment -
start: root
start: element
end: element
comment: - another comment -
start: element
end: element
start: (http://testns/empty-element
end: (http://testns/empty-element
end: root
```

Events with custom targets

You can combine the pull parser with a parser target. In that case, it is the target’s responsibility to generate event values. Whatever it returns from its .start() and .end() methods will be returned by the pull parser as the second item of the parse events tuple.

```python
>>> class Target(object):
...     def start(self, tag, attrib):
...         print('--> start(%s" % tag)
...         return '>>START: %s<<' % tag
...     def end(self, tag):
```

```
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```
Events with custom targets

Incremental event parsing

...     print('-> end(%s)' % tag)
...     return '>>END: %s<<' % tag
... def close(self):
...     print('-> close()')
...     return "CLOSED!"

>>> event_types = ('start', 'end')
>>> parser = etree.XMLPullParser(event_types, target=Target())

>>> parser.feed('<root><child1 /><child2 /></root>')</n
-> start(root)
-> start(child1)
-> end(child1)
-> start(child2)
-> end(child2)
-> end(root)

>>> for action, value in parser.read_events():
...     print('%s: %s' % (action, value))
start: >>START: root<<
start: >>START: child1<<
end: >>END: child1<<
start: >>START: child2<<
end: >>END: child2<<
end: >>END: root<<

>>> print(parser.close())
-> close()
CLOSED!

As you can see, the event values do not even have to be Element objects. The target is generally free to decide how it wants to create an XML tree or whatever else it wants to make of the parser callbacks. In many cases, however, you will want to make your custom target inherit from the TreeBuilder class in order to have it build a tree that you can process normally. The start() and end() methods of TreeBuilder return the Element object that was created, so you can override them and modify the input or output according to your needs. Here is an example that filters attributes before they are being added to the tree:

>>> class AttributeFilter(etree.TreeBuilder):
...     def start(self, tag, attrib):
...         attrib = dict(attrib)
...         if 'evil' in attrib:
...             del attrib['evil']
...         return super(AttributeFilter, self).start(tag, attrib)

>>> parser = etree.XMLPullParser(target=AttributeFilter())

>>> parser.feed('<root><child1 test="123" /><child2 evil="YES" /></root>')

>>> for action, element in parser.read_events():
...     print('%s: %s(%r)' % (action, element.tag, element.attrib))
end: child1({'test': '123'})
end: child2({})
end: root({})

>>> root = parser.close()
iterparse and iterwalk

As known from ElementTree, the `iterparse()` utility function returns an iterator that generates parser events for an XML file (or file-like object), while building the tree. You can think of it as a blocking wrapper around the `XMLPullParser` that automatically and incrementally reads data from the input file for you and provides a single iterator for them:

```python
>>> xml = '''
... <root>
...   <element key='value'>text</element>
...   <element>text</element>tail
...   <empty-element xmlns="http://testns/" />
... </root>
...'''

>>> context = etree.iterparse(StringIO(xml))

>>> for action, elem in context:
...     print("%s: %s" % (action, elem.tag))
end: element
end: element
end: {http://testns/}empty-element
end: root
```

After parsing, the resulting tree is available through the `root` property of the iterator:

```python
>>> context.root.tag
'root'
```

The other event types can be activated with the `events` keyword argument:

```python
>>> events = ("start", "end")
>>> context = etree.iterparse(StringIO(xml), events=events)

>>> for action, elem in context:
...     print("%s: %s" % (action, elem.tag))
start: root
start: element
end: element
start: element
end: element
start: {http://testns/}empty-element
end: {http://testns/}empty-element
end: root
```

`iterparse()` also supports the `tag` argument for selective event iteration and several other parameters that control the parser setup. You can also use it to parse HTML input by passing `html=True`.

iterwalk

A second extension over ElementTree is the `iterwalk()` function. It behaves exactly like `iterparse()`, but works on Elements and ElementTrees. Here is an example for a tree parsed by `iterparse()`:

```python
>>> f = StringIO(xml)

>>> context = etree.iterparse(f, events=("start", "end"), tag="element")

>>> for action, elem in context:
```
...    print("%s: %s" % (action, elem.tag))
start: element
end: element
start: element
end: element

>>> root = context.root

And now we can take the resulting in-memory tree and iterate over it using iterwalk() to get the exact same
events without parsing the input again:

>>> context = etree.iterwalk(
...    root, events=('start', 'end'), tag='element')

>>> for action, elem in context:
...    print("%s: %s" % (action, elem.tag))
start: element
end: element
start: element
end: element

Python unicode strings

lxml.etree has broader support for Python unicode strings than the ElementTree library. First of all, where ElementTree would raise an exception, the parsers in lxml.etree can handle unicode strings straight away. This is
most helpful for XML snippets embedded in source code using the XML() function:

>>> root = etree.XML( u'<test>  +  </test>' )

This requires, however, that unicode strings do not specify a conflicting encoding themselves and thus lie about
their real encoding:

>>> etree.XML( u'<?xml version="1.0" encoding="ASCII"?

Traceback (most recent call last):
...
ValueError: Unicode strings with encoding declaration are not supported. Please use bytes input or XML fragments without declaration.

Similarly, you will get errors when you try the same with HTML data in a unicode string that specifies a charset
in a meta tag of the header. You should generally avoid converting XML/HTML data to unicode before passing it
into the parsers. It is both slower and error prone.

Serialising to Unicode strings

To serialize the result, you would normally use the tostring() module function, which serializes to plain
ASCII by default or a number of other byte encodings if asked for:

>>> etree.tostring(root)
'b'<test> &#63697; + &#63698; </test>'

>>> etree.tostring(root, encoding='UTF-8', xml_declaration=False)
'b'<test> \xef\xa3\x91 + \xef\xa3\x92 </test>'

As an extension, lxml.etree recognises the name 'unicode' as an argument to the encoding parameter to build a
Python unicode representation of a tree:
Serialising to Unicode strings

```python
>>> etree.tostring(root, encoding='unicode')
u'<test> \uf8d1 + \uf8d2 </test>'

>>> el = etree.Element("test")
>>> etree.tostring(el, encoding='unicode')
u'<test/>'

>>> subel = etree.SubElement(el, "subtest")
>>> etree.tostring(el, encoding='unicode')
u'<test><subtest/></test>'

>>> tree = etree.ElementTree(el)
>>> etree.tostring(tree, encoding='unicode')
u'<test><subtest/></test>'
```

The result of `tostring(encoding='unicode')` can be treated like any other Python unicode string and then passed back into the parsers. However, if you want to save the result to a file or pass it over the network, you should use `write()` or `tostring()` with a byte encoding (typically UTF-8) to serialize the XML. The main reason is that unicode strings returned by `tostring(encoding='unicode')` are not byte streams and they never have an XML declaration to specify their encoding. These strings are most likely not parsable by other XML libraries.

For normal byte encodings, the `tostring()` function automatically adds a declaration as needed that reflects the encoding of the returned string. This makes it possible for other parsers to correctly parse the XML byte stream. Note that using `tostring()` with UTF-8 is also considerably faster in most cases.
Chapter 10

Validation with lxml

Apart from the built-in DTD support in parsers, lxml currently supports three schema languages: DTD, Relax NG and XML Schema. All three provide identical APIs in lxml, represented by validator classes with the obvious names.

lxml also provides support for ISO-Schematron, based on the pure-XSLT skeleton implementation of Schematron:

There is also basic support for pre-ISO-Schematron through the libxml2 Schematron features. However, this does not currently support error reporting in the validation phase due to insufficiencies in the implementation as of libxml2 2.6.30.

The usual setup procedure:

```python
>>> from lxml import etree
```

Validation at parse time

The parser in lxml can do on-the-fly validation of a document against a DTD or an XML schema. The DTD is retrieved automatically based on the DOCTYPE of the parsed document. All you have to do is use a parser that has DTD validation enabled:

```python
>>> parser = etree.XMLParser(dtd_validation=True)
```

Obviously, a request for validation enables the DTD loading feature. There are two other options that enable loading the DTD, but that do not perform any validation. The first is the `load_dtd` keyword option, which simply loads the DTD into the parser and makes it available to the document as external subset. You can retrieve the DTD from the parsed document using the `docinfo` property of the result ElementTree object. The internal subset is available as `internalDTD`, the external subset is provided as `externalDTD`.

The third way to activate DTD loading is with the `attribute_defaults` option, which loads the DTD and weaves attribute default values into the document. Again, no validation is performed unless explicitly requested.

XML schema is supported in a similar way, but requires an explicit schema to be provided:

```python
>>> schema_root = etree.XML('''
...   <xsd:schema xmlns:xsd="http://www.w3.org/2001/XMLSchema">
...     <xsd:element name="a" type="xsd:integer"/>
...   </xsd:schema>
... ''')
```
DTD

As described above, the parser support for DTDs depends on internal or external subsets of the XML file. This means that the XML file itself must either contain a DTD or must reference a DTD to make this work. If you want to validate an XML document against a DTD that is not referenced by the document itself, you can use the DTD class.

To use the DTD class, you must first pass a filename or file-like object into the constructor to parse a DTD:

```python
>>> f = StringIO("<!ELEMENT b EMPTY>")
>>> dtd = etree.DTD(f)
```

Now you can use it to validate documents:

```python
>>> root = etree.XML("<b/>")
>>> print(dtd.validate(root))
True

>>> root = etree.XML("<b><a/></b>")
>>> print(dtd.validate(root))
False
```

The reason for the validation failure can be found in the error log:

```python
>>> print(dtd.error_log.filter_from_errors()[0])
<string>:1:0:ERROR:VALID:DTD_NOT_EMPTY: Element b was declared EMPTY this one has content
```

As an alternative to parsing from a file, you can use the external_id keyword argument to parse from a catalog. The following example reads the DocBook DTD in version 4.2, if available in the system catalog:

```python
dtd = etree.DTD(external_id = "//OASIS//DTD DocBook XML V4.2//EN")
```

The DTD information is available as attributes on the DTD object. The method iterelements provides an iterator over the element declarations:

```python
>>> dtd = etree.DTD(StringIO('’<!ELEMENT a EMPTY><!ELEMENT b EMPTY>’))
>>> for el in dtd.iterelements():
...     print(el.name)
 a
 b
```

The method elements returns the element declarations as a list:

```python
>>> dtd = etree.DTD(StringIO('’<!ELEMENT a EMPTY><!ELEMENT b EMPTY>’))
```
An element declaration object provides the following attributes/methods:

- **name**: The name of the element;
- **type**: The element type, one of “undefined”, “empty”, “any”, “mixed” or “element”;
- **content**: Element content declaration (see below);
- **iterattributes()**: Return an iterator over attribute declarations (see below);
- **attributes()**: Return a list of attribute declarations.

The **content** attribute contains information about the content model of the element. These element content declaration objects form a binary tree (via the **left** and **right** attributes), that makes it possible to reconstruct the content model expression. Here’s a list of all attributes:

- **name**: If this object represents an element in the content model expression, **name** is the name of the element, otherwise it is **None**;
- **type**: The type of the node: one of “pcdata”, “element”, “seq” or “or”;
- **occur**: How often this element (or this combination of elements) may occur: one of “once”, “opt”, “mult” or “plus”
- **left**: The left hand subexpression
- **right**: The right hand subexpression

For example, the element declaration `<!ELEMENT a (a|b)+>` results in the following element content declaration objects:

```python
>>> dtd = etree.DTD(StringIO('<!ELEMENT a (a|b)+>'))
>>> content = dtd.elements()[0].content
>>> content.type, content.occur, content.name
('or', 'plus', None)
>>> left, right = content.left, content.right
>>> left.type, left.occur, left.name
('element', 'once', 'a')
>>> right.type, right.occur, right.name
('element', 'once', 'b')
```

Attributes declarations have the following attributes/methods:

- **name**: The name of the attribute;
- **elemname**: The name of the element the attribute belongs to;
- **type**: The attribute type, one of “cdata”, “id”, “idref”, “idrefs”, “entity”, “entities”, “nmtoken”, “nmtokens”, “enumeration” or “notation”;
- **default**: The type of the default value, one of “none”, “required”, “implied” or “fixed”;
- **defaultValue**: The default value;
- **itervalues()**: Return an iterator over the allowed attribute values (if the attribute if of type “enumeration”);
- **values()**: Return a list of allowed attribute values.
Entity declarations are available via the `iterentities` and `entities` methods:

```python
>>> dtd = etree.DTD(StringIO('<!ENTITY hurz "&#x40;"'))
>>> entity = dtd.entities()[0]
>>> entity.name, entity.orig, entity.content
('hurz', '@', '@')
```

### RelaxNG

The RelaxNG class takes an ElementTree object to construct a Relax NG validator:

```python
>>> f = StringIO('...
... <element name="a" xmlns="http://relaxng.org/ns/structure/1.0">
...     <zeroOrMore>
...         <element name="b">
...             <text />
...         </element>
...     </zeroOrMore>
... </element>
...
')
>>> relaxng_doc = etree.parse(f)
>>> relaxng = etree.RelaxNG(relaxng_doc)
```

Alternatively, pass a filename to the `file` keyword argument to parse from a file. This also enables correct handling of include files from within the RelaxNG parser.

You can then validate some ElementTree document against the schema. You’ll get back True if the document is valid against the Relax NG schema, and False if not:

```python
>>> valid = StringIO('<a><b></b></a>
... doc = etree.parse(valid)
... relaxng.validate(doc)
True
```

Calling the schema object has the same effect as calling its validate method. This is sometimes used in conditional statements:

```python
>>> invalid = StringIO('<a><c></c></a>
... doc2 = etree.parse(invalid)
... if not relaxng(doc2):
...     print("invalid!")
invalid!
```

If you prefer getting an exception when validating, you can use the `assert_` or `assertValid` methods:

```python
>>> relaxng.assertValid(doc2)
Traceback (most recent call last):
...
lxml.etree.DocumentInvalid: Did not expect element c there, line 1
```
If you want to find out why the validation failed in the second case, you can look up the error log of the validation process and check it for relevant messages:

```python
>>> log = relaxng.error_log
>>> print(log.last_error)
<string>:1:0:ERROR:RELAXNGV:RELAXNG_ERR_ELEMWRONG: Did not expect element c there
```

You can see that the error (ERROR) happened during RelaxNG validation (RELAXNGV). The message then tells you what went wrong. You can also look at the error domain and its type directly:

```python
>>> error = log.last_error
>>> print(error.domain_name)
RELAXNGV
>>> print(error.type_name)
RELAXNG_ERR_ELEMWRONG
```

Note that this error log is local to the RelaxNG object. It will only contain log entries that appeared during the validation.

Similar to XSLT, there’s also a less efficient but easier shortcut method to do one-shot RelaxNG validation:

```python
>>> doc.relaxng(relaxng_doc)
True
>>> doc2.relaxng(relaxng_doc)
False
```

libxml2 does not currently support the RelaxNG Compact Syntax. However, the trang translator can convert the compact syntax to the XML syntax, which can then be used with lxml.

**XMLSchema**

lxml.etree also has XML Schema (XSD) support, using the class lxml.etree.XMLSchema. The API is very similar to the Relax NG and DTD classes. Pass an ElementTree object to construct a XMLSchema validator:

```python
>>> f = StringIO('''
... <xsd:schema xmlns:xsd="http://www.w3.org/2001/XMLSchema">
...   <xsd:element name="a" type="AType"/>
...   <xsd:complexType name="AType">
...     <xsd:sequence>
...       <xsd:element name="b" type="xsd:string"/>
...     </xsd:sequence>
...   </xsd:complexType>
... </xsd:schema>
... ''')
>>> xmlschema_doc = etree.parse(f)
>>> xmlschema = etree.XMLSchema(xmlschema_doc)
```

You can then validate some ElementTree document with this. Like with RelaxNG, you’ll get back true if the document is valid against the XML schema, and false if not:

```python
>>> valid = StringIO('<a><b></b></a>')
>>> doc = etree.parse(valid)
>>> xmlschema.validate(doc)
```

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True

>>> invalid = StringIO('<a><c></c></a>
>>> doc2 = etree.parse(invalid)
>>> xmlschema.validate(doc2)
False

Calling the schema object has the same effect as calling its validate method. This is sometimes used in conditional statements:

```python
>>> invalid = StringIO('<a><c></c></a>
>>> doc2 = etree.parse(invalid)
>>> if not xmlschema(doc2):
...     print("invalid!")
invalid!
```

If you prefer getting an exception when validating, you can use the `assert_` or `assertValid` methods:

```python
>>> xmlschema.assertValid(doc2)
Traceback (most recent call last):
  ... lxml.etree.DocumentInvalid: Element 'c': This element is not expected. Expected is ( b ).
>>> xmlschema.assert_(doc2)
Traceback (most recent call last):
  ... AssertionError: Element 'c': This element is not expected. Expected is ( b )., line 1
```

Error reporting works as for the RelaxNG class:

```python
>>> log = xmlschema.error_log
>>> error = log.last_error
>>> print(error.domain_name)
SCHEMASV
>>> print(error.type_name)
SCHEMAV_ELEMENT_CONTENT
```

If you were to print this log entry, you would get something like the following. Note that the error message depends on the libxml2 version in use:

```
<string>:1:ERROR::SCHEMAV_ELEMENT_CONTENT: Element 'c': This element is not expected. Expected is ( b ).
```

Similar to XSLT and RelaxNG, there’s also a less efficient but easier shortcut method to do XML Schema validation:

```python
>>> doc.xmlschema(xmlschema_doc)
True
>>> doc2.xmlschema(xmlschema_doc)
False
```

### Schematron

From version 2.3 on lxml features ISO-Schematron support built on the de-facto reference implementation of Schematron, the pure-XSLT-1.0 skeleton implementation. This is provided by the lxml.isoschematron package that implements the Schematron class, with an API compatible to the other validators’. Pass an Element or `ElementTree` object to construct a Schematron validator:
>>> from lxml import isoschematron
>>> f = StringIO('"
... <schema xmlns="http://purl.oclc.org/dsdl/schematron" >
...    <pattern id="sum_equals_100_percent">
...       <title>Sum equals 100%.</title>
...       <rule context="Total">
...          <assert test="sum(//Percent)=100">Sum is not 100%.</assert>
...       </rule>
...    </pattern>
... </schema>
..."
')

>>> sct_doc = etree.parse(f)
>>> schematron = isoschematron.Schematron(sct_doc)

You can then validate some ElementTree document with this. Just like with XMLSchema or RelaxNG, you’ll get back true if the document is valid against the schema, and false if not:

>>> valid = StringIO('"
... <Total>
...    <Percent>20</Percent>
...    <Percent>30</Percent>
...    <Percent>50</Percent>
... </Total>
..."
')

>>> doc = etree.parse(valid)
>>> schematron.validate(doc)
True

>>> etree.SubElement(doc.getroot(), "Percent").text = "10"

>>> schematron.validate(doc)
False

Calling the schema object has the same effect as calling its validate method. This can be useful for conditional statements:

```python
>>> is_valid = isoschematron.Schematron(sct_doc)

>>> if not is_valid(doc):
...     print("invalid!")
invalid!
```

Built on a pure-xslt implementation, the actual validator is created as an XSLT 1.0 stylesheet using these steps:

1. Process inclusions
2. Process abstract patterns
3. Compile the schematron schema to XSLT

To allow more control over the individual steps, isoschematron.Schematron supports an extended API:

The `include` and `expand` keyword arguments can be used to switch off steps 1) and 2).
To set parameters for steps 1), 2) and 3) dictionaries containing parameters for XSLT can be provided using the keyword arguments `include_params`, `expand_params` or `compile_params`. Schematron automatically converts these parameters to stylesheet parameters so you need not worry to set string parameters using quotes or to use XSLT's `strparam()`. If you ever need to pass an XPath as argument to the XSLT stylesheet you can pass in an etree.XPath object (see XPath and XSLT with lxml: Stylesheet-parameters for background on this).

The phase parameter of the compile step is additionally exposed as a keyword argument. If set, it overrides occurrence in compile_params. Note that isoschematron.Schematron might expose more common parameters as additional keyword args in the future.

By setting `store_schematron` to True, the (included-and-expanded) schematron document tree is stored and made available through the `schematron` property.

Similarly, setting `store_xslt` to True will result in the validation XSLT document tree being kept; it can be retrieved through the `validator_xslt` property.

Finally, with `store_report` set to True (default: False), the resulting validation report document gets stored and can be accessed as the `validation_report` property.

Using the phase parameter of isoschematron.Schematron allows for selective validation of predefined pattern groups:

```python
>>> f = StringIO('''
... <schema xmlns="http://purl.oclc.org/dsdl/schematron">
...  <phase id="phase.sum_check">
...   <active pattern="sum_equals_100_percent"/>
...  </phase>
...  <phase id="phase.entries_check">
...   <active pattern="all_positive"/>
...  </phase>
... </schema>
''')
>>> sct_doc = etree.parse(f)
>>> schematron = isoschematron.Schematron(sct_doc)

... valid = StringIO('''
... <Total>
... <Percent>20</Percent>
... <Percent>30</Percent>
... <Percent>50</Percent>
... </Total>
''')

>>> doc = etree.parse(valid)
```
If the constraint of Percent entries being positive is not of interest in a certain validation scenario, it can now be disabled:

```python
>>> selective = isoschematron.Schematron(sct_doc, phase="phase.sum_check")
>>> selective.validate(doc)
True
```

The usage of validation phases is a unique feature of ISO-Schematron and can be a very powerful tool e.g. for establishing validation stages or to provide different validators for different “validation audiences”.

Since version 2.0, lxml.etree features pre-ISO-Schematron support, using the class lxml.etree.Schematron. It requires at least libxml2 2.6.21 to work. The API is the same as for the other validators. Pass an ElementTree object to construct a Schematron validator:

```python
>>> f = StringIO(''
... <schema xmlns="http://www.ascc.net/xml/schematron">
... <pattern name="Sum equals 100%.">
... </pattern>
... </schema>
... '')
```

```python
>>> sct_doc = etree.parse(f)
>>> schematron = etree.Schematron(sct_doc)
```

You can then validate some ElementTree document with this. Like with RelaxNG, you’ll get back true if the document is valid against the schema, and false if not:

```python
>>> valid = StringIO('''
... <Total>
... <Percent>20</Percent>
... <Percent>30</Percent>
... <Percent>50</Percent>
... </Total>
... ''')
>>> schematron.validate(doc)
True
```
Calling the schema object has the same effect as calling its validate method. This is sometimes used in conditional statements:

```python
>>> is_valid = etree.Schematron(sct_doc)

>>> if not is_valid(doc):
...     print("invalid!")
invalid!
```

Note that libxml2 restricts error reporting to the parsing step (when creating the Schematron instance). There is not currently any support for error reporting during validation.
Chapter 11

XPath and XSLT with lxml

lxml supports XPath 1.0, XSLT 1.0 and the EXSLT extensions through libxml2 and libxslt in a standards compliant way.

The usual setup procedure:

```python
>>> from lxml import etree
```

**XPath**

lxml.etree supports the simple path syntax of the `find`, `findall` and `findtext` methods on ElementTree and Element, as known from the original ElementTree library (ElementPath). As an lxml specific extension, these classes also provide an `xpath()` method that supports expressions in the complete XPath syntax, as well as custom extension functions.

There are also specialized XPath evaluator classes that are more efficient for frequent evaluation: XPath and XPathEvaluator. See the performance comparison to learn when to use which. Their semantics when used on Elements and ElementTrees are the same as for the `xpath()` method described here.

**The `xpath()` method**

For ElementTree, the `xpath` method performs a global XPath query against the document (if absolute) or against the root node (if relative):

```python
>>> f = StringIO('<foo><bar></bar></foo>')</n
>>> tree = etree.parse(f)

>>> r = tree.xpath('/foo/bar')
>>> len(r)
1
>>> r[0].tag
'bar'

>>> r = tree.xpath('bar')
>>> r[0].tag
'bar'
```
When `xpath()` is used on an Element, the XPath expression is evaluated against the element (if relative) or against the root tree (if absolute):

```python
>>> root = tree.getroot()
>>> r = root.xpath('bar')
>>> r[0].tag
'bar'

>>> bar = root[0]
>>> r = bar.xpath('/foo/bar')
>>> r[0].tag
'bar'

>>> tree = bar.getroottree()
>>> r = tree.xpath('/foo/bar')
>>> r[0].tag
'bar'
```

The `xpath()` method has support for XPath variables:

```python
>>> expr = "//*[local-name() = $name]"
>>> print(root.xpath(expr, name = "foo")[0].tag)
foo

>>> print(root.xpath(expr, name = "bar")[0].tag)
bar

>>> print(root.xpath("$text", text = "Hello World!"))
Hello World!
```

**Namespaces and prefixes**

If your XPath expression uses namespace prefixes, you must define them in a prefix mapping. To this end, pass a dictionary to the `namespaces` keyword argument that maps the namespace prefixes used in the XPath expression to namespace URIs:

```python
>>> f = StringIO('''
... <a:foo xmlns:a="http://codespeak.net/ns/test1"
...     xmlns:b="http://codespeak.net/ns/test2">
...     <b:bar>Text</b:bar>
... </a:foo>
...'''
)
>>> doc = etree.parse(f)

>>> r = doc.xpath('/t:foo/b:bar',
...                namespaces={'t': 'http://codespeak.net/ns/test1',
...                'b': 'http://codespeak.net/ns/test2'})
>>> len(r)
1

>>> r[0].tag
'{http://codespeak.net/ns/test2}bar'

>>> r[0].text
'Text'
```
XPath return values

The prefixes you choose here are not linked to the prefixes used inside the XML document. The document may define whatever prefixes it likes, including the empty prefix, without breaking the above code.

Note that XPath does not have a notion of a default namespace. The empty prefix is therefore undefined for XPath and cannot be used in namespace prefix mappings.

There is also an optional extensions argument which is used to define custom extension functions in Python that are local to this evaluation. The namespace prefixes that they use in the XPath expression must also be defined in the namespace prefix mapping.

XPath return values

The return value types of XPath evaluations vary, depending on the XPath expression used:

- True or False, when the XPath expression has a boolean result
- a float, when the XPath expression has a numeric result (integer or float)
- a ’smart’ string (as described below), when the XPath expression has a string result.
- a list of items, when the XPath expression has a list as result. The items may include Elements (also comments and processing instructions), strings and tuples. Text nodes and attributes in the result are returned as ’smart’ string values. Namespace declarations are returned as tuples of strings: (prefix, URI).

XPath string results are ’smart’ in that they provide a getparent() method that knows their origin:

- for attribute values, result.getparent() returns the Element that carries them. An example is //foo/@attribute, where the parent would be a foo Element.
- for the text() function (as in //text()), it returns the Element that contains the text or tail that was returned.

You can distinguish between different text origins with the boolean properties is_text, is_tail and is_attribute.

Note that getparent() may not always return an Element. For example, the XPath functions string() and concat() will construct strings that do not have an origin. For them, getparent() will return None.

There are certain cases where the smart string behaviour is undesirable. For example, it means that the tree will be kept alive by the string, which may have a considerable memory impact in the case that the string value is the only thing in the tree that is actually of interest. For these cases, you can deactivate the parental relationship using the keyword argument smart_strings.

```python
>>> root = etree.XML("<root><a>TEXT</a></root>")

>>> find_text = etree.XPath("//text()")
>>> text = find_text(root)[0]
>>> print(text)
TEXT
>>> print(text.getparent().text)
TEXT

>>> find_text = etree.XPath("//text()", smart_strings=False)
>>> text = find_text(root)[0]
>>> print(text)
TEXT
>>> hasattr(text, 'getparent')
False
```

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Generating XPath expressions

ElementTree objects have a method `getpath(element)`, which returns a structural, absolute XPath expression to find that element:

```python
>>> a = etree.Element("a")
>>> b = etree.SubElement(a, "b")
>>> c = etree.SubElement(a, "c")
>>> d1 = etree.SubElement(c, "d")
>>> d2 = etree.SubElement(c, "d")

>>> tree = etree.ElementTree(c)
>>> print tree.getpath(d2)
/c/d[2]
>>> tree.xpath(tree.getpath(d2)) == [d2]
True
```

The XPath class

The XPath class compiles an XPath expression into a callable function:

```python
>>> root = etree.XML("<root><a><b/></a><b/></root>")

>>> find = etree.XPath("//b")
>>> print find(root)[0].tag
b
```

The compilation takes as much time as in the `xpath()` method, but it is done only once per class instantiation. This makes it especially efficient for repeated evaluation of the same XPath expression.

Just like the `xpath()` method, the XPath class supports XPath variables:

```python
>>> count_elements = etree.XPath("count(//*[local-name() = $name])")

>>> print count_elements(root, name = "a")
1.0
>>> print count_elements(root, name = "b")
2.0
```

This supports very efficient evaluation of modified versions of an XPath expression, as compilation is still only required once.

Prefix-to-namespace mappings can be passed as second parameter:

```python
>>> root = etree.XML("<root xmlns='NS'><a><b/></a><b/></root>")

>>> find = etree.XPath("//n:b", namespaces={'n':"NS"})
>>> print find(root)[0].tag
{NS}b
```

Regular expressions in XPath

By default, XPath supports regular expressions in the EXSLT namespace:
The XPathEvaluator classes

lxml.etree provides two other efficient XPath evaluators that work on ElementTrees or Elements respectively: XPathDocumentEvaluator and XPathElementEvaluator. They are automatically selected if you use the XPathEvaluator helper for instantiation:

```python
>>> root = etree.XML("<root><a><b/></a><b/></root>")
>>> xpatheval = etree.XPathEvaluator(root)

>>> print(isinstance(xpatheval, etree.XPathElementEvaluator))
True

>>> print(xpatheval("//b")[0].tag)
b
```

This class provides efficient support for evaluating different XPath expressions on the same Element or Element-Tree.

ETXPath

ElementTree supports a language named ElementPath in its find*() methods. One of the main differences between XPath and ElementPath is that the XPath language requires an indirection through prefixes for namespace support, whereas ElementTree uses the Clark notation (\{ns\}name) to avoid prefixes completely. The other major difference regards the capabilities of both path languages. Where XPath supports various sophisticated ways of restricting the result set through functions and boolean expressions, ElementPath only supports pure path traversal without nesting or further conditions. So, while the ElementPath syntax is self-contained and therefore easier to write and handle, XPath is much more powerful and expressive.

lxml.etree bridges this gap through the class ETXPath, which accepts XPath expressions with namespaces in Clark notation. It is identical to the XPath class, except for the namespace notation. Normally, you would write:

```python
>>> root = etree.XML("<root xmlns='ns'><a><b/></a><b/></root>")

>>> find = etree.XPath("//p:b", namespaces={'p' : 'ns'})

>>> print(find(root)[0].tag)
{ns}b
```

ETXPath allows you to change this to:

```python
>>> find = etree.ETXPath("//{ns}b")

>>> print(find(root)[0].tag)
{ns}b
```
Error handling

lxml.etree raises exceptions when errors occur while parsing or evaluating an XPath expression:

```python
>>> find = etree.XPath("\\")
Traceback (most recent call last):
... lxml.etree.XPathSyntaxError: Invalid expression
```

lxml will also try to give you a hint what went wrong, so if you pass a more complex expression, you may get a somewhat more specific error:

```python
>>> find = etree.XPath("//*[1.1.1]")
Traceback (most recent call last):
... lxml.etree.XPathSyntaxError: Invalid predicate
```

During evaluation, lxml will emit an XPathEvalError on errors:

```python
>>> find = etree.XPath("//ns:a")
>>> find(root)
Traceback (most recent call last):
... lxml.etree.XPathEvalError: Undefined namespace prefix
```

This works for the XPath class, however, the other evaluators (including the xpath() method) are one-shot operations that do parsing and evaluation in one step. They therefore raise evaluation exceptions in all cases:

```python
>>> root = etree.Element("test")
>>> find = root.xpath("//*[1.1.1]")
Traceback (most recent call last):
... lxml.etree.XPathEvalError: Invalid predicate
```

```python
>>> find = root.xpath("//ns:a")
Traceback (most recent call last):
... lxml.etree.XPathEvalError: Undefined namespace prefix
```

```python
>>> find = root.xpath("\\")
Traceback (most recent call last):
... lxml.etree.XPathEvalError: Invalid expression
```

Note that lxml versions before 1.3 always raised an XPathSyntaxError for all errors, including evaluation errors. The best way to support older versions is to except on the superclass XPathError.

XSLT

lxml.etree introduces a new class, lxml.etree.XSLT. The class can be given an ElementTree or Element object to construct an XSLT transformer:

```python
>>> xslt_root = etree.XML("''\n... <xsl:stylesheet version="1.0"
... xmlns:xsl=http://www.w3.org/1999/XSL/Transform">
... <xsl:template match="/">
```

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XSLT result objects

XSLT

...
<foo><xsl:value-of select="/a/b/text()" /></foo>
...
</xsl:template>
... </xsl:stylesheet>’’’)
>>> transform = etree.XSLT(xslt_root)
You can then run the transformation on an ElementTree document by simply calling it, and this results in another
ElementTree object:
>>> f = StringIO(’<a><b>Text</b></a>’)
>>> doc = etree.parse(f)
>>> result_tree = transform(doc)
By default, XSLT supports all extension functions from libxslt and libexslt as well as Python regular expressions
through the EXSLT regexp functions. Also see the documentation on custom extension functions, XSLT extension
elements and document resolvers. There is a separate section on controlling access to external documents and
resources.

XSLT result objects
The result of an XSL transformation can be accessed like a normal ElementTree document:
>>> root = etree.XML(’<a><b>Text</b></a>’)
>>> result = transform(root)
>>> result.getroot().text
’Text’
but, as opposed to normal ElementTree objects, can also be turned into an (XML or text) string by applying the
str() function:
>>> str(result)
’<?xml version="1.0"?>\n<foo>Text</foo>\n’
The result is always a plain string, encoded as requested by the xsl:output element in the stylesheet. If
you want a Python unicode string instead, you should set this encoding to UTF-8 (unless the ASCII default is
sufficient). This allows you to call the builtin unicode() function on the result:
>>> unicode(result)
u’<?xml version="1.0"?>\n<foo>Text</foo>\n’
You can use other encodings at the cost of multiple recoding. Encodings that are not supported by Python will
result in an error:
>>>
...
...
...
...
...
...
...
>>>

xslt_tree = etree.XML(’’’\
<xsl:stylesheet version="1.0"
xmlns:xsl="http://www.w3.org/1999/XSL/Transform">
<xsl:output encoding="UCS4"/>
<xsl:template match="/">
<foo><xsl:value-of select="/a/b/text()" /></foo>
</xsl:template>
</xsl:stylesheet>’’’)
transform = etree.XSLT(xslt_tree)

>>> result = transform(doc)
>>> unicode(result)
Traceback (most recent call last):
...

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Stylesheet parameters

It is possible to pass parameters, in the form of XPath expressions, to the XSLT template:

```python
>>> xslt_tree = etree.XML('""
... <xsl:stylesheet version="1.0"
... xmlns:xsl="http://www.w3.org/1999/XSL/Transform">
... <xsl:param name="a" />
... <foo><xsl:value-of select="$a" /></foo>
</xsl:template>
</xsl:stylesheet>"
```

```python
transform = etree.XSLT(xslt_tree)
```

```python
doc_root = etree.XML('<a><b>Text</b></a>')
```

The parameters are passed as keyword parameters to the transform call. First, let’s try passing in a simple integer expression:

```python
>>> result = transform(doc_root, a="5")
```

```python
str(result)
'<?xml version="1.0"?>
<foo>5</foo>
'
```

You can use any valid XPath expression as parameter value:

```python
>>> result = transform(doc_root, a="/a/b/text()")
```

```python
str(result)
'<?xml version="1.0"?>
<foo>Text</foo>
'
```

It’s also possible to pass an XPath object as a parameter:

```python
>>> result = transform(doc_root, a=etree.XPath("/a/b/text()"))
```

```python
str(result)
'<?xml version="1.0"?>
<foo>Text</foo>
'
```

Passing a string expression looks like this:

```python
>>> result = transform(doc_root, a="'A'")
```

```python
str(result)
'<?xml version="1.0"?>
<foo>A</foo>
'
```

To pass a string that (potentially) contains quotes, you can use the .strparam() class method. Note that it does not escape the string. Instead, it returns an opaque object that keeps the string value.

```python
plain_string_value = etree.XSLT.strparam(" It’s “Monty Python” “")
```

```python
>>> result = transform(doc_root, a=plain_string_value)
```

```python
str(result)
'<?xml version="1.0"?>
<foo> It’s "Monty Python" </foo>
'
```

If you need to pass parameters that are not legal Python identifiers, pass them inside of a dictionary:

```python
transform = etree.XSLT(etree.XML('""
... <xsl:stylesheet version="1.0"
... xmlns:xsl="http://www.w3.org/1999/XSL/Transform">
... <xsl:param name="non-python-identifier" />
... <xsl:template match="/">
```

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Like most of the processing oriented objects in lxml.etree, XSLT provides an error log that lists messages and error output from the last run. See the parser documentation for a description of the error log.

```python
>>> xslt_root = etree.XML('''
    ... <xsl:stylesheet version="1.0"
    ... xmlns:xsl="http://www.w3.org/1999/XSL/Transform">
    ... <xsl:template match="/">
    ... <xsl:value-of select="/a/b/text()" /></xsl:template>
    ... </xsl:stylesheet>''')
>>> transform = etree.XSLT(xslt_root)
```
The `xslt()` tree method

There’s also a convenience method on ElementTree objects for doing XSL transformations. This is less efficient if you want to apply the same XSL transformation to multiple documents, but is shorter to write for one-shot operations, as you do not have to instantiate a stylesheet yourself:

```python
>>> result = doc.xslt(xslt_tree, a='A')
>>> str(result)
'<?xml version="1.0"?>
<foo>A</foo>
'
```

This is a shortcut for the following code:

```python
>>> transform = etree.XSLT(xslt_tree)
>>> result = transform(doc, a='A')
>>> str(result)
'<?xml version="1.0"?>
<foo>A</foo>
'
```

Dealing with stylesheet complexity

Some applications require a larger set of rather diverse stylesheets. lxml.etree allows you to deal with this in a number of ways. Here are some ideas to try.

The most simple way to reduce the diversity is by using XSLT parameters that you pass at call time to configure the stylesheets. The `partial()` function in the `functools` module of Python 2.5 may come in handy here. It allows you to bind a set of keyword arguments (i.e. stylesheet parameters) to a reference of a callable stylesheet. The same works for instances of the XPath() evaluator, obviously.

You may also consider creating stylesheets programmatically. Just create an XSL tree, e.g. from a parsed template, and then add or replace parts as you see fit. Passing an XSL tree into the XSLT() constructor multiple times will create independent stylesheets, so later modifications of the tree will not be reflected in the already created stylesheets. This makes stylesheet generation very straightforward.

A third thing to remember is the support for custom extension functions and XSLT extension elements. Some things are much easier to express in XSLT than in Python, while for others it is the complete opposite. Finding the right mixture of Python code and XSL code can help a great deal in keeping applications well designed and maintainable.

Profiling

If you want to know how your stylesheet performed, pass the `profile_run` keyword to the transform:

```python
>>> result = transform(doc, a="/a/b/text()", profile_run=True)
>>> profile = result.xslt_profile
```

The value of the `xslt_profile` property is an ElementTree with profiling data about each template, similar to the following:

```xml
<profile>
  <template rank="1" match="/" name="" mode="" calls="1" time="1" average="1"/>
</profile>
```

Note that this is a read-only document. You must not move any of its elements to other documents. Please deep-copy the document if you need to modify it. If you want to free it from memory, just do:

```python
>>> del result.xslt_profile
```
Chapter 12

lxml.objectify

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lxml supports an alternative API similar to the Amara bindery or gnosis.xml.objectify through a custom Element implementation. The main idea is to hide the usage of XML behind normal Python objects, sometimes referred to as data-binding. It allows you to use XML as if you were dealing with a normal Python object hierarchy.

Accessing the children of an XML element deploys object attribute access. If there are multiple children with the same name, slicing and indexing can be used. Python data types are extracted from XML content automatically and made available to the normal Python operators.

To set up and use objectify, you need both the lxml.etree module and lxml.objectify:

```python
>>> from lxml import etree
>>> from lxml import objectify
```

The objectify API is very different from the ElementTree API. If it is used, it should not be mixed with other element implementations (such as trees parsed with lxml.etree), to avoid non-obvious behaviour.

The benchmark page has some hints on performance optimisation of code using lxml.objectify.

To make the doctests in this document look a little nicer, we also use this:

```python
>>> import lxml.usedoctest
```

Imported from within a doctest, this relieves us from caring about the exact formatting of XML output.

The lxml.objectify API

In lxml.objectify, element trees provide an API that models the behaviour of normal Python object trees as closely as possible.

Element access through object attributes

The main idea behind the objectify API is to hide XML element access behind the usual object attribute access pattern. Asking an element for an attribute will return the sequence of children with corresponding tag names:
Element access through object attributes

```python
>>> root = objectify.Element("root")
>>> b = objectify.SubElement(root, "b")
>>> print(root.b[0].tag)
b
>>> root.index(root.b[0])
0
>>> b = objectify.SubElement(root, "b")
>>> print(root.b[0].tag)
b
>>> print(root.b[1].tag)
b
>>> root.index(root.b[1])
1

For convenience, you can omit the index '0' to access the first child:

```python
>>> print(root.b.tag)
b
```python
>>> root.index(root.b)
0
```python
>>> del root.b
```

Iteration and slicing also obey the requested tag:

```python
>>> x1 = objectify.SubElement(root, "x")
>>> x2 = objectify.SubElement(root, "x")
>>> x3 = objectify.SubElement(root, "x")

>>> [ el.tag for el in root.x ]
['x', 'x', 'x']
```
```
>>> [ el.tag for el in root.x[1:3] ]
['x', 'x']
```
```
>>> [ el.tag for el in root.x[-1:] ]
['x']
```
```
>>> del root.x[1:2]
>>> [ el.tag for el in root.x ]
['x', 'x']
```

If you want to iterate over all children or need to provide a specific namespace for the tag, use the `iterchildren()` method. Like the other methods for iteration, it supports an optional tag keyword argument:

```python
>>> [ el.tag for el in root.iterchildren() ]
['b', 'x', 'x']
```
```
>>> [ el.tag for el in root.iterchildren(tag='b') ]
['b']
```
```
>>> [ el.tag for el in root.b ]
['b']
```

XML attributes are accessed as in the normal ElementTree API:

```python
>>> c = objectify.SubElement(root, "c", myattr="someval")
>>> print(root.c.get("myattr"))
someval
```
In addition to the normal ElementTree API for appending elements to trees, subtrees can also be added by assigning them to object attributes. In this case, the subtree is automatically deep copied and the tag name of its root is updated to match the attribute name:

```python
>>> el = objectify.Element("yet_another_child")
>>> root.new_child = el
>>> print(root.new_child.tag)
new_child
>>> print(el.tag)
yet_another_child

>>> root.y = [ objectify.Element("y"), objectify.Element("y") ]
>>> [ el.tag for el in root.y ]
['y', 'y']

The latter is a short form for operations on the full slice:

```python
>>> root.y[:] = [ objectify.Element("y") ]
>>> [ el.tag for el in root.y ]
['y']
```
Creating objectify trees

As with lxml.etree, you can either create an objectify tree by parsing an XML document or by building one from scratch. To parse a document, just use the parse() or fromstring() functions of the module:

```python
>>> fileobject = StringIO('<test/>')
>>> tree = objectify.parse(fileobject)
>>> print(isinstance(tree.getroot(), objectify.ObjectifiedElement))
True
>>> root = objectify.fromstring('<test/>')
>>> print(isinstance(root, objectify.ObjectifiedElement))
True
```

To build a new tree in memory, objectify replicates the standard factory function Element() from lxml.etree:

```python
>>> obj_el = objectify.Element("new")
>>> print(isinstance(obj_el, objectify.ObjectifiedElement))
True
```

After creating such an Element, you can use the usual API of lxml.etree to add SubElements to the tree:

```python
>>> child = objectify.SubElement(obj_el, "newchild", attr="value")
```

New subelements will automatically inherit the objectify behaviour from their tree. However, all independent elements that you create through the Element() factory of lxml.etree (instead of objectify) will not support the objectify API by themselves:

```python
>>> subel = objectify.SubElement(obj_el, "sub")
>>> print(isinstance(subel, objectify.ObjectifiedElement))
True
```

```python
>>> independent_el = etree.Element("new")
>>> print(isinstance(independent_el, objectify.ObjectifiedElement))
False
```

Tree generation with the E-factory

To simplify the generation of trees even further, you can use the E-factory:

```python
>>> E = objectify.E
>>> root = E.root(...
...   E.a(5),
...   E.b(6.1),
...   E.c(True),
...   E.d("how", tell="me")
... )
```

```python
>>> print(etree.tostring(root, pretty_print=True))
<root xmlns:py="http://codespeak.net/lxml/objectify/pytype">
  <a py:pytype="int">5</a>
  <b py:pytype="float">6.1</b>
  <c py:pytype="bool">true</c>
  <d py:pytype="str" tell="me">how</d>
</root>
```
Namespace handling

This allows you to write up a specific language in tags:

```python
>>> ROOT = objectify.E.root
>>> TITLE = objectify.E.title
>>> HOWMANY = getattr(objectify.E, "how-many")

>>> root = ROOT(
...   TITLE("The title"),
...   HOWMANY(5)
... )

>>> print(etree.tostring(root, pretty_print=True))
<root xmlns:py="http://codespeak.net/lxml/objectify/pytype">
  <title py:pytype="str">The title</title>
  <how-many py:pytype="int">5</how-many>
</root>
```

objectify.E is an instance of objectify.ElementMaker. By default, it creates pytype annotated Elements without a namespace. You can switch off the pytype annotation by passing False to the annotate keyword argument of the constructor. You can also pass a default namespace and an nsmap:

```python

>>> root = myE.root( myE.someint(2) )

>>> print(etree.tostring(root, pretty_print=True))
<root xmlns="http://my/ns">
  <someint>2</someint>
</root>
```

Namespace handling

During tag lookups, namespaces are handled mostly behind the scenes. If you access a child of an Element without specifying a namespace, the lookup will use the namespace of the parent:

```python
>>> root = objectify.Element("{http://ns/}root")
>>> b = objectify.SubElement(root, "{http://ns/}b")
>>> c = objectify.SubElement(root, "{http://other/}c")

>>> print(root.b.tag)
{http://ns/}b
```

Note that the SubElement() factory of lxml.etree does not inherit any namespaces when creating a new subelement. Element creation must be explicit about the namespace, and is simplified through the E-factory as described above.

Lookups, however, inherit namespaces implicitly:

```python
>>> print(root.b.tag)
{http://ns/}b

>>> print(root.c)
Traceback (most recent call last):
... AttributeError: no such child: {http://ns/}c
```
To access an element in a different namespace than its parent, you can use `getattr()`:

```python
>>> c = getattr(root, '{http://other/}c')
>>> print(c.tag)
{http://other/}c
```

For convenience, there is also a quick way through item access:

```python
>>> c = root['{http://other/}c']
>>> print(c.tag)
{http://other/}c
```

The same approach must be used to access children with tag names that are not valid Python identifiers:

```python
>>> el = objectify.SubElement(root, '{http://ns/}tag-name')
>>> print(root['tag-name'].tag)
{http://ns/}tag-name

>>> new_el = objectify.SubElement(new_el, '{http://ns/}child')
>>> new_el = objectify.SubElement(new_el, '{http://ns/}child')
```

```python
>>> root['tag-name'] = [new_el, new_el]
>>> print(len(root['tag-name']))
2
```

```python
>>> print(root['tag-name'].child)
{http://ns/}child
```

```python
>>> print(root['tag-name'][1].child.tag)
{http://ns/}child
```

or for names that have a special meaning in lxml.objectify:

```python
>>> root = objectify.XML('<root><text>TEXT</text></root>')
>>> print(root.text.text)
Traceback (most recent call last):
  ...
AttributeError: 'NoneType' object has no attribute 'text'

>>> print(root['text'].text)
TEXT
```

**Asserting a Schema**

When dealing with XML documents from different sources, you will often require them to follow a common schema. In lxml.objectify, this directly translates to enforcing a specific object tree, i.e. expected object attributes are ensured to be there and to have the expected type. This can easily be achieved through XML Schema validation at parse time. Also see the documentation on validation on this topic.

First of all, we need a parser that knows our schema, so let’s say we parse the schema from a file-like object (or
When creating the validating parser, we must make sure it returns objectify trees. This is best done with the `makeparser()` function:

```python
>>> parser = objectify.makeparser(schema = schema)
```

Now we can use it to parse a valid document:

```python
>>> xml = "<a><b>test</b></a>"
>>> a = objectify.fromstring(xml, parser)
```

```python
>>> print(a.b)
test
```

Or an invalid document:

```python
>>> xml = "<a><b>test</b><c/></a>"
>>> a = objectify.fromstring(xml, parser)
Traceback (most recent call last):
lxml.etree.XMLSyntaxError: Element ‘c’: This element is not expected.
```

Note that the same works for parse-time DTD validation, except that DTDs do not support any data types by design.

## ObjectPath

For both convenience and speed, objectify supports its own path language, represented by the `ObjectPath` class:

```python
>>> root = objectify.Element("{http://ns/}root")
>>> b1 = objectify.SubElement(root, "{http://ns/}b")
>>> c = objectify.SubElement(b1, "{http://ns/}c")
>>> b2 = objectify.SubElement(root, "{http://other/}b")
>>> d = objectify.SubElement(root, "{http://other/}d")
```

```python
>>> path = objectify.ObjectPath("root.b.c")
>>> print(path)
root.b.c
>>> path.hasattr(root)
True
>>> print(path.find(root).tag)
{http://ns/}c
```
ObjectPath

```python
>>> find = objectify.ObjectPath("root.b.c")
>>> print(find(root).tag)
{http://ns/}c

>>> find = objectify.ObjectPath("root.(http://other/)d")
>>> print(find(root).tag)
{http://other/}d

>>> find = objectify.ObjectPath("root.(not)there")
>>> print(find(root).tag)
AttributeError: no such child: {not}there

>>> find = objectify.ObjectPath("{not}there")
>>> print(find(root).tag)
Traceback (most recent call last):
  ...
ValueError: root element does not match: need {not}there, got {http://ns/}root

>>> find = objectify.ObjectPath("root.b[1]")
>>> print(find(root).tag)
{http://ns/}b

>>> find = objectify.ObjectPath("root.(http://ns/)b[1]")
>>> print(find(root).tag)
{http://ns/}b

Apart from strings, ObjectPath also accepts lists of path segments:

>>> find = objectify.ObjectPath(['root', 'b', 'c'])
>>> print(find(root).tag)
{http://ns/}c

>>> find = objectify.ObjectPath(['root', '{http://ns/}b[1]'])
>>> print(find(root).tag)
{http://ns/}b

You can also use relative paths starting with a '.' to ignore the actual root element and only inherit its namespace:

>>> find = objectify.ObjectPath(".b[1]")
>>> print(find(root).tag)
{http://ns/}b

>>> find = objectify.ObjectPath(['', 'b[1]'])
>>> print(find(root).tag)
{http://ns/}b

>>> find = objectify.ObjectPath(".unknown[1]")
>>> print(find(root).tag)
Traceback (most recent call last):
  ...
AttributeError: no such child: {http://ns/}unknown

>>> find = objectify.ObjectPath(".{http://other/}unknown[1]")
>>> print(find(root).tag)
Traceback (most recent call last):
  ...
```
...  

**AttributeError**: no such child: {http://other/}unknown

For convenience, a single dot represents the empty ObjectPath (identity):

```python
>>> find = objectify.ObjectPath(".")
>>> print(find(root).tag)
{http://ns/}root
```

ObjectPath objects can be used to manipulate trees:

```python
>>> root = objectify.Element("{http://ns/}root")

>>> path = objectify.ObjectPath(".some.child.{http://other/}unknown")
>>> path.hasattr(root)
False
>>> path.find(root)
Traceback (most recent call last):
...

**AttributeError**: no such child: {http://ns/}some

>>> path.setattr(root, "my value")  # creates children as necessary
>>> path.hasattr(root)
True
>>> print(path.find(root).text)
my value
>>> print(root.some.child["{http://other/}unknown"].text)
my value

>>> print(len(path.find(root)))
1

>>> path.addattr(root, "my new value")
>>> print(len(path.find(root)))
2

>>> [el.text for el in path.find(root)]
['my value', 'my new value']
```

As with attribute assignment, `setattr()` accepts lists:

```python
>>> path.setattr(root, ["v1", "v2", "v3"])
>>> [el.text for el in path.find(root)]
['v1', 'v2', 'v3']
```

Note, however, that indexing is only supported in this context if the children exist. Indexing of non existing children will not extend or create a list of such children but raise an exception:

```python
>>> path = objectify.ObjectPath(".\{non\}existing[1]"
>>> path.setattr(root, "my value")
Traceback (most recent call last):
...

**TypeError**: creating indexed path attributes is not supported
```

It is worth noting that ObjectPath does not depend on the `objectify` module or the ObjectifiedElement implementation. It can also be used in combination with Elements from the normal lxml.etree API.
Python data types

The objectify module knows about Python data types and tries its best to let element content behave like them. For example, they support the normal math operators:

```python
>>> root = objectify.fromstring(
... "<root><a>5</a><b>11</b><c>true</c><d>hoi</d></root>"
)
>>> root.a + root.b
16
>>> root.a += root.b
>>> print(root.a)
16
>>> root.a = 2
>>> print(root.a + 2)
4
>>> print(1 + root.a)
3
>>> print(root.c)
True
>>> root.c = False
>>> if not root.c:
...   print("false!")
false!
```

However, data elements continue to provide the objectify API. This means that sequence operations such as `len()`, slicing and indexing (e.g. of strings) cannot behave as the Python types. Like all other tree elements, they show the normal slicing behaviour of objectify elements:

```python
>>> root = objectify.fromstring("<root><a>test</a><b>toast</b></root>")
>>> print(root.a + " me")
# behaves like a string, right?
test me
>>> len(root.a)
# but there's only one 'a' element!
1
>>> [ a.tag for a in root.a ]
['a']
>>> print(root.a[0].tag)
a
>>> print(root.a)
```

If you need to run sequence operations on data types, you must ask the API for the real Python value. The string value is always available through the normal ElementTree .text attribute. Additionally, all data classes provide a .pyval attribute that returns the value as plain Python type:

```python
>>> print(root.d + " test !")
hoi test !
>>> root.d = "%s - %s"
>>> print(root.d % (1234, 12345))
1234 - 12345
```
Recursive tree dump

>>> root = objectify.fromstring("<root><a>test</a><b>5</b></root>")
>>> root.a.text
'test'
>>> root.a.pyval
'test'

>>> root.b.text
'5'
>>> root.b.pyval
5

Note, however, that both attributes are read-only in objectify. If you want to change values, just assign them directly to the attribute:

>>> root.a.text = "25"
Traceback (most recent call last):
  ...
TypeError: attribute 'text' of 'StringElement' objects is not writable

>>> root.a.pyval = 25
Traceback (most recent call last):
  ...
TypeError: attribute 'pyval' of 'StringElement' objects is not writable

>>> root.a = 25
>>> print(root.a)
25
>>> print(root.a.pyval)
25

In other words, objectify data elements behave like immutable Python types. You can replace them, but not modify them.

Recursive tree dump

To see the data types that are currently used, you can call the module level dump() function that returns a recursive string representation for elements:

>>> root = objectify.fromstring(""
... <root xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
...  <a attr1="foo" attr2="bar">1</a>
...  <a>1.2</a>
...  <b>1</b>
...  <b>true</b>
...  <c>what?</c>
...  <d xsi:nil="true"/>
... </root>
... "")

>>> print(objectify.dump(root))
root = None [ObjectifiedElement]
a = 1 [IntElement]
  * attr1 = 'foo'
  * attr2 = 'bar'
a = 1.2 [FloatElement]
Recursive string representation of elements

You can freely switch between different types for the same child:

```python
>>> root = objectify.fromstring("<root><a>5</a></root>"
>>> print(objectify.dump(root))
root = None [ObjectifiedElement]
  a = 5 [IntElement]

>>> root.a = 'nice string!
>>> print(objectify.dump(root))
root = None [ObjectifiedElement]
  a = 'nice string!' [StringElement]
    * py:pytype = 'str'

>>> root.a = True
>>> print(objectify.dump(root))
root = None [ObjectifiedElement]
  a = True [BoolElement]
    * py:pytype = 'bool'

>>> root.a = [1, 2, 3]
>>> print(objectify.dump(root))
root = None [ObjectifiedElement]
  a = 1 [IntElement]
    * py:pytype = 'int'
  a = 2 [IntElement]
    * py:pytype = 'int'
  a = 3 [IntElement]
    * py:pytype = 'int'

>>> root.a = (1, 2, 3)
>>> print(objectify.dump(root))
root = None [ObjectifiedElement]
  a = 1 [IntElement]
    * py:pytype = 'int'
  a = 2 [IntElement]
    * py:pytype = 'int'
  a = 3 [IntElement]
    * py:pytype = 'int'
```

Recursive string representation of elements

Normally, elements use the standard string representation for str() that is provided by lxml.etree. You can enable a pretty-print representation for objectify elements like this:

```python
>>> objectify.enable_recursive_str()
```

```python
>>> root = objectify.fromstring("""
... <root xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
...   <a attr1="foo" attr2="bar">1</a>
... </root>""
```

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How data types are matched

Objectify uses two different types of Elements. Structural Elements (or tree Elements) represent the object tree structure. Data Elements represent the data containers at the leafs. You can explicitly create tree Elements with the objectify.Element() factory and data Elements with the objectify.DataElement() factory.

When Element objects are created, lxml.objectify must determine which implementation class to use for them. This is relatively easy for tree Elements and less so for data Elements. The algorithm is as follows:

1. If an element has children, use the default tree class.
2. If an element is defined as xsi:nil, use the NoneElement class.
3. If a “Python type hint” attribute is given, use this to determine the element class, see below.
4. If an XML Schema xsi:type hint is given, use this to determine the element class, see below.
5. Try to determine the element class from the text content type by trial and error.
6. If the element is a root node then use the default tree class.
7. Otherwise, use the default class for empty data classes.

You can change the default classes for tree Elements and empty data Elements at setup time. The ObjectifyElementClassLookup() call accepts two keyword arguments, tree_class and empty_data_class, that determine the Element classes used in these cases. By default, tree_class is a class called ObjectifiedElement and empty_data_class is a StringElement.
Type annotations

The “type hint” mechanism deploys an XML attribute defined as lxml.objectify.PYTYPE_ATTRIBUTE. It may contain any of the following string values: int, long, float, str, unicode, NoneType:

```python
>>> print(lxml.objectify.PYTYPE_ATTRIBUTE)
{http://codespeak.net/lxml/objectify/pytype}pytype
```

```python
ns, name = objectify.PYTYPE_ATTRIBUTE[1:].split('}')
```

```python
root = objectify.fromstring("...
... <root xmlns:py='{}
...  <a py:pytype='str'>5</a>
...  <b py:pytype='int'>5</b>
...  <c py:pytype='NoneType' />
...
... */py:pytype='{}/ns)
```

```python
>>> print(root.a + 10)
510
>>> print(root.b + 10)
15
>>> print(root.c)
None
```

Note that you can change the name and namespace used for this attribute through the set_pytype_attribute_tag(tag) module function, in case your application ever needs to. There is also a utility function annotate() that recursively generates this attribute for the elements of a tree:

```python
>>> root = objectify.fromstring("<root><a>test</a><b>5</b></root>"
```

```python
>>> print(objectify.dump(root))
root = None [ObjectifiedElement]
a = 'test' [StringElement]
b = 5 [IntElement]
```

```python
>>> objectify.annotate(root)
```

```python
>>> print(objectify.dump(root))
root = None [ObjectifiedElement]
a = 'test' [StringElement]
  * py:pytype = 'str'
b = 5 [IntElement]
  * py:pytype = 'int'
```

XML Schema datatype annotation

A second way of specifying data type information uses XML Schema types as element annotations. Objectify knows those that can be mapped to normal Python types:

```python
>>> root = objectify.fromstring(
... )
```

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XML Schema datatype annotation

How data types are matched

... 

```python
>>> print(objectify.dump(root))
root = None [ObjectifiedElement]
  d = 5.0 [FloatElement]
    * xsi:type = 'xsd:double'
  i = 5 [IntElement]
    * xsi:type = 'xsd:int'
  s = '5' [StringElement]
    * xsi:type = 'xsd:string'
```

Again, there is a utility function `xsiannotate()` that recursively generates the “xsi:type” attribute for the elements of a tree:

```python
>>> root = objectify.fromstring('''...
... <root><a>test</a><b>5</b><c>true</c></root>
... ''')
```

```python
>>> print(objectify.dump(root))
root = None [ObjectifiedElement]
a = 'test' [StringElement]
  * xsi:type = 'xsd:string'
b = 5 [IntElement]
  * xsi:type = 'xsd:integer'
c = True [BoolElement]
  * xsi:type = 'xsd:boolean'
```

Note, however, that `xsiannotate()` will always use the first XML Schema datatype that is defined for any given Python type, see also Defining additional data classes.

The utility function `deannotate()` can be used to get rid of ‘py:pytype’ and/or ‘xsi:type’ information:

```python
>>> root = objectify.fromstring('''
... <root xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
... xmlns:xsd="http://www.w3.org/2001/XMLSchema">
...   <d xsi:type="xsd:double">5</d>
...   <i xsi:type="xsd:int" >5</i>
...   <s xsi:type="xsd:string">5</s>
... </root>''')
```

```python
>>> objectify.annotate(root)
>>> print(objectify.dump(root))
root = None [ObjectifiedElement]
d = 5.0 [FloatElement]
  * xsi:type = 'xsd:double'
  * py:pytype = 'float'
i = 5 [IntElement]
  * xsi:type = 'xsd:int'
  * py:pytype = 'int'
s = '5' [StringElement]
  * xsi:type = 'xsd:string'
  * py:pytype = 'str'
```

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The DataElement factory

For convenience, the DataElement() factory creates an Element with a Python value in one step. You can pass the required Python type name or the XSI type name:

```python
>>> root = objectify.Element("root")
>>> root.x = objectify.DataElement(5, _pytype="int")
>>> print(objectify.dump(root))
```
The DataElement factory

How data types are matched

```python
root = None [ObjectifiedElement]
x = 5 [IntElement]
    * py:pytype = 'int'

>>> root.x = objectify.DataElement(5, _pytype="str", myattr="someval")
>>> print(objectify.dump(root))
root = None [ObjectifiedElement]
x = '5' [StringElement]
    * myattr = 'someval'
    * py:pytype = 'str'

>>> root.x = objectify.DataElement(5, _xsi="integer")
>>> print(objectify.dump(root))
root = None [ObjectifiedElement]
x = 5 [IntElement]
    * py:pytype = 'int'
    * xsi:type = 'xsd:integer'
```

XML Schema types reside in the XML schema namespace thus DataElement() tries to correctly prefix the xsi:type attribute value for you:

```python
>>> root = objectify.Element("root")
>>> root.s = objectify.DataElement(5, _xsi="string")

>>> objectify.deannotate(root, xsi=False)
>>> print(etree.tostring(root, pretty_print=True))
    <s xsi:type="xsd:string">5</s>
</root>
```

DataElement() uses a default nsmap to set these prefixes:

```python
>>> el = objectify.DataElement('5', _xsi='string')
>>> namespaces = list(el.nsmap.items())
>>> namespaces.sort()
>>> for prefix, namespace in namespaces:
...     print("%s - %s" % (prefix, namespace))
py - http://codespeak.net/lxml/objectify/pytype
xsd - http://www.w3.org/2001/XMLSchema
xsi - http://www.w3.org/2001/XMLSchema-instance

>>> print(el.get("http://www.w3.org/2001/XMLSchema-instance\type"))
xsd:string
```

While you can set custom namespace prefixes, it is necessary to provide valid namespace information if you choose to do so:

```python
>>> el = objectify.DataElement('5', _xsi='foo:string',
...     nsmap={'foo': 'http://www.w3.org/2001/XMLSchema'})
>>> namespaces = list(el.nsmap.items())
>>> namespaces.sort()
>>> for prefix, namespace in namespaces:
...     print("%s - %s" % (prefix, namespace))
foo - http://www.w3.org/2001/XMLSchema
py - http://codespeak.net/lxml/objectify/pytype
xsi - http://www.w3.org/2001/XMLSchema-instance
```

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Defining additional data classes

How data types are matched

>>> print(el.get("(http://www.w3.org/2001/XMLSchema-instance)type"))
foo:string

Note how lxml chose a default prefix for the XML Schema Instance namespace. We can override it as in the following example:

```python
>>> el = objectify.DataElement('5', _xsi='foo:string',
...                            nsmap={'foo': 'http://www.w3.org/2001/XMLSchema',
...                                  'myxsi': 'http://www.w3.org/2001/XMLSchema-instance'})
>>> namespaces = list(el.nsmap.items())
>>> namespaces.sort()
>>> for prefix, namespace in namespaces:
...    print("%s - %s\n", prefix, namespace)
foo - http://www.w3.org/2001/XMLSchema
myxsi - http://www.w3.org/2001/XMLSchema-instance
py - http://codespeak.net/lxml/objectify/pytype
```

```python
>>> print(el.get("(http://www.w3.org/2001/XMLSchema-instance)type"))
foo:string
```

Care must be taken if different namespace prefixes have been used for the same namespace. Namespace information gets merged to avoid duplicate definitions when adding a new sub-element to a tree, but this mechanism does not adapt the prefixes of attribute values:

```python
>>> root = objectify.fromstring("<root xmlns:schema="http://www.w3.org/2001/XMLSchema"/>")
>>> print(etree.tostring(root, pretty_print=True))
<root xmlns:schema="http://www.w3.org/2001/XMLSchema"/>
```

```python
>>> s = objectify.DataElement("17", _xsi="string")
>>> print(etree.tostring(s, pretty_print=True))
```

```python
>>> root.s = s
>>> print(etree.tostring(root, pretty_print=True))
<root xmlns:schema="http://www.w3.org/2001/XMLSchema">
</root>
```

It is your responsibility to fix the prefixes of attribute values if you choose to deviate from the standard prefixes. A convenient way to do this for xsi:type attributes is to use the `xsiannotate()` utility:

```python
>>> objectify.xsiannotate(root)
>>> print(etree.tostring(root, pretty_print=True))
<root xmlns:schema="http://www.w3.org/2001/XMLSchema">
</root>
```

Of course, it is discouraged to use different prefixes for one and the same namespace when building up an objectify tree.

Defining additional data classes

You can plug additional data classes into objectify that will be used in exactly the same way as the predefined types. Data classes can either inherit from `ObjectifiedDataElement` directly or from one of the specialised classes like `NumberElement` or `BoolElement`. The numeric types require an initial call to the `NumberElement` method `self._setValueParser(function)` to set their type conversion function (string -> numeric...
Python type). This call should be placed into the element \_init() method.

The registration of data classes uses the PyType class:

```
>>> class ChristmasDate(objectify.ObjectifiedDataElement):
...     def call_santa(self):
...         print("Ho ho ho!")

>>> def checkChristmasDate(date_string):
...     if not date_string.startswith('24.12.'):  
...         raise ValueError # or TypeError

>>> xmas_type = objectify.PyType('date', checkChristmasDate, ChristmasDate)
```

The PyType constructor takes a string type name, an (optional) callable type check and the custom data class. If a type check is provided it must accept a string as argument and raise ValueError or TypeError if it cannot handle the string value.

PyTypes are used if an element carries a py:pytype attribute denoting its data type or, in absence of such an attribute, if the given type check callable does not raise a ValueError/TypeError exception when applied to the element text.

If you want, you can also register this type under an XML Schema type name:

```
>>> xmas_type.xmlSchemaTypes = ("date",)
```

XML Schema types will be considered if the element has an xsi:type attribute that specifies its data type. The line above binds the XSD type date to the newly defined Python type. Note that this must be done before the next step, which is to register the type. Then you can use it:

```
>>> xmas_type.register()

```

If you need to specify dependencies between the type check functions, you can pass a sequence of type names through the before and after keyword arguments of the register() method. The PyType will then try to register itself before or after the respective types, as long as they are currently registered. Note that this only impacts the currently registered types at the time of registration. Types that are registered later on will not care about the dependencies of already registered types.

If you provide XML Schema type information, this will override the type check function defined above:

```
>>> root = objectify.fromstring("<root xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
...     <a xsi:type="date">12.24.2000</a>
... </root>"")
>>> root.a.call_santa()
12.24.2000
```

If you provide XML Schema type information, this will override the type check function defined above:

```
>>> root = objectify.fromstring("<root><a xsi:type="date">12.24.2000</a>
... </root>"")
>>> root.a.call_santa()
Ho ho ho!
```
To unregister a type, call its `unregister()` method:

```python
>>> root.a.call_santa()
Ho ho ho!
>>> xmas_type.unregister()
>>> root.a.call_santa()
Traceback (most recent call last):
 ...  
AttributeError: no such child: call_santa
```

Be aware, though, that this does not immediately apply to elements to which there already is a Python reference. Their Python class will only be changed after all references are gone and the Python object is garbage collected.

---

**Advanced element class lookup**

In some cases, the normal data class setup is not enough. Being based on `lxml.etree`, however, `lxml.objectify` supports very fine-grained control over the Element classes used in a tree. All you have to do is configure a different class lookup mechanism (or write one yourself).

The first step for the setup is to create a new parser that builds objectify documents. The objectify API is meant for data-centric XML (as opposed to document XML with mixed content). Therefore, we configure the parser to let it remove whitespace-only text from the parsed document if it is not enclosed by an XML element. Note that this alters the document infoset, so if you consider the removed spaces as data in your specific use case, you should go with a normal parser and just set the element class lookup. Most applications, however, will work fine with the following setup:

```python
>>> parser = objectify.makeparser(remove_blank_text=True)
```

What this does internally, is:

```python
>>> parser = etree.XMLParser(remove_blank_text=True)
>>> lookup = objectify.ObjectifyElementClassLookup()
>>> parser.set_element_class_lookup(lookup)
```

If you want to change the lookup scheme, say, to get additional support for namespace specific classes, you can register the objectify lookup as a fallback of the namespace lookup. In this case, however, you have to take care that the namespace classes inherit from `objectify.ObjectifiedElement`, not only from the normal `lxml.etree.ElementBase`, so that they support the `objectify` API. The above setup code then becomes:

```python
>>> lookup = etree.ElementNamespaceClassLookup( ...          objectify.ObjectifyElementClassLookup() )  
>>> parser.set_element_class_lookup(lookup)
```

See the documentation on class lookup schemes for more information.

---

**What is different from lxml.etree?**

Such a different Element API obviously implies some side effects to the normal behaviour of the rest of the API.

- `len(<element>)` returns the sibling count, not the number of children of `<element>`. You can retrieve the number of children with the `countchildren()` method.

- Iteration over elements does not yield the children, but the siblings. You can access all children with the `iterchildren()` method on elements or retrieve a list by calling the `getchildren()` method.
The find, findall and findtext methods require a different implementation based on ETXPath. In lxml.etree, they use a Python implementation based on the original iteration scheme. This has the disadvantage that they may not be 100% backwards compatible, and the additional advantage that they now support any XPath expression.
Chapter 13

lxml.html

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Since version 2.0, lxml comes with a dedicated Python package for dealing with HTML: `lxml.html`. It is based on lxml’s HTML parser, but provides a special Element API for HTML elements, as well as a number of utilities for common HTML processing tasks.

The main API is based on the `lxml.etree` API, and thus, on the ElementTree API.

Parsing HTML

Parsing HTML fragments

There are several functions available to parse HTML:

- **parse(filename_url_or_file)**: Parses the named file or url, or if the object has a `.read()` method, parses from that.
  
  If you give a URL, or if the object has a `.geturl()` method (as file-like objects from `urllib.urlopen()` have), then that URL is used as the base URL. You can also provide an explicit `base_url` keyword argument.

- **document_fromstring(string)**: Parses a document from the given string. This always creates a correct HTML document, which means the parent node is `<html>`, and there is a body and possibly a head.

- **fragment_fromstring(string, create_parent=False)**: Returns an HTML fragment from a string.

  The fragment must contain just a single element, unless `create_parent` is given; e.g., `fragment_fromstring(string, create_parent='div')` will wrap the element in a `<div>`.

- **fragments_fromstring(string)**: Returns a list of the elements found in the fragment.

- **fromstring(string)**: Returns `document_fromstring` or `fragment_fromstring`, based on whether the string looks like a full document, or just a fragment.

Really broken pages

The normal HTML parser is capable of handling broken HTML, but for pages that are far enough from HTML to call them ‘tag soup’, it may still fail to parse the page in a useful way. A way to deal with this is `ElementSoup`. 
which deploys the well-known BeautifulSoup parser to build an lxml HTML tree.

However, note that the most common problem with web pages is the lack of (or the existence of incorrect) encoding declarations. It is therefore often sufficient to only use the encoding detection of BeautifulSoup, called UnicodeDammit, and to leave the rest to lxml’s own HTML parser, which is several times faster.

### HTML Element Methods

HTML elements have all the methods that come with ElementTree, but also include some extra methods:

- **.drop_tree()**: Drops the element and all its children. Unlike `el.getparent().remove(el)` this does not remove the tail text; with `drop_tree` the tail text is merged with the previous element.

- **.drop_tag()**: Drops the tag, but keeps its children and text.

- **.find_class(class_name)**: Returns a list of all the elements with the given CSS class name. Note that class names are space separated in HTML, so `doc.find_class_name('highlight')` will find an element like `<div class="sidebar highlight">`. Class names are case sensitive.

- **.find_rel_links(rel)**: Returns a list of all the `<a rel={rel}>` elements. E.g., `doc.find_rel_links('tag')` returns all the links marked as tags.

- **.get_element_by_id(id, default=None)**: Return the element with the given `id`, or the `default` if none is found. If there are multiple elements with the same `id` (which there shouldn’t be, but there often is), this returns only the first.

- **.text_content()**: Returns the text content of the element, including the text content of its children, with no markup.

- **.cssselect(expr)**: Select elements from this element and its children, using a CSS selector expression. (Note that .xpath(expr) is also available as on all lxml elements.)

- **.label**: Returns the corresponding `<label>` element for this element, if any exists (None if there is none). Label elements have a `label.for_element` attribute that points back to the element.

- **.base_url**: The base URL for this element, if one was saved from the parsing. This attribute is not settable. Is None when no base URL was saved.

### Running HTML doctests

One of the interesting modules in the `lxml.html` package deals with doctests. It can be hard to compare two HTML pages for equality, as whitespace differences aren’t meaningful and the structural formatting can differ. This is even more a problem in doctests, where output is tested for equality and small differences in whitespace or the order of attributes can let a test fail. And given the verbosity of tag-based languages, it may take more than a quick look to find the actual differences in the doctest output.

Luckily, lxml provides the `lxml.doctestcompare` module that supports relaxed comparison of XML and HTML pages and provides a readable diff in the output when a test fails. The HTML comparison is most easily used by importing the `usedoctest` module in a doctest:

```python
>>> import lxml.html.usedoctest
```

Now, if you have a HTML document and want to compare it to an expected result document in a doctest, you can do the following:
>>> import lxml.html
>>> html = lxml.html.fromstring('''
... <html><body onload="" color="white">
...   <p>Hi !</p>
... </body></html>
... ''')

>>> print lxml.html.tostring(html)
<html><body onload="" color="white"><p>Hi !</p></body></html>

>>> print lxml.html.tostring(html)
<html> <body color="white" onload=""><p>Hi !</p> </body> </html>

>>> print lxml.html.tostring(html)
<html> <body color="white" onload="">
  <p>Hi !</p>
 </body> </html>

In documentation, you would likely prefer the pretty printed HTML output, as it is the most readable. However, the three documents are equivalent from the point of view of an HTML tool, so the doctest will silently accept any of the above. This allows you to concentrate on readability in your doctests, even if the real output is a straight ugly HTML one-liner.

Note that there is also an lxml.usedoctest module which you can import for XML comparisons. The HTML parser notably ignores namespaces and some other XMLisms.

Creating HTML with the E-factory

lxml.html comes with a predefined HTML vocabulary for the E-factory, originally written by Fredrik Lundh. This allows you to quickly generate HTML pages and fragments:

>>> from lxml.html import builder as E
>>> from lxml.html import usedoctest

>>> html = E.HTML(
...   E.HEAD(
...     E.LINK(rel="stylesheet", href="great.css", type="text/css"),
...     E.TITLE("Best Page Ever")
...   ),
...   E.BODY(E.H1(E.CLASS("heading"), "Top News"),
...     E.P("World News only on this page", style="font-size: 200%"),
...     "Ah, and here’s some more text, by the way.",
...     lxml.html.fromstring("<p>... and this is a parsed fragment ...</p>")
...   )
... )

>>> print lxml.html.tostring(html)
<html>
  <head>
    <link href="great.css" rel="stylesheet" type="text/css">
    <title>Best Page Ever</title>
  </head>
  <body>
    <h1 class="heading">Top News</h1>
    <p>World News only on this page</p>
    "Ah, and here’s some more text, by the way."
    &lt;p&gt;... and this is a parsed fragment ...&lt;/p&gt;
  </body>
</html>
<body>
  <h1 class="heading">Top News</h1>
  <p style="font-size: 200%">World News only on this page</p>
  Ah, and here’s some more text, by the way.
  <p>... and this is a parsed fragment ...</p>
</body>
</html>

Note that you should use lxml.html.tostring and not lxml.tostring(doc) will return the XML representation of the document, which is not valid HTML. In particular, things like <script src="..."></script> will be serialized as <script src="...">, which completely confuses browsers.

### Viewing your HTML

A handy method for viewing your HTML: lxml.html.open_in_browser(lxml_doc) will write the document to disk and open it in a browser (with the webbrowser module).

### Working with links

There are several methods on elements that allow you to see and modify the links in a document.

- **.iterlinks():** This yields (element, attribute, link, pos) for every link in the document. attribute may be None if the link is in the text (as will be the case with a <style> tag with @import).

  This finds any link in an action, archive, background, cite, classid, codebase, data, href, longdesc, profile, src, usemap, dynsrc, or lowsrc attribute. It also searches style attributes for url(link), and <style> tags for @import and url().

  This function does not pay attention to <base href>.

- **.resolve_base_href():** This function will modify the document in-place to take account of <base href> if the document contains that tag. In the process it will also remove that tag from the document.

- **.make_links_absolute(base_href, resolve_base_href=True):** This makes all links in the document absolute, assuming that base_href is the URL of the document. So if you pass base_href="http://localhost/foo/bar.html" and there is a link to baz.html that will be rewritten as http://localhost/foo/baz.html.

  If resolve_base_href is true, then any <base href> tag will be taken into account (just calling self.resolve_base_href()).

- **.rewrite_links(link_repl_func, resolve_base_href=True, base_href=None):** This rewrites all the links in the document using your given link replacement function. If you give a base_href value, all links will be passed in after they are joined with this URL.

  For each link link_repl_func(link) is called. That function then returns the new link, or None to remove the attribute or tag that contains the link. Note that all links will be passed in, including links like "#anchor" (which is purely internal), and things like "mailto:bob@example.com" (or javascript:...).

  If you want access to the context of the link, you should use .iterlinks() instead.

### Functions

In addition to these methods, there are corresponding functions:
Forms

- `iterlinks(html)`
- `make_links_absolute(html, base_href, ...)`
- `rewrite_links(html, link_repl_func, ...)`
- `resolve_base_href(html)`

These functions will parse `html` if it is a string, then return the new HTML as a string. If you pass in a document, the document will be copied (except for `iterlinks()`), the method performed, and the new document returned.

Forms

Any `<form>` elements in a document are available through the list `doc.forms` (e.g., `doc.forms[0]`). Form, input, select, and textarea elements each have special methods.

Input elements (including `<select>` and `<textarea>`) have these attributes:

- `.name`: The name of the element.
- `.value`: The value of an input, the content of a textarea, the selected option(s) of a select. This attribute can be set.

  In the case of a select that takes multiple options (`<select multiple>`) this will be a set of the selected options; you can add or remove items to select and unselect the options.

Select attributes:

- `.value_options`: For select elements, this is all the possible values (the values of all the options).
- `.multiple`: For select elements, true if this is a `<select multiple>` element.

Input attributes:

- `.type`: The type attribute in `<input>` elements.
- `.checkable`: True if this can be checked (i.e., true for type=radio and type=checkbox).
- `.checked`: If this element is checkable, the checked state. Raises AttributeError on non-checkable inputs.

The form itself has these attributes:

- `.inputs`: A dictionary-like object that can be used to access input elements by name. When there are multiple input elements with the same name, this returns list-like structures that can also be used to access the options and their values as a group.

- `.fields`: A dictionary-like object used to access values by their name. `form.inputs` returns elements, this only returns values. Setting values in this dictionary will affect the form inputs. Basically `form.inputs[x]` is equivalent to `form.inputs[x].value` and `form.fields[x] = y` is equivalent to `form.inputs[x].value = y`. (Note that sometimes `form.inputs[x]` returns a compound object, but these objects also have `.value` attributes.)

  If you set this attribute, it is equivalent to `form.fields.clear(); form.fields.update(new_value)`

- `.form_values()`: Returns a list of `[name, value], ...`, suitable to be passed to `urllib.urlencode()` for form submission.

- `.action`: The action attribute. This is resolved to an absolute URL if possible.

- `.method`: The method attribute, which defaults to GET.
Form Filling Example

Note that you can change any of these attributes (values, method, action, etc) and then serialize the form to see the updated values. You can, for instance, do:

```python
>>> from lxml.html import fromstring, tostring
>>>
form_page = fromstring('''<html><body><form>
...  Your name: <input type="text" name="name"> <br>
...  Your phone: <input type="text" name="phone"> <br>
...  Your favorite pets: <br>
...  Dogs: <input type="checkbox" name="interest" value="dogs"> <br>
...  Cats: <input type="checkbox" name="interest" value="cats"> <br>
...  Llamas: <input type="checkbox" name="interest" value="llamas"> <br>
...  </form></body></html>''')
```  
```python
form = form_page.forms[0]
>>> form.fields = dict(
...  name='John Smith',
...  phone='555-555-3949',
...  interest=set(['cats', 'llamas']))
```  
```python
>>> print tostring(form)
<html><body><form>
  Your name: <input name="name" type="text" value="John Smith">
  Your phone: <input name="phone" type="text" value="555-555-3949">
  Your favorite pets:
  Dogs: <input name="interest" type="checkbox" value="dogs"> 
  Cats: <input checked name="interest" type="checkbox" value="cats">
  Llamas: <input checked name="interest" type="checkbox" value="llamas">
  </form></body></html>
```

Form Submission

You can submit a form with `lxml.html.submit_form(form_element)`. This will return a file-like object (the result of `urllib.urlopen()`).

If you have extra input values you want to pass you can use the keyword argument `extra_values`, like `extra_values={'submit': 'Yes!'}`. This is the only way to get submit values into the form, as there is no state of “submitted” for these elements.

You can pass in an alternate opener with the `open_http` keyword argument, which is a function with the signature `open_http(method, url, values)`.

Example:

```python
>>> from lxml.html import parse, submit_form
```
Cleaning up HTML

The module `lxml.html.clean` provides a `Cleaner` class for cleaning up HTML pages. It supports removing embedded or script content, special tags, CSS style annotations and much more.

Say, you have an evil web page from an untrusted source that contains lots of content that upsets browsers and tries to run evil code on the client side:

```python
>>> html = '''
... <html>
...   <head>
...     <script type="text/javascript" src="evil-site"></script>
...     <link rel="alternate" type="text/rss" src="evil-rss">
...     <style>
...       body {background-image: url(javascript:do_evil)};
...       div {color: expression(evil)};
...     </style>
...   </head>
...   <body onload="evil_function()">
...     <!-- I am interpreted for EVIL! -->
...     <a href="javascript:evil_function()">a link</a>
...     <a href="#" onclick="evil_function()">another link</a>
...     <p onclick="evil_function()">a paragraph</p>
...     <div style="display: none">secret EVIL!</div>
...     <object> of EVIL! </object>
...     <iframe src="evil-site"></iframe>
...     <form action="evil-site">
...       Password: <input type="password" name="password">
...     </form>
...     <blink>annoying EVIL!</blink>
...     <a href="evil-site">spam spam SPAM!</a>
...     <image src="evil!">
...   </body>
... </html>'''
```

To remove the all suspicious content from this unparsed document, use the `clean_html` function:

```python
>>> from lxml.html.clean import clean_html
>>> print clean_html(html)

<a href="">a link</a>
<a href="#">another link</a>
<p>a paragraph</p>
<div>secret EVIL!</div>
of EVIL!

Password:
```
Cleaning up HTML

The Cleaner class supports several keyword arguments to control exactly which content is removed:

```python
>>> from lxml.html.clean import Cleaner

>>> cleaner = Cleaner(page_structure=False, links=False)

>>> print cleaner.clean_html(html)
<html>
  <head>
    <link rel="alternate" src="evil-rss" type="text/rss">
    <style>* deleted *</style>
  </head>
  <body>
    <a href="">a link</a>
    <a href="#">another link</a>
    <p>a paragraph</p>
    <div>secret EVIL!</div>
of EVIL!
  Password:
  annoying EVIL!
  <a href="evil-site">spam spam SPAM!</a>
  <img src="evil!">
  </body>
</html>
```

```python
>>> cleaner = Cleaner(style=True, links=True, add_nofollow=True,
                   page_structure=False, safe_attrs_only=False)

>>> print cleaner.clean_html(html)
<html>
  <head>
  </head>
  <body>
    <a href="">a link</a>
    <a href="#">another link</a>
    <p>a paragraph</p>
    <div>secret EVIL!</div>
of EVIL!
  Password:
  annoying EVIL!
  <a href="evil-site" rel="nofollow">spam spam SPAM!</a>
  <img src="evil!">
  </body>
</html>
```

You can also whitelist some otherwise dangerous content with Cleaner(host_whitelist=['www.youtube.com']), which would allow embedded media from YouTube, while still filtering out embedded media from other sites.

See the docstring of Cleaner for the details of what can be cleaned.
autolink

In addition to cleaning up malicious HTML, lxml.html.clean contains functions to do other things to your HTML. This includes autolinking:

\[
\text{autolink(doc, ...)} \\
\text{autolink_html(html, ...)}
\]

This finds anything that looks like a link (e.g., http://example.com) in the text of an HTML document, and turns it into an anchor. It avoids making bad links.

Links in the elements <textarea>,<pre>,<code>, anything in the head of the document. You can pass in a list of elements to avoid in avoid_elements=['textarea', ...].

Links to some hosts can be avoided. By default links to localhost*, example.* and 127.0.0.1 are not autolinked. Pass in avoid_hosts=[list_of_regexes] to control this.

Elements with the nolink CSS class are not autolinked. Pass in avoid_classes=['code', ...] to control this.

The autolink_html() version of the function parses the HTML string first, and returns a string.

wordwrap

You can also wrap long words in your html:

\[
\text{word_break(doc, max_width=40, ...)} \\
\text{word_break_html(html, ...)}
\]

This finds any long words in the text of the document and inserts &‌‌#8203; in the document (which is the Unicode zero-width space).

This avoids the elements <pre>,<textarea>, and <code>. You can control this with avoid_elements=['textarea', ...].

It also avoids elements with the CSS class nobreak. You can control this with avoid_classes=['code', ...].

Lastly you can control the character that is inserted with break_character=u’\u200b’. However, you cannot insert markup, only text.

word_break_html(html) parses the HTML document and returns a string.

HTML Diff

The module lxml.html.diff offers some ways to visualize differences in HTML documents. These differences are content oriented. That is, changes in markup are largely ignored; only changes in the content itself are highlighted.

There are two ways to view differences: htmldiff and html_annotate. One shows differences with <ins> and <del>, while the other annotates a set of changes similar to svn blame. Both these functions operate on text, and work best with content fragments (only what goes in <body>), not complete documents.

Example of htmldiff:
Examples

from lxml.html.diff import htmldiff, html_annotate
>>> doc1 = '''<p>Here is some text.</p>'''
>>> doc2 = '''<p>Here is <b>a lot</b> of <i>text</i>.</p>'''
>>> doc3 = '''<p>Here is <b>a little</b> <i>text</i>.</p>'''
>>> print htmldiff(doc1, doc2)
<p>Here is <ins><b>a lot</b> of <i>text</i>.</ins> <del>some text.</del> </p>
>>> print html_annotate([(doc1, 'author1'), (doc2, 'author2'),
... (doc3, 'author3')])
<p><span title="author1">Here is</span><b><span title="author2">a</span><span title="author3">little</span></b><i><span title="author2">text</span></i><span title="author2">.</span></p>

As you can see, it is imperfect as such things tend to be. On larger tracts of text with larger edits it will generally do better.

The html_annotate function can also take an optional second argument, markup. This is a function like markup(text, version) that returns the given text marked up with the given version. The default version, the output of which you see in the example, looks like:

def default_markup(text, version):
    return '<span title="%s">%s</span>' % (cgi.escape(unicode(version), 1), text)

Examples

Microformat Example

This example parses the hCard microformat.

First we get the page:

>>> import urllib
>>> from lxml.html import fromstring
>>> url = 'http://microformats.org/
>>> content = urllib.urlopen(url).read()
>>> doc = fromstring(content)
>>> doc.make_links_absolute(url)

Then we create some objects to put the information in:

>>> class Card(object):
...     def __init__(self, **kw):
...             for name, value in kw:
...                 setattr(self, name, value)
...     def __init__(self, phone, types=()):
...             self.phone, self.types = phone, types

And some generally handy functions for microformats:

>>> def get_text(el, class_name):
...         els = el.find_class(class_name)
...         if els:
...             return els[0].text_content()
... else:
...     return ''

>>> def get_value(el):
...     return get_text(el, 'value') or el.text_content()

>>> def get_all_texts(el, class_name):
...     return [e.text_content() for e in els.find_class(class_name)]

>>> def parse_addresses(el):
...     # Ideally this would parse street, etc.
...     return el.find_class('adr')

Then the parsing:

>>> for el in doc.find_class('hcard'):
...     card = Card()
...     card.el = el
...     card.fn = get_text(el, 'fn')
...     card.tels = []
...     for tel_el in card.find_class('tel'):
...         card.tels.append(Phone(get_value(tel_el),
...                                 get_all_texts(tel_el, 'type')))
...     card.addresses = parse_addresses(el)
Chapter 14

lxml.cssselect

lxml supports a number of interesting languages for tree traversal and element selection. The most important is obviously XPath, but there is also ObjectPath in the lxml.objectify module. The newest child of this family is CSS selection, which is made available in form of the lxml.cssselect module.

Although it started its life in lxml, cssselect is now an independent project. It translates CSS selectors to XPath 1.0 expressions that can be used with lxml’s XPath engine. lxml.cssselect adds a few convenience shortcuts into that package.

The CSSSelector class

The most important class in the lxml.cssselect module is CSSSelector. It provides the same interface as the XPath class, but accepts a CSS selector expression as input:

```python
>>> from lxml.cssselect import CSSSelector
>>> sel = CSSSelector('div.content')
>>> sel
#doctest: +ELLIPSIS
<CSSSelector ... for 'div.content'>
>>> sel.css
'div.content'
```

The selector actually compiles to XPath, and you can see the expression by inspecting the object:

```python
>>> sel.path
'descendant-or-self::div[@class and contains(concat(' ', normalize-space(@class), ' '), ' content ')]'
```

To use the selector, simply call it with a document or element object:

```python
>>> from lxml.etree import fromstring
>>> h = fromstring('''<div id="outer">
... <div id="inner" class="content body">
... text
... </div></div>''')
>>> [e.get('id') for e in sel(h)]
['inner']
```

Using CSSSelector is equivalent to translating with cssselect and using the XPath class:

```python
>>> from cssselect import GenericTranslator
>>> from lxml.etree import XPath
```
CSSSelector takes a translator parameter to let you choose which translator to use. It can be ‘xml’ (the default), ‘xhtml’, ‘html’ or a Translator object.

The cssselect method

 lxml Element objects have a cssselect convenience method.

```python
>>> h.cssselect('div.content') == sel(h)
True
```

Note however that pre-compiling the expression with the CSSSelector or XPath class can provide a substantial speedup.

The method also accepts a translator parameter. On HtmlElement objects, the default is changed to ‘html’.

Supported Selectors

Most Level 3 selectors are supported. The details are in the cssselect documentation.

Namespaces

In CSS you can use namespace-prefix|element, similar to namespace-prefix:element in an XPath expression. In fact, it maps one-to-one, and the same rules are used to map namespace prefixes to namespace URIs: the CSSSelector class accepts a dictionary as its namespaces argument.
Chapter 15

BeautifulSoup Parser

BeautifulSoup is a Python package that parses broken HTML, just like lxml supports it based on the parser of libxml2. BeautifulSoup uses a different parsing approach. It is not a real HTML parser but uses regular expressions to dive through tag soup. It is therefore more forgiving in some cases and less good in others. It is not uncommon that lxml/libxml2 parses and fixes broken HTML better, but BeautifulSoup has superior support for encoding detection. It very much depends on the input which parser works better.

To prevent users from having to choose their parser library in advance, lxml can interface to the parsing capabilities of BeautifulSoup through the lxml.html.soupparser module. It provides three main functions: fromstring() and parse() to parse a string or file using BeautifulSoup into an lxml.html document, and convert_tree() to convert an existing BeautifulSoup tree into a list of top-level Elements.

Parsing with the soupparser

The functions fromstring() and parse() behave as known from ElementTree. The first returns a root Element, the latter returns an ElementTree.

There is also a legacy module called lxml.html.ElementSoup, which mimics the interface provided by ElementTree’s own ElementSoup module. Note that the soupparser module was added in lxml 2.0.3. Previous versions of lxml 2.0.x only have the ElementSoup module.

Here is a document full of tag soup, similar to, but not quite like, HTML:

```python
>>> tag_soup = '<meta><head><title>Hello</title><body onload=crash()>Hi all<p/>
```

all you need to do is pass it to the fromstring() function:

```python
>>> from lxml.html.soupparser import fromstring
>>> root = fromstring(tag_soup)
```

To see what we have here, you can serialise it:

```python
>>> from lxml.etree import tostring
>>> print(tostring(root, pretty_print=True).strip())
<html>
<meta/>
<head>
  <title>Hello</title>
</head>
<body onload="crash()">Hi all<p/></body>
```
Not quite what you’d expect from an HTML page, but, well, it was broken already, right? BeautifulSoup did its best, and so now it’s a tree.

To control which Element implementation is used, you can pass a `makeelement` factory function to `parse()` and `fromstring()`. By default, this is based on the HTML parser defined in `lxml.html`.

For a quick comparison, libxml2 2.6.32 parses the same tag soup as follows. The main difference is that libxml2 tries harder to adhere to the structure of an HTML document and moves misplaced tags where they (likely) belong. Note, however, that the result can vary between parser versions.

```html
<html>
  <head>
    <meta/>
    <title>Hello</title>
  </head>
  <body>
    <p>Hi all</p>
  </body>
</html>
```

**Entity handling**

By default, the BeautifulSoup parser also replaces the entities it finds by their character equivalent.

```python
g>>> tag_soup = '<body>&copy;&euro;&#45;&#245;&#445;<p>'
```

```python
g>>> body = fromstring(tag_soup).find('.//body')
```

```python
g>>> body.text
'xa9\xe2\x82\xac-xf5u01bd'
```

If you want them back on the way out, you can just serialise with the default encoding, which is 'US-ASCII'.

```python
g>>> tostring(body)
'<body>&#169;&#8364;-&#245;&#445;<p/>'
```

```python
g>>> tostring(body, method="html")
'<body>&#169;&#8364;-&#245;&#445;<p/>'
```

Any other encoding will output the respective byte sequences.

```python
g>>> tostring(body, encoding="utf-8")
'xc2\xa9\xe2\x82\xac-\xc3\xb5\xc6\xbdp/>'
```
Using soupparser as a fallback

The downside of using this parser is that it is much slower than the HTML parser of lxml. So if performance matters, you might want to consider using soupparser only as a fallback for certain cases.

One common problem of lxml’s parser is that it might not get the encoding right in cases where the document contains a <meta> tag at the wrong place. In this case, you can exploit the fact that lxml serialises much faster than most other HTML libraries for Python. Just serialise the document to unicode and if that gives you an exception, re-parse it with BeautifulSoup to see if that works better.

```python
>>> tag_soup = '...
... <meta http-equiv="Content-Type"
... content="text/html;charset=utf-8" />
... <html>
... <head>
... <title>Hello World!</title>
... </head>
... <body>Hi all</body>
... </html>'

>>> import lxml.html
>>> import lxml.html.soupparser

>>> root = lxml.html.fromstring(tag_soup)
>>> try:
...     ignore = tostring(root, encoding='unicode')
... except UnicodeDecodeError:
...     root = lxml.html.soupparser.fromstring(tag_soup)
```

Using only the encoding detection

If you prefer a ‘real’ (and fast) HTML parser instead of the regular expression based one in BeautifulSoup, you can still benefit from BeautifulSoup’s support for encoding detection in the UnicodeDammit class.

```python
>>> from BeautifulSoup import UnicodeDammit

>>> def decode_html(html_string):
...     converted = UnicodeDammit(html_string, isHTML=True)
...     if not converted.unicode:
...         raise UnicodeDecodeError(
...             "Failed to detect encoding, tried [%s]",
...             ', '.join(converted.triedEncodings))
...     # print converted.originalEncoding
...     return converted.unicode

>>> root = lxml.html.fromstring(decode_html(tag_soup))
```
Chapter 16

html5lib Parser

html5lib is a Python package that implements the HTML5 parsing algorithm which is heavily influenced by current browsers and based on the WHATWG HTML5 specification.

lxml can benefit from the parsing capabilities of html5lib through the lxml.html.html5parser module. It provides a similar interface to the lxml.html module by providing fromstring(), parse(), document_fromstring(), fragment_fromstring() and fragments_fromstring() that work like the regular html parsing functions.

Differences to regular HTML parsing

There are a few differences in the returned tree to the regular HTML parsing functions from lxml.html. html5lib normalizes some elements and element structures to a common format. For example even if a tables does not have a tbody html5lib will inject one automatically:

```python
>>> from lxml.html import tostring, html5parser
>>> tostring(html5parser.fromstring("<table><td>foo")
'\n<table><tbody><tr><td>foo</td></tr></tbody></table>"
```

Also the parameters the functions accept are different.

Function Reference

`parse(filename_url_or_file)`: Parses the named file or url, or if the object has a .read() method, parses from that.

`document_fromstring(html, guess_charset=True)`: Parses a document from the given string. This always creates a correct HTML document, which means the parent node is <html>, and there is a body and possibly a head.

If a bytestring is passed and guess_charset is true the chardet library (if installed) will guess the charset if ambiguities exist.

`fragment_fromstring(string, create_parent=False, guess_charset=False)`: Returns an HTML fragment from a string. The fragment must contain just a single element, unless create_parent is given; e.g., fragment_fromstring(string, create_parent='div') will wrap the element in a <div>. If create_parent is true the default parent tag (div) is used.
If a bytestring is passed and `guess_charset` is true the chardet library (if installed) will guess the charset if ambiguities exist.

`fragments_fromstring(string, no_leading_text=False, parser=None)`: Returns a list of the elements found in the fragment. The first item in the list may be a string. If `no_leading_text` is true, then it will be an error if there is leading text, and it will always be a list of only elements.

If a bytestring is passed and `guess_charset` is true the chardet library (if installed) will guess the charset if ambiguities exist.

`fromstring(string)`: Returns `document_fromstring` or `fragment_fromstring`, based on whether the string looks like a full document, or just a fragment.

Additionally all parsing functions accept a `parser` keyword argument that can be set to a custom parser instance. To create custom parsers you can subclass the `HTMLParser` and `XHTMLParser` from the same module. Note that these are the parser classes provided by html5lib.
Part III

Extending lxml
Chapter 17

Document loading and URL resolving

The normal way to load external entities (such as DTDs) is by using XML catalogs. Lxml also has support for user
provided document loaders in both the parsers and XSL transformations. These so-called resolvers are subclasses
of the etree.Resolver class.

XML Catalogs

When loading an external entity for a document, e.g. a DTD, the parser is normally configured to prevent network
access (see the no_network parser option). Instead, it will try to load the entity from their local file system path
or, in the most common case that the entity uses a network URL as reference, from a local XML catalog.

XML catalogs are the preferred and agreed-on mechanism to load external entities from XML processors. Most
tools will use them, so it is worth configuring them properly on a system. Many Linux installations use them by
default, but on other systems they may need to get enabled manually. The libxml2 site has some documentation
on how to set up XML catalogs

URI Resolvers

Here is an example of a custom resolver:

```python
>>> from lxml import etree

>>> class DTDResolver(etree.Resolver):
...     def resolve(self, url, id, context):
...         print("Resolving URL \\
...             "% url)
...         return self.resolve_string(  
...             <!ENTITY myentity \\
...             "[resolved text: %s"]"> % url, context)
```

This defines a resolver that always returns a dynamically generated DTD fragment defining an entity. The url
argument passes the system URL of the requested document, the id argument is the public ID. Note that any of
these may be None. The context object is not normally used by client code.

Resolving is based on the methods of the Resolver object that build internal representations of the result document.
The following methods exist:

- `resolve_string` takes a parsable string as result document
• `resolve_filename` takes a filename
• `resolve_file` takes an open file-like object that has at least a read() method
• `resolve_empty` resolves into an empty document

The `resolve()` method may choose to return None, in which case the next registered resolver (or the default resolver) is consulted. Resolving always terminates if `resolve()` returns the result of any of the above `resolve_*()` methods.

Resolvers are registered local to a parser:

```python
generated_xml = '<!DOCTYPE doc SYSTEM "MissingDTD.dtd"><doc>&myentity;</doc>'
parser = etree.XMLParser(load_dtd=True)
parser.resolvers.add(DTDResolver())
xml = parser.parse(StringIO(generated_xml))
root = xml.getroot()
print(root.text)
```

The entity in the document was correctly resolved by the generated DTD fragment.

### Document loading in context

XML documents memorise their initial parser (and its resolvers) during their life-time. This means that a lookup process related to a document will use the resolvers of the document’s parser. We can demonstrate this with a resolver that only responds to a specific prefix:

```python
class PrefixResolver(etree.Resolver):
    def __init__(self, prefix):
        self.prefix = prefix
        self.result_xml = """"""""""
        <xsl:stylesheet
        xmlns:xsl="http://www.w3.org/1999/XSL/Transform">
        <test xmlns="testNS">
            %s-TEST</test>
        </xsl:stylesheet>
        """""""""""
    def resolve(self, url, pubid, context):
        if url.startswith(self.prefix):
            print("Resolved url %s as prefix %s" % (url, self.prefix))
            return self.resolve_string(self.result_xml, context)
```

We demonstrate this in XSLT and use the following stylesheet as an example:

```xml
<xsl:stylesheet version="1.0"
    xmlns:xsl="http://www.w3.org/1999/XSL/Transform">
    <xsl:include href="honk:test"/>
    <xsl:template match="/">
        <test>
            <xsl:value-of select="document(’hoi:test’)/**/text()"/>
```
Note that it needs to resolve two URIs: `honk:test` when compiling the XSLT document (i.e. when resolving `xsl:import` and `xsl:include` elements) and `hoi:test` at transformation time, when calls to the document function are resolved. If we now register different resolvers with two different parsers, we can parse our document twice in different resolver contexts:

```python
>>> hoi_parser = etree.XMLParser()
>>> normal_doc = etree.parse(StringIO(xml_text), hoi_parser)

>>> hoi_parser.resolvers.add( PrefixResolver("hoi") )
>>> hoi_doc = etree.parse(StringIO(xml_text), hoi_parser)

>>> honk_parser = etree.XMLParser()
>>> honk_parser.resolvers.add( PrefixResolver("honk") )
>>> honk_doc = etree.parse(StringIO(xml_text), honk_parser)
```

These contexts are important for the further behaviour of the documents. They memorise their original parser so that the correct set of resolvers is used in subsequent lookups. To compile the stylesheet, XSLT must resolve the `honk:test` URI in the `xsl:import` element. The `hoi` resolver cannot do that:

```python
>>> transform = etree.XSLT(normal_doc)
Traceback (most recent call last):
...  lxml.etree.XSLTParseError: Cannot resolve URI honk:test
```

```python
>>> transform = etree.XSLT(hoi_doc)
Traceback (most recent call last):
...  lxml.etree.XSLTParseError: Cannot resolve URI honk:test
```

However, if we use the `honk` resolver associated with the respective document, everything works fine:

```python
>>> transform = etree.XSLT(honk_doc)
Resolved url honk:test as prefix honk
```

Running the transform accesses the same parser context again, but since it now needs to resolve the `hoi` URI in the call to the document function, its `honk` resolver will fail to do so:

```python
>>> result = transform(normal_doc)
Traceback (most recent call last):
...  lxml.etree.XSLTApplyError: Cannot resolve URI hoi:test
```

```python
>>> result = transform(hoi_doc)
Traceback (most recent call last):
...  lxml.etree.XSLTApplyError: Cannot resolve URI hoi:test
```

```python
>>> result = transform(honk_doc)
Traceback (most recent call last):
...  lxml.etree.XSLTApplyError: Cannot resolve URI hoi:test
```

This can only be solved by adding a `hoi` resolver to the original parser:
I/O access control in XSLT

By default, XSLT supports all extension functions from libxslt and libexslt as well as Python regular expressions through EXSLT. Some extensions enable style sheets to read and write files on the local file system.

XSLT has a mechanism to control the access to certain I/O operations during the transformation process. This is most interesting where XSL scripts come from potentially insecure sources and must be prevented from modifying the local file system. Note, however, that there is no way to keep them from eating up your precious CPU time, so this should not stop you from thinking about what XSLT you execute.

Access control is configured using the XSLTAccessControl class. It can be called with a number of keyword arguments that allow or deny specific operations:

```python
>>> transform = etree.XSLT(honk_doc)
Resolved url honk:test as prefix honk
>>> result = transform(normal_doc)
Resolved url hoi:test as prefix hoi

>>> ac = etree.XSLTAccessControl(read_network=False)
>>> transform = etree.XSLT(honk_doc, access_control=ac)
Resolved url honk:test as prefix honk
>>> result = transform(normal_doc)
Traceback (most recent call last):
...
lxml.etree.XSLTApplyError: xsltLoadDocument: read rights for hoi:test denied
```

There are a few things to keep in mind:

- XSL parsing (xsl:import, etc.) is not affected by this mechanism
- read_file=False does not imply write_file=False, all controls are independent.
- read_file only applies to files in the file system. Any other scheme for URLs is controlled by the _network keywords.
- If you need more fine-grained control than switching access on and off, you should consider writing a

---

We can see that the hoi resolver was called to generate a document that was then inserted into the result document by the XSLT transformation. Note that this is completely independent of the XML file you transform, as the URI is resolved from within the stylesheet context:

```python
>>> honk_parser.resolvers.add( PrefixResolver("hoi") )
>>> result = transform(honk_doc)
Resolved url hoi:test as prefix hoi
>>> print(str(result)[:-1])
<?xml version="1.0"?>
<test>hoi-TEST</test>
```

It may be seen as a matter of taste what resolvers the generated document inherits. For XSLT, the output document inherits the resolvers of the input document and not those of the stylesheet. Therefore, the last result does not inherit any resolvers at all.

---

I/O access control in XSLT

---

We can see that the hoi resolver was called to generate a document that was then inserted into the result document by the XSLT transformation. Note that this is completely independent of the XML file you transform, as the URI is resolved from within the stylesheet context:

```python
>>> result = transform(normal_doc)
Resolved url hoi:test as prefix hoi
>>> print(str(result)[:-1])
<?xml version="1.0"?>
<test>hoi-TEST</test>
```
custom document loader that returns empty documents or raises exceptions if access is denied.
Chapter 18

Python extensions for XPath and XSLT

This document describes how to use Python extension functions in XPath and XSLT like this:

<xsl:value-of select="f:myPythonFunction(.//sometag)" />

and extension elements in XSLT as in the following example:

<xsl:template match="*">
  <my:python-extension>
    <some-content />
  </my:python-extension>
</xsl:template>

XPath Extension functions

Here is how an extension function looks like. As the first argument, it always receives a context object (see below). The other arguments are provided by the respective call in the XPath expression, one in the following examples. Any number of arguments is allowed:

>>> def hello(context, a):
...   return "Hello %s" % a

>>> def ola(context, a):
...   return "Ola %s" % a

>>> def loadsofargs(context, *args):
...   return "Got %d arguments." % len(args)

The FunctionNamespace

In order to use a function in XPath or XSLT, it needs to have a (namespaced) name by which it can be called during evaluation. This is done using the FunctionNamespace class. For simplicity, we choose the empty namespace (None):

>>> from lxml import etree

>>> ns = etree.FunctionNamespace(None)

>>> ns[‘hello’] = hello

>>> ns[‘countargs’] = loadsofargs
This registers the function hello with the name hello in the default namespace (None), and the function loadsofargs with the name countargs. Now we’re going to create a document that we can run XPath expressions against:

```python
>>> root = etree.XML('<a><b>Haegar</b></a>')
```

Done. Now we can have XPath expressions call our new function:

```python
>>> print(root.xpath("hello('Dr. Falken')"))
Hello Dr. Falken
```

```python
>>> print(root.xpath('hello(local-name(*))'))
Hello b
```

```python
>>> print(root.xpath('hello(string(b))'))
Hello Haegar
```

```python
>>> print(root.xpath('countargs(., b, ./*)'))
Got 3 arguments.
```

Note how we call both a Python function (hello) and an XPath built-in function (string) in exactly the same way. Normally, however, you would want to separate the two in different namespaces. The FunctionNamespace class allows you to do this:

```python
>>> ns = etree.FunctionNamespace('http://mydomain.org/myfunctions')
>>> ns['hello'] = hello
>>> prefixmap = { 'f' : 'http://mydomain.org/myfunctions' }
>>> print(root.xpath('f:hello(local-name(*))', namespaces=prefixmap))
Hello b
```

**Global prefix assignment**

In the last example, you had to specify a prefix for the function namespace. If you always use the same prefix for a function namespace, you can also register it with the namespace:

```python
>>> ns = etree.FunctionNamespace('http://mydomain.org/myother/functions')
>>> ns.prefix = 'es'
>>> ns['hello'] = ola
>>> print(root.xpath('es:hello(local-name(*))'))
Ola b
```

This is a global assignment, so take care not to assign the same prefix to more than one namespace. The resulting behaviour in that case is completely undefined. It is always a good idea to consistently use the same meaningful prefix for each namespace throughout your application.

The prefix assignment only works with functions and FunctionNamespace objects, not with the general Namespace object that registers element classes. The reasoning is that elements in lxml do not care about prefixes anyway, so it would rather complicate things than be of any help.

**The XPath context**

Functions get a context object as first parameter. In lxml 1.x, this value was None, but since lxml 2.0 it provides two properties: **eval_context** and **context_node**. The context node is the Element where the current function is called:

```python
>>> def print_tag(context, nodes):
...     print("%s: %s\n" % (context.context_node.tag, [ n.tag for n in nodes ]))
```

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Evaluators and XSLT XPath Extension functions

```python
>>> ns = etree.FunctionNamespace('http://mydomain.org/printtag')
>>> ns.prefix = "pt"
>>> ns["print_tag"] = print_tag

>>> ignore = root.xpath("//*[pt:print_tag(.//*)]")
a: ['b']
b: []
```

The `eval_context` is a dictionary that is local to the evaluation. It allows functions to keep state:

```python
>>> def print_context(context):
...     context.eval_context[context.context_node.tag] = "done"
...     print(sorted(context.eval_context.items()))
>>> ns["print_context"] = print_context

>>> ignore = root.xpath("//*[pt:print_context()]")
[['a', 'done'], ['a', 'done'], ('b', 'done')]
```

Evaluators and XSLT

Extension functions work for all ways of evaluating XPath expressions and for XSL transformations:

```python
>>> e = etree.XPathEvaluator(doc)
>>> print(e('es:hello(local-name(/a)')))
Ola a

>>> namespaces = {'f' : 'http://mydomain.org/myfunctions'}
>>> e = etree.XPathEvaluator(doc, namespaces=namespaces)
>>> print(e('f:hello(local-name(/a)')))
Hello a
```

```xml
...<stylesheet version="1.0"
... xmlns="http://www.w3.org/1999/XSL/Transform"
... xmlns:es="http://mydomain.org/myother/functions">
...<output method="text" encoding="ASCII"/>
...<template match="/">
...<value-of select="es:hello(string(/b))"/>
... </template>
... </stylesheet>
...''
```

```python
>>> print(xslt(doc))
Ola Haegar
```

It is also possible to register namespaces with a single evaluator after its creation. While the following example involves no functions, the idea should still be clear:

```python
>>> f = StringIO('<a xmlns="http://mydomain.org/myfunctions" /></a>
>>> ns_doc = etree.parse(f)
>>> e = etree.XPathEvaluator(ns_doc)
>>> e('/a')
[]
```

This returns nothing, as we did not ask for the right namespace. When we register the namespace with the evaluator, however, we can access it via a prefix:
Evaluator-local extensions

Apart from the global registration of extension functions, there is also a way of making extensions known to a single Evaluator or XSLT. All evaluators and the XSLT object accept a keyword argument `extensions` in their constructor. The value is a dictionary mapping (namespace, name) tuples to functions:

```python
>>> extensions = {('local-ns', 'local-hello') : hello}
>>> namespaces = {'l' : 'local-ns'}

>>> e = etree.XPathEvaluator(doc, namespaces=namespaces, extensions=extensions)
>>> print(e('l:local-hello(string(b)')))
Hello Haegar
```

For larger numbers of extension functions, you can define classes or modules and use the `Extension` helper:

```python
>>> class MyExt:
...     def function1(self, _, arg):
...         return '1'+arg
...     def function2(self, _, arg):
...         return '2'+arg
...     def function3(self, _, arg):
...         return '3'+arg

>>> ext_module = MyExt()
>>> functions = ('function1', 'function2', 'function3')
>>> extensions = etree.Extension( ext_module, functions, ns='local-ns' )

>>> e = etree.XPathEvaluator(doc, namespaces=namespaces, extensions=extensions)
>>> print(e('l:local-hello(string(b)')))
1Hello Haegar
```

The optional second argument to `Extension` can either be a sequence of names to select from the module, a dictionary that explicitly maps function names to their XPath alter-ego or `None` (explicitly passed) to take all available functions under their original name (if their name does not start with "_").

The additional `ns` keyword argument takes a namespace URI or `None` (also if left out) for the default namespace. The following examples will therefore all do the same thing:

```python
>>> functions = ('function1', 'function2', 'function3')
>>> extensions = etree.Extension( ext_module, functions, ns='local-ns' )
>>> e = etree.XPathEvaluator(doc, extensions=extensions)
>>> print(e('function1(function2(function3(string(b))))'))
123Hello Haegar
```
>>> extensions = etree.Extension( ext_module, functions, ns=None )
>>> e = etree.XPathEvaluator(doc, extensions=extensions)
>>> print(e('function1(function2(function3(string(b))))'))
123Haegar

>>> extensions = etree.Extension(ext_module)
>>> e = etree.XPathEvaluator(doc, extensions=extensions)
>>> print(e('function1(function2(function3(string(b))))'))
123Haegar

>>> functions = {
...    'function1' : 'function1',
...    'function2' : 'function2',
...    'function3' : 'function3'
... }
>>> extensions = etree.Extension(ext_module, functions)
>>> e = etree.XPathEvaluator(doc, extensions=extensions)
>>> print(e('function1(function2(function3(string(b))))'))
123Haegar

For convenience, you can also pass a sequence of extensions:

>>> extensions1 = etree.Extension(ext_module)
>>> extensions2 = etree.Extension(ext_module, ns='local-ns')
>>> e = etree.XPathEvaluator(doc, extensions=[extensions1, extensions2],
...    namespaces=namespaces)
>>> print(e('function1(l:function2(function3(string(b))))'))
123Haegar

What to return from a function

Extension functions can return any data type for which there is an XPath equivalent (see the documentation on XPath return values). This includes numbers, boolean values, elements and lists of elements. Note that integers will also be returned as floats:

>>> def returnsFloat(_):
...    return 1.7
>>> def returnsInteger(_):
...    return 1
>>> def returnsBool(_):
...    return True
>>> def returnFirstNode(_, nodes):
...    return nodes[0]

>>> ns = etree.FunctionNamespace(None)
>>> ns['float'] = returnsFloat
>>> ns['int'] = returnsInteger
>>> ns['bool'] = returnsBool
>>> ns['first'] = returnFirstNode

>>> e = etree.XPathEvaluator(doc)
>>> e("float()")
1.7
>>> e("int ()")
What to return from a function

XPath Extension functions

1.0
>>> int( e("int()") )
1
>>> e("bool()")
True
>>> e("count(first(//b))")
1.0

As the last example shows, you can pass the results of functions back into the XPath expression. Elements and sequences of elements are treated as XPath node-sets:

>>> def returnsNodeSet(_):
...    results1 = etree.Element('results1')
...    etree.SubElement(results1, 'result').text = "Alpha"
...    etree.SubElement(results1, 'result').text = "Beta"
...    results2 = etree.Element('results2')
...    etree.SubElement(results2, 'result').text = "Gamma"
...    etree.SubElement(results2, 'result').text = "Delta"
...    results3 = etree.SubElement(results2, 'subresult')
...    return [results1, results2, results3]

>>> ns['new-node-set'] = returnsNodeSet

>>> e = etree.XPathEvaluator(doc)

>>> r = e("new-node-set()/result")
>>> print([ t.text for t in r ])
['Alpha', 'Beta', 'Gamma', 'Delta']

>>> r = e("new-node-set()")
>>> print([ t.tag for t in r ])
['results1', 'results2', 'subresult']

>>> print([ len(t) for t in r ])  
[2, 3, 0]

>>> r[0][0].text
'Alpha'

>>> etree.tostring(r[0])
'b"<results1><result>Alpha</result><result>Beta</result></results1>"

>>> etree.tostring(r[1])
'b"<results2><result>Gamma</result><result>Delta</result><subresult/></results2>"

>>> etree.tostring(r[2])
'b"<subresult/>"

The current implementation deep-copies newly created elements in node-sets. Only the elements and their children are passed on, no outlying parents or tail texts will be available in the result. This also means that in the above example, the subresult elements in results2 and results3 are no longer identical within the node-set, they belong to independent trees:

>>> print("%s - %s" % (r[1][-1].tag, r[2].tag))
'subresult - subresult'

>>> print(r[1][-1] == r[2])
False
XSLT extension elements

Just like the XPath extension functions described above, lxml supports custom extension elements in XSLT. This means, you can write XSLT code like this:

```xml
<xsl:template match="*">
  <my:python-extension>
    <some-content />
  </my:python-extension>
</xsl:template>
```

And then you can implement the element in Python like this:

```python
>>> class MyExtElement(etree.XSLTExtension):
...     def execute(self, context, self_node, input_node, output_parent):
...         print("Hello from XSLT!")
...         output_parent.text = "I did it!"
...         # just copy own content input to output
...         output_parent.extend( list(self_node) )
```

The arguments passed to the `.execute()` method are:

- **context** The opaque evaluation context. You need this when calling back into the XSLT processor.
- **self_node** A read-only Element object that represents the extension element in the stylesheet.
- **input_node** The current context Element in the input document (also read-only).
- **output_parent** The current insertion point in the output document. You can append elements or set the text value (not the tail). Apart from that, the Element is read-only.

Declaring extension elements

In XSLT, extension elements can be used like any other XSLT element, except that they must be declared as extensions using the standard XSLT `extension-element-prefixes` option:

```xml
>>> xslt_ext_tree = etree.XML('"
.... <xsl:stylesheet version="1.0"
....   xmlns:xsl="http://www.w3.org/1999/XSL/Transform"
....   xmlns:my="testns"
....   extension-element-prefixes="my">
....   <xsl:template match="/">
....     <foo><my:ext><child>XYZ</child></my:ext></foo>
....     <xsl:template>
....       <xsl:template match="child">
....         <CHILD>--xyz--</CHILD>
....       </xsl:template>
```

This is an implementation detail that you should be aware of, but you should avoid relying on it in your code. Note that elements taken from the source document (the most common case) do not suffer from this restriction. They will always be passed unchanged.
Applying XSL templates

To register the extension, add its namespace and name to the extension mapping of the XSLT object:

```python
>>> my_extension = MyExtElement()
>>> extensions = { ('testns', 'ext') : my_extension }
>>> transform = etree.XSLT(xslt_ext_tree, extensions = extensions)
```

Note how we pass an instance here, not the class of the extension. Now we can run the transformation and see how our extension is called:

```python
>>> root = etree.XML('<dummy/>')
>>> result = transform(root)
>>> str(result)
'<?xml version="1.0"?>
<foo>I did it!<child>XYZ</child></foo>
'
```

Applying XSL templates

XSLT extensions are a very powerful feature that allows you to interact directly with the XSLT processor. You have full read-only access to the input document and the stylesheet, and you can even call back into the XSLT processor to process templates. Here is an example that passes an Element into the .apply_templates() method of the XSLTExtension instance:

```python
>>> class MyExtElement(etree.XSLTExtension):
...     def execute(self, context, self_node, input_node, output_parent):
...         child = self_node[0]
...         results = self.apply_templates(context, child)
...         output_parent.append(results[0])

>>> my_extension = MyExtElement()
>>> extensions = { ('testns', 'ext') : my_extension }
>>> transform = etree.XSLT(xslt_ext_tree, extensions = extensions)

>>> root = etree.XML('<dummy/>')
>>> result = transform(root)
>>> str(result)
'<?xml version="1.0"?>
<foo><CHILD>--xyz--</CHILD></foo>
'
```

Here, we applied the templates to a child of the extension element itself, i.e. to an element inside the stylesheet instead of an element of the input document.

The return value of .apply_templates() is always a list. It may contain a mix of elements and strings, collected from the XSLT processing result. If you want to append these values to the output parent, be aware that you cannot use the .append() method to add strings. In many cases, you would only be interested in elements anyway, so you can discard strings (e.g. formatting whitespace) and append the rest.

If you want to include string results in the output, you can either build an appropriate tree yourself and append that, or you can manually add the string values to the current output tree, e.g. by concatenating them with the .tail of the last element that was appended.

Note that you can also let lxml build the result tree for you by passing the output_parent into the .apply_templates() method. In this case, the result will be None and all content found by applying templates will be appended to the output parent.
If you do not care about string results at all, e.g. because you already know that they will only contain whitespace, you can pass the option `elements_only=True` to the `.apply_templates()` method, or pass `remove_blank_text=True` to remove only those strings that consist entirely of whitespace.

**Working with read-only elements**

There is one important thing to keep in mind: all Elements that the `execute()` method gets to deal with are read-only Elements, so you cannot modify them. They also will not easily work in the API. For example, you cannot pass them to the `tostring()` function or wrap them in an `ElementTree`.

What you can do, however, is to deepcopy them to make them normal Elements, and then modify them using the normal etree API. So this will work:

```python
>>> from copy import deepcopy
>>> class MyExtElement(etree.XSLTExtension):
...     def execute(self, context, self_node, input_node, output_parent):
...         child = deepcopy(self_node[0])
...         child.text = "NEW TEXT"
...         output_parent.append(child)
```

```python
>>> my_extension = MyExtElement()
>>> extensions = { ('testns', 'ext') : my_extension }
>>> transform = etree.XSLT(xslt_ext_tree, extensions = extensions)
```

```python
>>> root = etree.XML('<dummy/>')
>>> result = transform(root)
>>> str(result)
'<?xml version="1.0"?>
<foo><child>NEW TEXT</child></foo>
'```
Chapter 19

Using custom Element classes in lxml

lxml has very sophisticated support for custom Element classes. You can provide your own classes for Elements and have lxml use them by default for all elements generated by a specific parser, only for a specific tag name in a specific namespace or even for an exact element at a specific position in the tree.

Custom Elements must inherit from the lxml.etree.ElementBase class, which provides the Element interface for subclasses:

```python
>>> from lxml import etree

>>> class honk(etree.ElementBase):
...    @property
...    def honking(self):
...        return self.get('honking') == 'true'
```

This defines a new Element class honk with a property honking.

The following document describes how you can make lxml.etree use these custom Element classes.

Background on Element proxies

Being based on libxml2, lxml.etree holds the entire XML tree in a C structure. To communicate with Python code, it creates Python proxy objects for the XML elements on demand.

The mapping between C elements and Python Element classes is completely configurable. When you ask lxml.etree for an Element by using its API, it will instantiate your classes for you. All you have to do is tell lxml which class to use for which kind of Element. This is done through a class lookup scheme, as described in the sections below.

Element initialization

There is one thing to know up front. Element classes must not have an __init__ or __new__ method. There should not be any internal state either, except for the data stored in the underlying XML tree. Element instances are created and garbage collected at need, so there is normally no way to predict when and how often a proxy
is created for them. Even worse, when the `__init__` method is called, the object is not even initialized yet to represent the XML tag, so there is not much use in providing an `__init__` method in subclasses.

Most use cases will not require any class initialisation or proxy state, so you can content yourself with skipping to the next section for now. However, if you really need to set up your element class on instantiation, or need a way to persistently store state in the proxy instances instead of the XML tree, here is a way to do so.

There is one important guarantee regarding Element proxies. Once a proxy has been instantiated, it will keep alive as long as there is a Python reference to it, and any access to the XML element in the tree will return this very instance. Therefore, if you need to store local state in a custom Element class (which is generally discouraged), you can do so by keeping the Elements in a tree alive. If the tree doesn’t change, you can simply do this:

```python
proxy_cache = list(root.iter())
```

or

```python
proxy_cache = set(root.iter())
```

or use any other suitable container. Note that you have to keep this cache manually up to date if the tree changes, which can get tricky in cases.

For proxy initialisation, ElementBase classes have an `__init__` method that can be overridden, as oppose to the normal `__init__` method. It can be used to modify the XML tree, e.g. to construct special children or verify and update attributes.

The semantics of `__init__` are as follows:

- It is called once on Element class instantiation time. That is, when a Python representation of the element is created by lxml. At that time, the element object is completely initialized to represent a specific XML element within the tree.
- The method has complete access to the XML tree. Modifications can be done in exactly the same way as anywhere else in the program.
- Python representations of elements may be created multiple times during the lifetime of an XML element in the underlying C tree. The `__init__` code provided by subclasses must take special care by itself that multiple executions either are harmless or that they are prevented by some kind of flag in the XML tree. The latter can be achieved by modifying an attribute value or by removing or adding a specific child node and then verifying this before running through the init process.
- Any exceptions raised in `__init__` will be propagated through the API call that lead to the creation of the Element. So be careful with the code you write here as its exceptions may turn up in various unexpected places.

### Setting up a class lookup scheme

The first thing to do when deploying custom element classes is to register a class lookup scheme on a parser. lxml.etree provides quite a number of different schemes that also support class lookup based on namespaces or attribute values. Most lookups support fallback chaining, which allows the next lookup mechanism to take over when the previous one fails to find a class.

For example, setting the `honk` Element as a default element class for a parser works as follows:

```python
>>> parser_lookup = etree.ElementDefaultClassLookup(element=honk)
>>> parser = etree.XMLParser()
>>> parser.set_element_class_lookup(parser_lookup)
```

There is one drawback of the parser based scheme: the `Element` factory does not know about your specialised
parser and creates a new document that deploys the default parser:

```python
>>> el = etree.Element("root")
>>> print(isinstance(el, honk))
False
```

You should therefore avoid using this factory function in code that uses custom classes. The `makeelement()` method of parsers provides a simple replacement:

```python
>>> el = parser.makeelement("root")
>>> print(isinstance(el, honk))
True
```

If you use a parser at the module level, you can easily redirect a module level `Element()` factory to the parser method by adding code like this:

```python
>>> module_level_parser = etree.XMLParser()
>>> Element = module_level_parser.makeelement
```

While the `XML()` and `HTML()` factories also depend on the default parser, you can pass them a different parser as second argument:

```python
>>> element = etree.XML("<test/>")
>>> print(isinstance(element, honk))
False

>>> element = etree.XML("<test/>", parser)
>>> print(isinstance(element, honk))
True
```

Whenever you create a document with a parser, it will inherit the lookup scheme and all subsequent element instantiations for this document will use it:

```python
>>> element = etree.fromstring("<test/>", parser)
>>> print(isinstance(element, honk))
True

>>> el = etree.SubElement(element, "subel")
>>> print(isinstance(el, honk))
True
```

For testing code in the Python interpreter and for small projects, you may also consider setting a lookup scheme on the default parser. To avoid interfering with other modules, however, it is usually a better idea to use a dedicated parser for each module (or a parser pool when using threads) and then register the required lookup scheme only for this parser.

### Default class lookup

This is the most simple lookup mechanism. It always returns the default element class. Consequently, no further fallbacks are supported, but this scheme is a nice fallback for other custom lookup mechanisms.

**Usage:**

```python
>>> lookup = etree.ElementDefaultClassLookup()
>>> parser = etree.XMLParser()
>>> parser.set_element_class_lookup(lookup)
```

Note that the default for new parsers is to use the global fallback, which is also the default lookup (if not configured otherwise).
To change the default element implementation, you can pass your new class to the constructor. While it accepts classes for element, comment and pi nodes, most use cases will only override the element class:

```python
g = parser.makeelement("myelement")
print(isinstance(g, honk))
False
lookup = etree.ElementDefaultClassLookup(element=honk)
parser.set_element_class_lookup(lookup)

g = parser.makeelement("myelement")
print(isinstance(g, honk))
True
g.honking
False

g = parser.makeelement("myelement", honking='true')
etree.tostring(g)
b’<myelement honking="true"/>’
g.honking
True
```

### Namespace class lookup

This is an advanced lookup mechanism that supports namespace/tag-name specific element classes. You can select it by calling:

```python
g = etree.ElementNamespaceClassLookup()
parser = etree.XMLParser()
parser.set_element_class_lookup(g)

See the separate section on implementing namespaces below to learn how to make use of it.

This scheme supports a fallback mechanism that is used in the case where the namespace is not found or no class was registered for the element name. Normally, the default class lookup is used here. To change it, pass the desired fallback lookup scheme to the constructor:

```python
g = etree.ElementDefaultClassLookup(element=honk)
g = etree.ElementNamespaceClassLookup(g)
parser.set_element_class_lookup(g)
```

### Attribute based lookup

This scheme uses a mapping from attribute values to classes. An attribute name is set at initialisation time and is then used to find the corresponding value in a dictionary. It is set up as follows:

```python
gid_class_mapping = {‘1234’ : honk} # maps attribute values to classes

lookup = etree.AttributeBasedElementClassLookup(gid_class_mapping)
parser = etree.XMLParser()
parser.set_element_class_lookup(lookup)

And here is how to use it:
Custom element class lookup

Setting up a class lookup scheme

```python
>>> xml = '<a id="123"><b id="1234" honking="true"/></a>'
>>> a = etree.fromstring(xml, parser)
```

```python
>>> a.honking  # id does not match!
AttributeError: 'lxml.etree._Element' object has no attribute 'honking'
```

```python
>>> a[0].honking
False
>>> a[1].honking
True
```

This lookup scheme uses its fallback if the attribute is not found or its value is not in the mapping. Normally, the default class lookup is used here. If you want to use the namespace lookup, for example, you can use this code:

```python
>>> fallback = etree.ElementNamespaceClassLookup()
>>> lookup = etree.AttributeBasedElementClassLookup(...
   'id', id_class_mapping, fallback)
>>> parser = etree.XMLParser()
>>> parser.set_element_class_lookup(lookup)
```

**Custom element class lookup**

This is the most customisable way of finding element classes on a per-element basis. It allows you to implement a custom lookup scheme in a subclass:

```python
>>> class MyLookup(etree.CustomElementClassLookup):
...     def lookup(self, node_type, document, namespace, name):
...         return honk  # be a bit more selective here ...
```

```python
>>> parser = etree.XMLParser()
>>> parser.set_element_class_lookup(MyLookup())
```

The `.lookup()` method must return either None (which triggers the fallback mechanism) or a subclass of `lxml.etree.ElementBase`. It can take any decision it wants based on the node type (one of "element", "comment", "PI", "entity"), the XML document of the element, or its namespace or tag name.

**Tree based element class lookup in Python**

Taking more elaborate decisions than allowed by the custom scheme is difficult to achieve in pure Python, as it results in a chicken-and-egg problem. It would require access to the tree - before the elements in the tree have been instantiated as Python Element proxies.

Luckily, there is a way to do this. The `PythonElementClassLookup` works similar to the custom lookup scheme:

```python
>>> class MyLookup(etree.PythonElementClassLookup):
...     def lookup(self, document, element):
...         return MyElementClass  # defined elsewhere
```

```python
>>> parser = etree.XMLParser()
>>> parser.set_element_class_lookup(MyLookup())
```

As before, the first argument to the `lookup()` method is the opaque document instance that contains the Element. The second arguments is a lightweight Element proxy implementation that is only valid during the lookup. Do
not try to keep a reference to it. Once the lookup is finished, the proxy will become invalid. You will get an 
AssertionError if you access any of the properties or methods outside the scope of the lookup call where 
they were instantiated.

During the lookup, the element object behaves mostly like a normal Element instance. It provides the properties 
tag, text, tail etc. and supports indexing, slicing and the getchildren(), getparent() etc. methods. 
It does not support iteration, nor does it support any kind of modification. All of its properties are read-only and 
it cannot be removed or inserted into other trees. You can use it as a starting point to freely traverse the tree and 
collect any kind of information that its elements provide. Once you have taken the decision which class to use for 
this element, you can simply return it and have lxml take care of cleaning up the instantiated proxy classes.

Sidenote: this lookup scheme originally lived in a separate module called lxml.pyclasslookup.

Generating XML with custom classes

Up to lxml 2.1, you could not instantiate proxy classes yourself. Only lxml.etree could do that when creating an 
object representation of an existing XML element. Since lxml 2.2, however, instantiating this class will simply 
create a new Element:

```python
>>> el = honk(honking = 'true')
>>> el.tag
'honk'
>>> el.honking
True
```

Note, however, that the proxy you create here will be garbage collected just like any other proxy. You can therefore 
not count on lxml.etree using the same class that you instantiated when you access this Element a second time after 
letting its reference go. You should therefore always use a corresponding class lookup scheme that returns your 
Element proxy classes for the elements that they create. The ElementNamespaceClassLookup is generally 
a good match.

You can use custom Element classes to quickly create XML fragments:

```python
>>> class hale(etree.ElementBase): pass
>>> class bopp(etree.ElementBase): pass

>>> el = hale( "some ", honk(honking = 'true'), bopp, " text" )

>>> print(etree.tostring(el, encoding='unicode'))
<hale>some <honk honking="true"/> <bopp/> text</hale>
```

Implementing namespaces

lxml allows you to implement namespaces, in a rather literal sense. After setting up the namespace class lookup 
mechanism as described above, you can build a new element namespace (or retrieve an existing one) by calling 
the get_namespace(uri) method of the lookup:

```python
>>> lookup = etree.ElementNamespaceClassLookup()
>>> parser = etree.XMLParser()
>>> parser.set_element_class_lookup(lookup)

>>> namespace = lookup.get_namespace('http://hui.de/honk')
```

and then register the new element type with that namespace, say, under the tag name honk:
Implementing namespaces

```python
>>> namespace[‘honk’] = honk
```

If you have many Element classes declared in one module, and they are all named like the elements they create, you can simply use `namespace.update(vars())` at the end of your module to declare them automatically. The implementation is smart enough to ignore everything that is not an Element class.

After this, you create and use your XML elements through the normal API of lxml:

```python
>>> xml = ‘<honk xmlns="http://hui.de/honk" honking="true"/>’
>>> honk_element = etree.XML(xml, parser)
>>> print(honk_element.honking)
True
```

The same works when creating elements by hand:

```python
>>> honk_element = parser.makeelement('{http://hui.de/honk}honk', ...
   honking='true')
>>> print(honk_element.honking)
True
```

Essentially, what this allows you to do, is to give Elements a custom API based on their namespace and tag name.

A somewhat related topic are extension functions which use a similar mechanism for registering extension functions in XPath and XSLT.

In the setup example above, we associated the `honk` Element class only with the `honk` element. If an XML tree contains different elements in the same namespace, they do not pick up the same implementation:

```python
>>> xml = '<honk xmlns="http://hui.de/honk" honking="true"><bla/></honk>'
>>> honk_element = etree.XML(xml, parser)
>>> print(honk_element.honking)
True
>>> print(honk_element[0].honking)
Traceback (most recent call last):
... AttributeError: 'lxml.etree._Element' object has no attribute 'honking'
```

You can therefore provide one implementation per element name in each namespace and have lxml select the right one on the fly. If you want one element implementation per namespace (ignoring the element name) or prefer having a common class for most elements except a few, you can specify a default implementation for an entire namespace by registering that class with the empty element name (None).

You may consider following an object oriented approach here. If you build a class hierarchy of element classes, you can also implement a base class for a namespace that is used if no specific element class is provided. Again, you can just pass None as an element name:

```python
>>> class HonkNSElement(etree.ElementBase):
...     def honk(self):
...         return "HONK"
>>> namespace[None] = HonkNSElement # default Element for namespace
```

Now you can rely on lxml to always return objects of type `HonkNSElement` or its subclasses for elements of this namespace:
Implementing namespaces

```python
>>> xml = '<honk xmlns="http://hui.de/honk" honking="true"><bla/></honk>'
>>> honk_element = etree.XML(xml, parser)

>>> print(type(honk_element))
<class 'HonkElement'>
>>> print(type(honk_element[0]))
<class 'HonkNSElement'>

>>> print(honk_element.honking)
True
>>> print(honk_element.honk())
HONK

>>> print(honk_element[0].honk())
HONK
>>> print(honk_element[0].honking)
Traceback (most recent call last):
  ...
AttributeError: 'HonkNSElement' object has no attribute 'honking'
```
Chapter 20

Sax support

In this document we’ll describe lxml’s SAX support. lxml has support for producing SAX events for an ElementTree or Element. lxml can also turn SAX events into an ElementTree. The SAX API used by lxml is compatible with that in the Python core (xml.sax), so is useful for interfacing lxml with code that uses the Python core SAX facilities.

Building a tree from SAX events

First of all, lxml has support for building a new tree given SAX events. To do this, we use the special SAX content handler defined by lxml named lxml.sax.ElementTreeContentHandler:

```python
>>> import lxml.sax

>>> handler = lxml.sax.ElementTreeContentHandler()
```

Now let’s fire some SAX events at it:

```python
>>> handler.startElementNS((None, 'a'), 'a', {})
>>> handler.startElementNS((None, 'b'), 'b', {(None, 'foo'): 'bar'})
>>> handler.characters('Hello world')
>>> handler.endElementNS((None, 'b'), 'b')
>>> handler.endElementNS((None, 'a'), 'a')
```

This constructs an equivalent tree. You can access it through the etree property of the handler:

```python
>>> tree = handler.etree
>>> lxml.etree.tostring(tree.getroot())
b’<a><b foo="bar">Hello world</b></a>’
```

By passing a makeelement function the constructor of ElementTreeContentHandler, e.g. the one of a parser you configured, you can determine which element class lookup scheme should be used.

Producing SAX events from an ElementTree or Element

Let’s make a tree we can generate SAX events for:

```python
>>> f = StringIO(<a><b>Text</b></a>)
>>> tree = lxml.etree.parse(f)
```
Interfacing with pulldom/minidom

To see whether the correct SAX events are produced, we’ll write a custom content handler:

```python
>>> from xml.sax.handler import ContentHandler
>>> class MyContentHandler(ContentHandler):
...     def __init__(self):
...         self.a_amount = 0
...         self.b_amount = 0
...         self.text = None
...     def startElementNS(self, name, qname, attributes):
...         uri, localname = name
...         if localname == 'a':
...             self.a_amount += 1
...         if localname == 'b':
...             self.b_amount += 1
...     def characters(self, data):
...         self.text = data
```

Note that it only defines the `startElementNS()` method and not `startElement()`. The SAX event generator in `lxml.sax` currently only supports namespace-aware processing.

To test the content handler, we can produce SAX events from the tree:

```python
>>> handler = MyContentHandler()
>>> lxml.sax.saxify(tree, handler)
```

This is what we expect:

```python
>>> handler.a_amount
1
>>> handler.b_amount
1
>>> handler.text
'Text'
```

Interfacing with pulldom/minidom

`lxml.sax` is a simple way to interface with the standard XML support in the Python library. Note, however, that this is a one-way solution, as Python’s DOM implementation cannot generate SAX events from a DOM tree.

You can use `xml.dom.pulldom` to build a minidom from `lxml`:

```python
>>> from xml.dom.pulldom import SAX2DOM
>>> handler = SAX2DOM()
>>> lxml.sax.saxify(tree, handler)
```

Pulldom makes the result available through the `document` attribute:

```python
>>> dom = handler.document
>>> print(dom.firstChild.localName)
a
```
Chapter 21

The public C-API of lxml.etree

As of version 1.1, lxml.etree provides a public C-API. This allows external C extensions to efficiently access public functions and classes of lxml, without going through the Python API.

The API is described in the file etreepublic.pxd, which is directly c-importable by extension modules implemented in Pyrex or Cython.

Writing external modules in Cython

This is the easiest way of extending lxml at the C level. A Cython (or Pyrex) module should start like this:

```cython
# My Cython extension

cimport etreepublic as cetree

cdef object etree
from lxml import etree

cetree.import_lxml__etree()
```

From this line on, you can access all public functions of lxml.etree from the cetree namespace like this:

```cython
py_tag = cetree.namespacedNameFromNsName("http://some/url", "myelement")
```

Public lxml classes are easily subclassed. For example, to implement and set a new default element class, you can write Cython code like the following:

```cython
from etreepublic cimport ElementBase
cdef class NewElementClass(ElementBase):
    def set_value(self, myval):
        self.set("my_attribute", myval)

etree.set_element_class_lookup(
    etree.DefaultElementClassLookup(element=NewElementClass))
```
Writing external modules in C

If you really feel like it, you can also interface with lxml.etree straight from C code. All you have to do is include the header file for the public API, import the lxml.etree module and then call the import function:

```c
/* My C extension */

/* common includes */
#include "Python.h"
#include "stdio.h"
#include "string.h"
#include "stdarg.h"
#include "libxml/xmlversion.h"
#include "libxml/encoding.h"
#include "libxml/hash.h"
#include "libxml/tree.h"
#include "libxml/xmlIO.h"
#include "libxml/xmlsave.h"
#include "libxml/globals.h"
#include "libxml/xmlstring.h"

/* lxml.etree specific includes */
#include "lxml-version.h"
#include "etree_defs.h"
#include "etree.h"

/* setup code */
import_lxml__etree()
```

Note that including etree.h does not automatically include the header files it requires. Note also that the above list of common includes may not be sufficient.
Part IV

Developing lxml
Chapter 22

How to build lxml from source

To build lxml from source, you need libxml2 and libxslt properly installed, *including the header files*. These are likely shipped in separate `-dev` or `-devel` packages like `libxml2-dev`, which you must install before trying to build lxml.

**Cython**

The lxml.etree and lxml.objectify modules are written in Cython. Since we distribute the Cython-generated `.c` files with lxml releases, however, you do not need Cython to build lxml from the normal release sources. We even encourage you to *not install Cython* for a normal release build, as the generated C code can vary quite heavily between Cython versions, which may or may not generate correct code for lxml. The pre-generated release sources were tested and therefore are known to work.

So, if you want a reliable build of lxml, we suggest to a) use a source release of lxml and b) disable or uninstall Cython for the build.

*Only* if you are interested in building lxml from a checkout of the developer sources (e.g. to test a bug fix that has not been release yet) or if you want to be an lxml developer, then you do need a working Cython installation. You can use `pip` to install it:

```
pip install -r requirements.txt
```

https://github.com/lxml/lxml/blob/master/requirements.txt

lxml currently requires at least Cython 0.20, later release versions should work as well.

**Github, git and hg**

The lxml package is developed in a repository on Github using Mercurial and the `hg-git` plugin. You can retrieve the current developer version using:

```
hg clone git://github.com/lxml/lxml.git lxml
```

This will create a directory `lxml` and download the source into it, including the complete development history. Don’t be afraid, the download is fairly quick. You can also browse the lxml repository through the web.
Building the sources

Clone the source repository as described above (or download the source tar-ball and unpack it) and then type:

    python setup.py build

or:

    python setup.py bdist_egg  # requires 'setuptools' or 'distribute'

To (re-)build the C sources with Cython, you must additionally pass the option --with-cython:

    python setup.py build --with-cython

If you want to test lxml from the source directory, it is better to build it in-place like this:

    python setup.py build_ext -i --with-cython

or, in Unix-like environments:

    make inplace

To speed up the build in test environments (e.g. on a continuous integration server), set the CFLAGS environment variable to disable C compiler optimisations (e.g. “-O0” for gcc, that’s minus-oh-zero), for example:

    CFLAGS="-O0" make inplace

If you get errors about missing header files (e.g. Python.h or libxml/xmlversion.h) then you need to make sure the development packages of Python, libxml2 and libxslt are properly installed. On Linux distributions, they are usually called something like libxml2-dev or libxslt-devel. If these packages were installed in non-standard places, try passing the following option to setup.py to make sure the right config is found:

    python setup.py build --with-xslt-config=/path/to/xslt-config

If this doesn’t help, you may have to add the location of the header files to the include path like:

    python setup.py build_ext -i -I /usr/include/libxml2

where the file is in /usr/include/libxml2/libxml/xmlversion.h

To use lxml.etree in-place, you can place lxml’s src directory on your Python module search path (PYTHONPATH) and then import lxml.etree to play with it:

    # cd lxml
    # PYTHONPATH=src python
    Python 2.7.2
    Type "help", "copyright", "credits" or "license" for more information.
    >>> from lxml import etree
    >>>

To make sure everything gets recompiled cleanly after changes, you can run make clean or delete the file src/lxml/etree.c.

Running the tests and reporting errors

The source distribution (tgz) and the source repository contain a test suite for lxml. You can run it from the top-level directory:

    python test.py
Note that the test script only tests the in-place build (see distutils building above), as it searches the src directory. You can use the following one-step command to trigger an in-place build and test it:

```
make test
```

This also runs the ElementTree and cElementTree compatibility tests. To call them separately, make sure you have lxml on your PYTHONPATH first, then run:

```
python selftest.py
```

and:

```
python selftest2.py
```

If the tests give failures, errors, or worse, segmentation faults, we’d really like to know. Please contact us on the mailing list, and please specify the version of lxml, libxml2, libxslt and Python you were using, as well as your operating system type (Linux, Windows, MacOS-X, ...).

**Building an egg or wheel**

This is the procedure to make an lxml egg or wheel for your platform. It assumes that you have setuptools or distribute installed, as well as the wheel package.

First, download the lxml-x.y.tar.gz release. This contains the pregenerated C files so that you can be sure you build exactly from the release sources. Unpack them and cd into the resulting directory. Then, to build a wheel, simply run the command

```
python setup.py bdist_wheel
```

or, to build a statically linked wheel with all of libxml2, libxslt and friends compiled in, run

```
python setup.py bdist_wheel --static-deps
```

The resulting .whl file will be written into the dist directory.

To build an egg file, run

```
python setup.py build_egg
```

If you are on a Unix-like platform, you can first build the extension modules using

```
python setup.py build
```

and then cd into the directory build/lib.your.platform to call strip on any .so file you find there. This reduces the size of the binary distribution considerably. Then, from the package root directory, call

```
python setup.py bdist_egg
```

This will quickly package the pre-built packages into an egg file and drop it into the dist directory.

**Building lxml on MacOS-X**

Apple regularly ships new system releases with horribly outdated system libraries. This is specifically the case for libxml2 and libxslt, where the system provided versions used to be too old to even build lxml for a long time.

While the Unix environment in MacOS-X makes it relatively easy to install Unix/Linux style package management tools and new software, it actually seems to be hard to get libraries set up for exclusive usage that MacOS-X ships
in an older version. Alternative distributions (like macports) install their libraries in addition to the system libraries, but the compiler and the runtime loader on MacOS still sees the system libraries before the new libraries. This can lead to undebuggable crashes where the newer library seems to be loaded but the older system library is used.

Apple discourages static building against libraries, which would help working around this problem. Apple does not ship static library binaries with its system and several package management systems follow this decision. Therefore, building static binaries requires building the dependencies first. The setup.py script does this automatically when you call it like this:

```
python setup.py build --static-deps
```

This will download and build the latest versions of libxml2 and libxslt from the official FTP download site. If you want to use specific versions, or want to prevent any online access, you can download both tar.gz release files yourself, place them into a subdirectory libs in the lxml distribution, and call setup.py with the desired target versions like this:

```
python setup.py build --static-deps --libxml2-version=2.9.1 --libxslt-version=1.1.28
```

```
sudo python setup.py install
```

Instead of build, you can use any target, like bdist_egg if you want to use setuptools to build an installable egg, or bdist_wheel for a wheel package.

Note that this also works with pip. Since you can’t pass command line options in this case, you have to use an environment variable instead:

```
STATIC_DEPS=true pip install lxml
```

To install the package into the system Python package directory, run the installation with “sudo”:

```
STATIC_DEPS=true sudo pip install lxml
```

The STATICBUILD environment variable is handled equivalently to the STATIC_DEPS variable, but is used by some other extension packages, too.

If you decide to do a non-static build, you may also have to install the command line tools in addition to the XCode build environment. They are available as a restricted download from here:

```
```

Without them, the compiler may not find the necessary header files of the XML libraries, according to the second comment in this ticket:

```
https://bugs.launchpad.net/lxml/+bug/1244094
```

---

**Static linking on Windows**

Most operating systems have proper package management that makes installing current versions of libxml2 and libxslt easy. The most famous exception is Microsoft Windows, which entirely lacks these capabilities. To work around the limits of this platform, lxml’s installation can download pre-built packages of the dependencies and build statically against them. Assuming you have a proper C compiler setup to build Python extensions, this should work:

```
python setup.py bdist_wininst --static-deps
```

It should create a windows installer in the pkg directory.
Building Debian packages from SVN sources

**Andreas Pakulat** proposed the following approach.

- `apt-get source lxml`
- remove the unpacked directory
- tar.gz the lxml SVN version and replace the orig.tar.gz that lies in the directory
- check md5sum of created tar.gz file and place new sum and size in dsc file
- `do dpkg-source -x lxml-{VERSION}.dsc` and cd into the newly created directory
- `run dch -i` and add a comment like “use trunk version”, this will increase the debian version number so apt/dpkg won’t get confused
- `run dpkg-buildpackage -rfakeroot -us -uc` to build the package

In case `dpkg-buildpackage` tells you that some dependencies are missing, you can either install them manually or run `apt-get build-dep lxml`.

That will give you .deb packages in the parent directory which can be installed using `dpkg -i`. 
Chapter 23

How to read the source of lxml

Author: Stefan Behnel

This document describes how to read the source code of lxml and how to start working on it. You might also be interested in the companion document that describes how to build lxml from sources.

What is Cython?

Cython is the language that lxml is written in. It is a very Python-like language that was specifically designed for writing Python extension modules.

The reason why Cython (or actually its predecessor Pyrex at the time) was chosen as an implementation language for lxml, is that it makes it very easy to interface with both the Python world and external C code. Cython generates all the necessary glue code for the Python API, including Python types, calling conventions and reference counting. On the other side of the table, calling into C code is not more than declaring the signature of the function and maybe some variables as being C types, pointers or structs, and then calling it. The rest of the code is just plain Python code.

The Cython language is so close to Python that the Cython compiler can actually compile many, many Python programs to C without major modifications. But the real speed gains of a C compilation come from type annotations that were added to the language and that allow Cython to generate very efficient C code.

Even if you are not familiar with Cython, you should keep in mind that a slow implementation of a feature is better than none. So, if you want to contribute and have an idea what code you want to write, feel free to start with a pure Python implementation. Chances are, if you get the change officially accepted and integrated, others will take the time to optimise it so that it runs fast in Cython.

Where to start?

First of all, read how to build lxml from sources to learn how to retrieve the source code from the Subversion repository and how to build it. The source code lives in the subdirectory src of the checkout.

The main extension modules in lxml are lxml.etree and lxml.objectify. All main modules have the file extension .pyx, which shows the descendence from Pyrex. As usual in Python, the main files start with a short description and a couple of imports. Cython distinguishes between the run-time import statement (as known from Python) and the compile-time cimport statement, which imports C declarations, either from external libraries or from other Cython modules.
Concepts

lxml’s tree API is based on proxy objects. That means, every Element object (or rather _Element object) is a proxy for a libxml2 node structure. The class declaration is (mainly):

```python
cdef class _Element:
    cdef _Document _doc
    cdef xmlNode* _c_node
```

It is a naming convention that C variables and C level class members that are passed into libxml2 start with a prefixed c_ (commonly libxml2 struct pointers), and that C level class members are prefixed with an underscore. So you will often see names like c_doc for an xmlDoc* variable (or c_node for an xmlNode*), or the above _c_node for a class member that points to an xmlNode struct (or _c_doc for an xmlDoc*).

It is important to know that every proxy in lxml has a factory function that properly sets up C level members. Proxy objects must never be instantiated outside of that factory. For example, to instantiate an _Element object or its subclasses, you must always call its factory function:

```python
    cdef xmlNode* c_node
cdef _Document doc
cdef _Element element
...
    element = _elementFactory(doc, c_node)
```

A good place to see how this factory is used are the Element methods getparent(), getnext() and getprevious().

The documentation

An important part of lxml is the documentation that lives in the doc directory. It describes a large part of the API and comprises a lot of example code in the form of doctests.

The documentation is written in the ReStructured Text format, a very powerful text markup language that looks almost like plain text. It is part of the docutils package.

The project web site of lxml is completely generated from these text documents. Even the side menu is just collected from the table of contents that the ReST processor writes into each HTML page. Obviously, we use lxml for this.

The easiest way to generate the HTML pages is by calling:

```bash
    make html
```

This will call the script doc/mkhtml.py to run the ReST processor on the files. After generating an HTML page the script parses it back in to build the side menu, and injects the complete menu into each page at the very end.

Running the make command will also generate the API documentation if you have epydoc installed. The epydoc package will import and introspect the extension modules and also introspect and parse the Python modules of lxml. The aggregated information will then be written out into an HTML documentation site.

lxml.etree

The main module, lxml.etree, is in the file lxml.etree.pyx. It implements the main functions and types of the ElementTree API, as well as all the factory functions for proxies. It is the best place to start if you want to find out how a specific feature is implemented.
At the very end of the file, it contains a series of `include` statements that merge the rest of the implementation into the generated C code. Yes, you read right: no importing, no source file namespace, just plain good old include and a huge C code result of more than 100,000 lines that we throw right into the C compiler.

The main include files are:

- **apihelpers.pxi** Private C helper functions. Except for the factory functions, most of the little functions that are used all over the place are defined here. This includes things like reading out the text content of a libxml2 tree node, checking input from the API level, creating a new Element node or handling attribute values. If you want to work on the lxml code, you should keep these functions in the back of your head, as they will definitely make your life easier.

- **classlookup.pxi** Element class lookup mechanisms. The main API and engines for those who want to define custom Element classes and inject them into lxml.

- **docloader.pxi** Support for custom document loaders. Base class and registry for custom document resolvers.

- **extensions.pxi** Infrastructure for extension functions in XPath/XSLT, including XPath value conversion and function registration.

- **iterparse.pxi** Incremental XML parsing. An iterator class that builds iterparse events while parsing.

- **nsclasses.pxi** Namespace implementation and registry. The registry and engine for Element classes that use the ElementNamespaceClassLookup scheme.

- **parser.pxi** Parsers for XML and HTML. This is the main parser engine. It’s the reason why you can parse a document from various sources in two lines of Python code. It’s definitely not the right place to start reading lxml’s source code.

- **parsertarget.pxi** An ElementTree compatible parser target implementation based on the SAX2 interface of libxml2.

- **proxy.pxi** Very low-level functions for memory allocation/deallocation and Element proxy handling. Ignoring this for the beginning will safe your head from exploding.

- **public-api.pxi** The set of C functions that are exported to other extension modules at the C level. For example, `lxml.objectify` makes use of these. See the C-level API documentation.

- **readonlytree.pxi** A separate read-only implementation of the Element API. This is used in places where non-intrusive access to a tree is required, such as the PythonElementClassLookup or XSLT extension elements.

- **saxparser.pxi** SAX-like parser interfaces as known from ElementTree’s TreeBuilder.

- **serializer.pxi** XML output functions. Basically everything that creates byte sequences from XML trees.

- **xinclude.pxi** XInclude support.

- **xmlerror.pxi** Error log handling. All error messages that libxml2 generates internally walk through the code in this file to end up in lxml’s Python level error logs.

  At the end of the file, you will find a long list of named error codes. It is generated from the libxml2 HTML documentation (using lxml, of course). See the script `update-error-constants.py` for this.

- **xmlid.pxi** XMLID and IDDict, a dictionary-like way to find Elements by their XML-ID attribute.

- **xpath.pxi** XPath evaluators.

- **xslt.pxi** XSL transformations, including the XSLT class, document lookup handling and access control.

The different schema languages (DTD, RelaxNG, XML Schema and Schematron) are implemented in the follow-
ing include files:

- dtd.pxi
- relaxng.pxi
- schematron.pxi
- xmlschema.pxi

**Python modules**

The *lxml* package also contains a number of pure Python modules:

**builder.py**  The E-factory and the ElementBuilder class. These provide a simple interface to XML tree generation.

**cssselect.py**  A CSS selector implementation based on XPath. The main class is called CSSSelector.

**doctestcompare.py**  A relaxed comparison scheme for XML/HTML markup in doctest.

**ElementInclude.py**  XInclude-like document inclusion, compatible with ElementTree.

**_elementpath.py**  XPath-like path language, compatible with ElementTree.

**sax.py**  SAX2 compatible interfaces to copy lxml trees from/to SAX compatible tools.

**usedoctest.py**  Wrapper module for doctestcompare.py that simplifies its usage from inside a doctest.

**lxml.objectify**

A Cython implemented extension module that uses the public C-API of lxml.etree. It provides a Python object-like interface to XML trees. The implementation resides in the file *lxml.objectify.pyx*.

**lxml.html**

A specialised toolkit for HTML handling, based on lxml.etree. This is implemented in pure Python.
Chapter 24

Credits

Main contributors

Stefan Behnel  main developer and maintainer
Martijn Faassen  creator of lxml and initial main developer
Ian Bicking  creator and maintainer of lxml.html
Holger Joukl  ISO-Schematron support, development on lxml.objectify, bug reports, feedback
Simon Sapin  external maintenance and development of the cssselect package
Marc-Antoine Parent  XPath extension function help and patches
Olivier Grisel  improved (c)ElementTree compatibility patches, website improvements.
Kasimier Buchcik  help with specs and libxml2
Florian Wagner  help with copy.deepcopy support, bug reporting
Emil Kroymann  help with encoding support, bug reporting
Paul Everitt  bug reporting, feedback on API design
Victor Ng  Discussions on memory management strategies, vlibxml2
Robert Kern  feedback on API design
Andreas Pakulat  rpath linking support, doc improvements
David Sankel  building statically on Windows
Marcin Kasperski  PDF documentation generation
Sidnei da Silva  official MS Windows builds
Pascal Oberndörfer  official Mac-OS builds

... and lots of other people who contributed to lxml by reporting bugs, discussing its functionality or blaming the docs for the bugs in their code. Thank you all, user feedback and discussions form a very important part of an Open Source project!
Special thanks goes to:

- Daniel Veillard and the libxml2 project for a great XML library.
- Fredrik Lundh for ElementTree, its API, and the competition through cElementTree.
- Greg Ewing (Pyrex) and Robert Bradshaw et al. (Cython) for the binding technology.
- Jonathan Stoppani for hosting the new mailing list on lxml.de.
- the codespeak crew, in particular Philipp von Weitershausen and Holger Krekel for originally hosting lxml on codespeak.net
Appendix A

Changes

3.4.4 (2015-04-25)

Bugs fixed

- An ElementTree compatibility test added in lxml 3.4.3 that failed in Python 3.4+ was removed again.

3.4.3 (2015-04-15)

Bugs fixed

- Expression cache in ElementPath was ignored. Fix by Changaco.
- LP#1426868: Passing a default namespace and a prefixed namespace mapping as nsmap into xmlfile.element() raised a TypeError.
- LP#1421927: DOCTYPE system URLs were incorrectly quoted when containing double quotes. Patch by Olli Pottonen.
- LP#1419354: meta-redirect URLs were incorrectly processed by iterlinks() if preceded by whitespace.

3.4.2 (2015-02-07)

Bugs fixed

- LP#1415907: Crash when creating an XMLSchema from a non-root element of an XML document.
- LP#1369362: HTML cleaning failed when hitting processing instructions with pseudo-attributes.
- CDATA() wrapped content was rejected for tail text.
- CDATA sections were not serialised as tail text of the top-level element.
3.4.1 (2014-11-20)

Features added

- New htmlfile HTML generator to accompany the incremental xmlfile serialisation API. Patch by Burak Arslan.

Bugs fixed

- lxml.sax.ElementTreeContentHandler did not initialise its superclass.

3.4.0 (2014-09-10)

Features added

- xmlfile(buffered=False) disables output buffering and flushes the content after each API operation (starting/ending element blocks or writes). A new method xf.flush() can alternatively be used to explicitly flush the output.

- lxml.html.document_fromstring has a new option ensure_head_body=True which will add an empty head and/or body element to the result document if missing.

- lxml.html.iterlinks now returns links inside meta refresh tags.

- New XMLParser option collect_ids=False to disable ID hash table creation. This can substantially speed up parsing of documents with many different IDs that are not used.

- The parser uses per-document hash tables for XML IDs. This reduces the load of the global parser dict and speeds up parsing for documents with many different IDs.

- ElementTree.getelementpath(element) returns a structural ElementPath expression for the given element, which can be used for lookups later.

- xmlfile() accepts a new argument close=True to close file(-like) objects after writing to them. Before, xmlfile() only closed the file if it had opened it internally.

- Allow “bytearray” type for ASCII text input.

Bugs fixed

Other changes

- LP#400588: decoding errors have become hard errors even in recovery mode. Previously, they could lead to an internal tree representation in a mixed encoding state, which lead to very late errors or even silently incorrect behaviour during tree traversal or serialisation.

- Requires Python 2.6, 2.7, 3.2 or later. No longer supports Python 2.4, 2.5 and 3.1, use lxml 3.3.x for those.

- Requires libxml2 2.7.0 or later and libxslt 1.1.23 or later, use lxml 3.3.x with older versions.
3.3.6 (2014-08-28)

Bugs fixed

- Prevent tree cycle creation when adding Elements as siblings.
- LP#1361948: crash when deallocating Element siblings without parent.
- LP#1354652: crash when traversing internally loaded documents in XSLT extension functions.

3.3.5 (2014-04-18)

Bugs fixed

- HTML cleaning could fail to strip javascript links that mix control characters into the link scheme.

3.3.4 (2014-04-03)

Features added

- Source line numbers above 65535 are available on Elements when using libxml2 2.9 or later.

Bugs fixed

- lxml.html.fragment_fromstring() failed for bytes input in Py3.

Other changes

3.3.3 (2014-03-04)

Bugs fixed

- LP#1287118: Crash when using Element subtypes with __slots__.

Other changes

- The internal classes _LogEntry and _Attrib can no longer be subclassed from Python code.
3.3.2 (2014-02-26)

Bugs fixed

- The properties resolvers and version, as well as the methods `set_element_class_lookup()` and `makeelement()`, were lost from `iterparse` objects in 3.3.0.
- LP#1222132: instances of XMLSchema, Schematron and RelaxNG did not clear their local `error_log` before running a validation.
- LP#1238500: `lxml.doctestcompare` mixed up “expected” and “actual” in attribute values.
- Some file I/O tests were failing in MS-Windows due to non-portable temp file usage. Initial patch by Gabi Davar.
- LP#910014: duplicate IDs in a document were not reported by DTD validation.
- LP#1185332: `tostring(method="html")` did not use HTML serialisation semantics for trailing tail text. Initial patch by Sylvain Viollon.
- LP#1281139: `.attrib` value of Comments lost its mutation methods in 3.3.0. Even though it is empty and immutable, it should still provide the same interface as that returned for Elements.

3.3.1 (2014-02-12)

Features added

Bugs fixed

- LP#1014290: HTML documents parsed with `parser.feed()` failed to find elements during tag iteration.
- LP#1273709: Building in PyPy failed due to missing support for `PyUnicode_Compare()` and `PyByteArray_*()` in PyPy’s C-API.
- LP#1274413: Compilation in MSVC failed due to missing “stdint.h” standard header file.
- LP#1274118: `iterparse()` failed to parse BOM prefixed files.

Other changes

3.3.0 (2014-01-26)

Features added

Bugs fixed

- The heuristic that distinguishes file paths from URLs was tightened to produce less false negatives.
Other changes

3.3.0beta5 (2014-01-18)

Features added

- The PEP 393 unicode parsing support gained a fallback for wchar strings which might still be somewhat common on Windows systems.

Bugs fixed

- Several error handling problems were fixed throughout the code base that could previously lead to exceptions being silently swallowed or not properly reported.
- The C-API function appendChild() is now deprecated as it does not propagate exceptions (its return type is void). The new function appendChildToElement() was added as a safe replacement.
- Passing a string into fromstringlist() raises an exception instead of parsing the string character by character.

Other changes

- Document cleanup code was simplified using the new GC features in Cython 0.20.

3.3.0beta4 (2014-01-12)

Features added

Bugs fixed

- The (empty) value returned by the attrib property of Entity and Comment objects was mutable.
- Element class lookup wasn’t available for the new pull parsers or when using a custom parser target.
- Setting Element attributes on instantiation with both the attrib argument and keyword arguments could modify the mapping passed as attrib.
- LP#1266171: DTDs instantiated from internal/external subsets (i.e. through the docinfo property) lost their attribute declarations.

Other changes

- Built with Cython 0.20pre (gitrev 012ae82eb) to prepare support for Python 3.4.
3.3.0beta3 (2014-01-02)

Features added

- Unicode string parsing was optimised for Python 3.3 (PEP 393).

Bugs fixed

- HTML parsing of Unicode strings could misdecode the input on some platforms.
- Crash in xmlfile() when closing open elements out of order in an error case.

Other changes

3.3.0beta2 (2013-12-20)

Features added

- `iterparse()` supports the `recover` option.

Bugs fixed

- Crash in `iterparse()` for HTML parsing.
- Crash in target parsing with attributes.

Other changes

- The safety check in the read-only tree implementation (e.g. used by `PythonElementClassLookup`) raises a more appropriate `ReferenceError` for illegal access after tree disposal instead of an `AssertionError`. This should only impact test code that specifically checks the original behaviour.

3.3.0beta1 (2013-12-12)

Features added

- New option `handle_failures` in `make_links_absolute()` and `resolve_base_href()` (lxml.html) that enables ignoring or discarding links that fail to parse as URLs.
- New parser classes `XMLPullParser` and `HTMLPullParser` for incremental parsing, as implemented for `ElementTree` in Python 3.4.
- `iterparse()` enables recovery mode by default for HTML parsing (html=True).
Bugs fixed

- LP#1255132: crash when trying to run validation over non-Element (e.g. comment or PI).
- Error messages in the log and in exception messages that originated from libxml2 could accidentally be picked up from preceding warnings instead of the actual error.
- The ElementMaker in lxml.objectify did not accept a dict as argument for adding attributes to the element it’s building. This works as in lxml.builder now.
- LP#1228881: repr(XSLTAccessControl) failed in Python 3.
- Raise ValueError when trying to append an Element to itself or to one of its own descendants, instead of running into an infinite loop.
- LP#1206077: htmldiff discarded whitespace from the output.
- Compressed plain-text serialisation to file-like objects was broken.
- lxml.html.formfill: Fix textarea form filling. The textarea used to be cleared before the new content was set, which removed the name attribute.

Other changes

- Some basic API classes use freelists internally for faster instantiation. This can speed up some iterparse() scenarios, for example.
  - iterparse() was rewritten to use the new *PullParser classes internally instead of being a parser itself.

3.2.5 (2014-01-02)

Features added

Bugs fixed

- Crash in xmlfile() when closing open elements out of order in an error case.
- Crash in target parsing with attributes.
- LP#1255132: crash when trying to run validation over non-Element (e.g. comment or PI).

Other changes

3.2.4 (2013-11-07)

Features added

Bugs fixed

- Memory leak when creating an XPath evaluator in a thread.
3.2.1 (2013-05-11)

- LP#1228881: `repr(XSLTAccessControl)` failed in Python 3.
- Raise `ValueError` when trying to append an `Element` to itself or to one of its own descendants.
- LP#1206077: htmldiff discarded whitespace from the output.
- Compressed plain-text serialisation to file-like objects was broken.

Other changes

3.2.3 (2013-07-28)

Bugs fixed

- Fix support for Python 2.4 which was lost in 3.2.2.

3.2.2 (2013-07-28)

Features added

Bugs fixed

- LP#1185701: spurious XMLSyntaxError after finishing `iterparse()`.
- Crash in lxml.objectify during xsi annotation.

Other changes

- Return values of user provided element class lookup methods are now validated against the type of the XML node they represent to prevent API class mismatches.

3.2.1 (2013-05-11)

Features added

- The methods `apply_templates()` and `process_children()` of XSLT extension elements have gained two new boolean options `elements_only` and `remove_blank_text` that discard either all strings or whitespace-only strings from the result list.

Bugs fixed

- When moving Elements to another tree, the namespace cleanup mechanism no longer drops namespace prefixes from attributes for which it finds a default namespace declaration, to prevent them from appearing as unnamespaced attributes after serialisation.
- Returning non-type objects from a custom class lookup method could lead to a crash.
• Instantiating and using subtypes of Comments and ProcessingInstructions crashed.

Other changes

3.2.0 (2013-04-28)

Features added

Bugs fixed

• LP#690319: Leading whitespace could change the behaviour of the string parsing functions in lxml.html.
• LP#599318: The string parsing functions in lxml.html are more robust in the face of uncommon HTML content like framesets or missing body tags. Patch by Stefan Seelmann.
• LP#712941: I/O errors while trying to access files with paths that contain non-ASCII characters could raise UnicodeDecodeError instead of properly reporting the IOError.
• LP#673205: Parsing from in-memory strings disabled network access in the default parser and made subsequent attempts to parse from a URL fail.
• LP#971754: lxml.html.clean appends ’nofollow’ to ’rel’ attributes instead of overwriting the current value.
• LP#715687: lxml.html.clean no longer discards scripts that are explicitly allowed by the user provided whitelist. Patch by Christine Koppelt.

Other changes

3.1.2 (2013-04-12)

Features added

Bugs fixed

• LP#1136509: Passing attributes through the namespace-unaware API of the sax bridge (i.e. the handler.startElement() method) failed with a TypeError. Patch by Mike Bayer.
• LP#1123074: Fix serialisation error in XSLT output when converting the result tree to a Unicode string.
• GH#105: Replace illegal usage of xmlBufLength() in libxml2 2.9.0 by properly exported API function xmlBufUse().
3.1beta1 (2012-12-21)

Other changes

3.1.1 (2013-03-29)

Features added

Bugs fixed

- LP#1160386: Write access to lxml.html.FormElement.fields raised an AttributeError in Py3.
- Illegal memory access during cleanup in incremental xmlfile writer.

Other changes

- The externally useless class lxml.etree._BaseParser was removed from the module dict.

3.1.0 (2013-02-10)

Features added

- GH#89: lxml.html.clean allows overriding the set of attributes that it considers 'safe'. Patch by Francis Devereux.

Bugs fixed

- LP#1104370: copy.copy(el.attrib) raised an exception. It now returns a copy of the attributes as a plain Python dict.
- GH#95: When used with namespace prefixes, the el.find*() methods always used the first namespace mapping that was provided for each path expression instead of using the one that was actually passed in for the current run.
- LP#1092521, GH#91: Fix undefined C symbol in Python runtimes compiled without threading support. Patch by Ulrich Seidl.

Other changes

3.1beta1 (2012-12-21)

Features added

- New build-time option --with-unicode-strings for Python 2 that makes the API always return Unicode strings for names and text instead of byte strings for plain ASCII content.
- New incremental XML file writing API etree.xmlfile().
E factory in lxml.objectify is callable to simplify the creation of tags with non-identifier names without having to resort to getattr().

Bugs fixed

- When starting from a non-namespaced element in lxml.objectify, searching for a child without explicitly specifying a namespace incorrectly found namespaced elements with the requested local name, instead of restricting the search to non-namespaced children.
- GH#85: Deprecation warnings were fixed for Python 3.x.
- GH#33: lxml.html.fromstring() failed to accept bytes input in Py3.
- LP#1080792: Static build of libxml2 2.9.0 failed due to missing file.

Other changes

- The externally useless class _ObjectifyElementMakerCaller was removed from the module API of lxml.objectify.
- LP#1075622: lxml.builder is faster for adding text to elements with many children. Patch by Anders Hammarquist.

3.0.2 (2012-12-14)

Features added

Bugs fixed

- Fix crash during interpreter shutdown by switching to Cython 0.17.3 for building.

Other changes

3.0.1 (2012-10-14)

Features added

Bugs fixed

- LP#1065924: Element proxies could disappear during garbage collection in PyPy without proper cleanup.
- GH#71: Failure to work with libxml2 2.6.x.
- LP#1065139: static MacOS-X build failed in Py3.
Other changes

3.0 (2012-10-08)

Features added

Bugs fixed

- End-of-file handling was incorrect in iterparse() when reading from a low-level C file stream and failed in libxml2 2.9.0 due to its improved consistency checks.

Other changes

- The build no longer uses Cython by default unless the generated C files are missing. To use Cython, pass the option "--with-cython". To ignore the fatal build error when Cython is required but not available (e.g. to run special setup.py commands that do not actually run a build), pass "--without-cython".

3.0beta1 (2012-09-26)

Features added

- Python level access to (optional) libxml2 memory debugging features to simplify debugging of memory leaks etc.

Bugs fixed

- Fix a memory leak in XPath by switching to Cython 0.17.1.
- Some tests were adapted to work with PyPy.

Other changes

- The code was adapted to work with the upcoming libxml2 2.9.0 release.

3.0alpha2 (2012-08-23)

Features added

- The .iter() method of elements now accepts tag arguments like "{*}name" to search for elements with a given local name in any namespace. With this addition, all combinations of wildcards now work as expected: "{ns}name", "{}name", "{*}name", "{ns}*", "(*)" and "{(*)}". Note that "name" is equivalent to "{}name", but "*" is "{(*)}". The same change applies to the .getiterator(), .itersiblings(), .iterancestors(), .iterchildren() and .itertext() methods; the strip_attributes(), strip_elements() and strip_tags() functions as well as the iterparse() class. Patch by Simon Sapin.
• C14N allows specifying the inclusive prefixes to be promoted to top-level during exclusive serialisation.

Bugs fixed

• Passing long Unicode strings into the feed() parser interface failed to read the entire string.

Other changes

3.0alpha1 (2012-07-31)

Features added

• Initial support for building in PyPy (through cpyext).
• DTD objects gained an API that allows read access to their declarations.
• xpathgrep.py gained support for parsing line-by-line (e.g. from grep output) and for surrounding the output with a new root tag.
• E-factory in lxml.builder accepts subtypes of known data types (such as string subtypes) when building elements around them.
• Tree iteration and iterparse() with a selective tag argument supports passing a set of tags. Tree nodes will be returned by the iterators if they match any of the tags.

Bugs fixed

• The .find*() methods in lxml.objectify no longer use XPath internally, which makes them faster in many cases (especially when short circuiting after a single or couple of elements) and fixes some behavioural differences compared to lxml.etree. Note that this means that they no longer support arbitrary XPath expressions but only the subset that the ElementPath language supports. The previous implementation was also redundant with the normal XPath support, which can be used as a replacement.
• el.find('*) could accidentally return a comment or processing instruction that happened to be in the wrong spot. (Same for the other .find*() methods.)
• The error logging is less intrusive and avoids a global setup where possible.
• Fixed undefined names in html5lib parser.
• xpathgrep.py did not work in Python 3.
• Element.attrib.update() did not accept an attrib of another Element as parameter.
• For subtypes of ElementBase that make the .text or .tail properties immutable (as in objectify, for example), inserting text when creating Elements through the E-Factory feature of the class constructor would fail with an exception, stating that the text cannot be modified.

Other changes

• The code base was overhauled to properly use `const` where the API of libxml2 and libxslt requests it. This also has an impact on the public C-API of lxml itself, as defined in etreepublic.pxd, as well as the
provided declarations in the `lxml/includes/` directory. Code that uses these declarations may have to be adapted. On the plus side, this fixes several C compiler warnings, also for user code, thus making it easier to spot real problems again.

- The functionality of “lxml.cssselect” was moved into a separate PyPI package called “cssselect”. To continue using it, you must install that package separately. The “lxml.cssselect” module is still available and provides the same interface, provided the “cssselect” package can be imported at runtime.

- Element attributes passed in as an `attrib` dict or as keyword arguments are now sorted by (namespaced) name before being created to make their order predictable for serialisation and iteration. Note that adding or deleting attributes afterwards does not take that order into account, i.e. setting a new attribute appends it after the existing ones.

- Several classes that are for internal use only were removed from the `lxml.etree` module dict: `_InputDocument`, `_ResolverRegistry`, `_ResolverContext`, `_BaseContext`, `_ExsltRegExp`, `_IterparseContext`, `_TempStore`, `_ExceptionContext`, `_ContentOnlyElement`, `_AttribIterator`, `_NamespaceRegistry`, `_ClassNamespaceRegistry`, `_FunctionNamespaceRegistry`, `_XPathFunctionNamespaceRegistry`, `_ParserDictionaryContext`, `_FileReaderContext`, `_ParserContext`, `_PythonSaxParserTarget`, `_TargetParserContext`, `_ReadOnlyProxy`, `_ReadOnlyPIProxy`, `_ReadOnlyEntityProxy`, `_ReadOnlyElementProxy`, `_OpaqueNodeWrapper`, `_OpaqueDocumentWrapper`, `_ModifyContentOnlyPIProxy`, `_ModifyContentOnlyEntityProxy`, `_AppendOnlyElementProxy`, `_SaxParserContext`, `_FilelikeWriter`, `_ParserSchemaValidationContext`, `_XPathContext`, `_XSLTResolverContext`, `_XSLTContext`, `_XSLTQuotedStringParam`


### 2.3.6 (2012-09-28)

**Features added**

**Bugs fixed**

- Passing long Unicode strings into the `feed()` parser interface failed to read the entire string.

**Other changes**

### 2.3.5 (2012-07-31)

**Features added**

**Bugs fixed**

- Crash when merging text nodes in `element.remove()`. 
2.3.2 (2011-11-11)

- Crash in sax/target parser when reporting empty doctype.

Other changes

2.3.4 (2012-03-26)

Features added

Bugs fixed

- Crash when building an nsmap (Element property) with empty namespace URIs.
- Crash due to race condition when errors (or user messages) occur during threaded XSLT processing.
- XSLT stylesheet compilation could ignore compilation errors.

Other changes

2.3.3 (2012-01-04)

Features added

- lxml.html.tostring() gained new serialisation options with_tail and doctype.

Bugs fixed

- Fixed a crash when using iterparse() for HTML parsing and requesting start events.
- Fixed parsing of more selectors in cssselect. Whitespace before pseudo-elements and pseudo-classes is significant as it is a descendant combinator. “E :pseudo” should parse the same as “E *:pseudo”, not “E:pseudo”. Patch by Simon Sapin.
- lxml.html.diff no longer raises an exception when hitting ’img’ tags without ’src’ attribute.

Other changes

2.3.2 (2011-11-11)

Features added

- lxml.objectify.deannotate() has a new boolean option cleanup_namespaces to remove the objectify namespace declarations (and generally clean up the namespace declarations) after removing the type annotations.
- lxml.objectify gained its own SubElement() function as a copy of etree.SubElement to avoid an otherwise redundant import of lxml.etree on the user side.
Bugs fixed

- Fixed the “descendant” bug in cssselect a second time (after a first fix in lxml 2.3.1). The previous change resulted in a serious performance regression for the XPath based evaluation of the translated expression. Note that this breaks the usage of some of the generated XPath expressions as XSLT location paths that previously worked in 2.3.1.

- Fixed parsing of some selectors in cssselect. Whitespace after combinators “>”, “+” and “~” is now correctly ignored. Previously is was parsed as a descendant combinator. For example, “div> .foo” was parsed the same as “div>* .foo” instead of “div>.foo”. Patch by Simon Sapin.

Other changes

2.3.1 (2011-09-25)

Features added

- New option `kill_tags` in `lxml.html.clean` to remove specific tags and their content (i.e. their whole subtree).

- `pi.get()` and `pi.attrib` on processing instructions to parse pseudo-attributes from the text content of processing instructions.

- `lxml.get_include()` returns a list of include paths that can be used to compile external C code against lxml.etree. This is specifically required for statically linked lxml builds when code needs to compile against the exact same header file versions as lxml itself.

- `Resolver.resolve_file()` takes an additional option `close_file` that configures if the file(-like) object will be closed after reading or not. By default, the file will be closed, as the user is not expected to keep a reference to it.

Bugs fixed

- HTML cleaning didn’t remove ’data:` links.

- The html5lib parser integration now uses the ‘official’ implementation in html5lib itself, which makes it work with newer releases of the library.

- In `lxml.sax`, `endElementNS()` could incorrectly reject a plain tag name when the corresponding start event inferred the same plain tag name to be in the default namespace.

- When an open file-like object is passed into `parse()` or `iterparse()`, the parser will no longer close it after use. This reverts a change in lxml 2.3 where all files would be closed. It is the users responsibility to properly close the file(-like) object, also in error cases.

- Assertion error in `lxml.html.cleaner` when discarding top-level elements.

- In lxml.cssselect, use the xpath ’A/B’ (short for ’A/descendant-or-self::node()/B’) instead of ’A/descendant::B’ for the css descendant selector (’A B’). This makes a few edge cases like "div +:last-child" consistent with the selector behavior in WebKit and Firefox, and makes more css expressions valid location paths (for use in xsl:template match).

- In lxml.html, non-selected `<option>` tags no longer show up in the collected form values.
- Adding/removing `<option>` values to/from a multiple select form field properly selects them and unselects them.

**Other changes**

- Static builds can specify the download directory with the `--download-dir` option.

### 2.3 (2011-02-06)

**Features added**

- When looking for children, `lxml.objectify` takes `{}tag` as meaning an empty namespace, as opposed to the parent namespace.

**Bugs fixed**

- When finished reading from a file-like object, the parser immediately calls its `.close()` method.
- When finished parsing, `iterparse()` immediately closes the input file.
- Work-around for libxml2 bug that can leave the HTML parser in a non-functional state after parsing a severely broken document (fixed in libxml2 2.7.8).
- The `marque` tag in HTML cleanup code is correctly named `marquee`.

**Other changes**

- Some public functions in the Cython-level C-API have more explicit return types.
Other changes

2.3alpha2 (2010-07-24)

Features added

Bugs fixed

- Crash in XSLT when generating text-only result documents with a stylesheet created in a different thread.

Other changes

- `repr()` of Element objects shows the hex ID with leading 0x (following ElementTree 1.3).

2.3alpha1 (2010-06-19)

Features added

- Keyword argument `namespaces` in `lxml.cssselect.CSSSelector()` to pass a prefix-to-namespace mapping for the selector.
- New function `lxml.etree.register_namespace(prefix, uri)` that globally registers a namespace prefix for a namespace that newly created Elements in that namespace will use automatically. Follows ElementTree 1.3.
- Support `unicode` string name as encoding parameter in `tostring()`, following ElementTree 1.3.
- Support `c14n` serialisation method in `ElementTree.write()` and `tostring()`, following ElementTree 1.3.
- The ElementPath expression syntax (`el.find*()` was extended to match the upcoming ElementTree 1.3 that will ship in the standard library of Python 3.2/2.7. This includes extended support for predicates as well as namespace prefixes (as known from XPath).
- During regular XPath evaluation, various ESXLT functions are available within their namespace when using libxslt 1.1.26 or later.
- Support passing a readily configured logger instance into `PyErrorLog`, instead of a logger name.
- On serialisation, the new `doctype` parameter can be used to override the DOCTYPE (internal subset) of the document.
- New parameter `output_parent` to `XSLTErrExtension.apply_templates()` to append the resulting content directly to an output element.
- `XSLTErrExtension.process_children()` to process the content of the XSLT extension element itself.
- ISO-Schematron support based on the de-facto Schematron reference 'skeleton implementation'.
- XSLT objects now take XPath object as `__call__` stylesheet parameters.
- Enable path caching in ElementPath (`el.find*()` to avoid parsing overhead.
• Setting the value of a namespaced attribute always uses a prefixed namespace instead of the default names-

• XSLT extension elements: support for XSLT context nodes other than elements: document root, comments,

• Support for strings (in addition to Elements) in node-sets returned by extension functions.

• Forms that lack an action attribute default to the base URL of the document on submit.

• XPath attribute result strings have an attrname property.

• Namespace URIs get validated against RFC 3986 at the API level (required by the XML namespace speci-

• Target parsers show their target object in the .target property (compatible with ElementTree).

Bugs fixed

• API is hardened against invalid proxy instances to prevent crashes due to incorrectly instantiated Element

• Prevent crash when instantiating CommentBase and friends.

• Export ElementTree compatible XML parser class as XMLTreeBuilder, as it is called in ET 1.2.

• ObjectifiedDataElements in lxml.objectify were not hashable. They now use the hash value of the underly-

• Parsing broken fragments in lxml.html could fail if the fragment contained an orphaned closing '</div>'
tag.

• Using XSLT extension elements around the root of the output document crashed.

• lxml.cssselect did not distinguish between x[attr="val"] and x [attr="val"] (with a space). The latter now matches the attribute independent of the element.

• Rewriting multiple links inside of HTML text content could end up replacing unrelated content as replacements could impact the reported position of subsequent matches. Modifications are now simplified by letting the iterlinks() generator in lxml.html return links in reversed order if they appear inside the same text node. Thus, replacements and link-internal modifications no longer change the position of links reported afterwards.

• The .value attribute of textarea elements in lxml.html did not represent the complete raw value (in-

• Target parser didn’t call .close() on the target object if parsing failed. Now it is guaranteed that

Other changes

• Official support for Python 3.1.2 and later.

• Static MS Windows builds can now download their dependencies themselves.

• Element.attrib no longer uses a cyclic reference back to its Element object. It therefore no longer
2.2.5 (2010-02-28)

Features added

- Support for running XSLT extension elements on the input root node (e.g. in a template matching on “/”).

Bugs fixed

- Crash in XPath evaluation when reading smart strings from a document other than the original context document.
- Support recent versions of html5lib by not requiring its XHTMLParser in htmlparser.py anymore.
- Manually instantiating the custom element classes in lxml.objectify could crash.
- Invalid XML text characters were not rejected by the API when they appeared in unicode strings directly after non-ASCII characters.
- lxml.html.open_http_urllib() did not work in Python 3.

2.2.8 (2010-09-02)

Bugs fixed

- Crash in newer libxml2 versions when moving elements between documents that had attributes on replaced XInclude nodes.
- Import fix for urljoin in Python 3.1+.

2.2.7 (2010-07-24)

Bugs fixed

- Crash in XSLT when generating text-only result documents with a stylesheet created in a different thread.

2.2.6 (2010-03-02)

Bugs fixed

- Fixed several Python 3 regressions by building with Cython 0.11.3.

2.2.5 (2010-02-28)

Features added

- Support for running XSLT extension elements on the input root node (e.g. in a template matching on “/”).

Bugs fixed

- Crash in XPath evaluation when reading smart strings from a document other than the original context document.
- Support recent versions of html5lib by not requiring its XHTMLParser in htmlparser.py anymore.
- Manually instantiating the custom element classes in lxml.objectify could crash.
- Invalid XML text characters were not rejected by the API when they appeared in unicode strings directly after non-ASCII characters.
- lxml.html.open_http_urllib() did not work in Python 3.
2.2.3 (2009-10-30)

- The functions `strip_tags()` and `strip_elements()` in `lxml.etree` did not remove all occurrences of a tag in all cases.
- Crash in XSLT extension elements when the XSLT context node is not an element.

2.2.4 (2009-11-11)

Bugs fixed

- Static build of libxml2/libxslt was broken.

2.2.3 (2009-10-30)

Features added

Bugs fixed

- The `resolve_entities` option did not work in the incremental feed parser.
- Looking up and deleting attributes without a namespace could hit a namespaced attribute of the same name instead.
- Late errors during calls to `SubElement()` (e.g. attribute related ones) could leave a partially initialised element in the tree.
- Modifying trees that contain parsed entity references could result in an infinite loop.
- `ObjectifiedElement.__setattr__` created an empty-string child element when the attribute value was rejected as a non-unicode/non-ascii string
- Syntax errors in `lxml.cssselect` could result in misleading error messages.
- Invalid syntax in CSS expressions could lead to an infinite loop in the parser of `lxml.cssselect`.
- CSS special character escapes were not properly handled in `lxml.cssselect`.
- CSS Unicode escapes were not properly decoded in `lxml.cssselect`.
- Select options in HTML forms that had no explicit `value` attribute were not handled correctly. The HTML standard dictates that their value is defined by their text content. This is now supported by `lxml.html`.
- XPath raised a TypeError when finding CDATA sections. This is now fully supported.
- Calling `help(lxml.objectify)` didn’t work at the prompt.
- The `ElementMaker` in `lxml.objectify` no longer defines the default namespaces when annotation is disabled.
- Feed parser failed to honour the ‘recover’ option on parse errors.
- Diverting the error logging to Python’s logging system was broken.
Other changes

2.2.2 (2009-06-21)

Features added

- New helper functions `strip_attributes()`, `strip_elements()`, `strip_tags()` in `lxml.etree` to remove attributes/subtrees/tags from a subtree.

Bugs fixed

- Namespace cleanup on subtree insertions could result in missing namespace declarations (and potentially crashes) if the element defining a namespace was deleted and the namespace was not used by the top element of the inserted subtree but only in deeper subtrees.

- Raising an exception from a parser target callback didn’t always terminate the parser.

- Only `{true, false, 1, 0}` are accepted as the lexical representation for `BoolElement` ({`True, False, T, F, t, f`} not any more), restoring `lxml <= 2.0` behaviour.

Other changes

2.2.1 (2009-06-02)

Features added

- Injecting default attributes into a document during XML Schema validation (also at parse time).

- Pass `huge_tree` parser option to disable parser security restrictions imposed by `libxml2 2.7`.

Bugs fixed

- The script for statically building `libxml2` and `libxslt` didn’t work in Py3.

- `XMLSchema()` also passes invalid schema documents on to `libxml2` for parsing (which could lead to a crash before release 2.6.24).

Other changes

2.2 (2009-03-21)

Features added

- Support for `standalone` flag in XML declaration through `tree.docinfo.standalone` and by passing `standalone=True/False` on serialisation.
Bugs fixed

- Crash when parsing an XML Schema with external imports from a filename.

2.2beta4 (2009-02-27)

Features added

- Support strings and instantiable Element classes as child arguments to the constructor of custom Element classes.
- GZip compression support for serialisation to files and file-like objects.

Bugs fixed

- Deep-copying an ElementTree copied neither its sibling PIs and comments nor its internal/external DTD subsets.
- Soupparser failed on broken attributes without values.
- Crash in XSLT when overwriting an already defined attribute using xsl:attribute.
- Crash bug in exception handling code under Python 3. This was due to a problem in Cython, not lxml itself.
- lxml.html.FormElement._name() failed for non top-level forms.
- TAG special attribute in constructor of custom Element classes was evaluated incorrectly.

Other changes

- Official support for Python 3.0.1.
- Element.findtext() now returns an empty string instead of None for Elements without text content.

2.2beta3 (2009-02-17)

Features added

- XSLT.strparam() class method to wrap quoted string parameters that require escaping.

Bugs fixed

- Memory leak in XPath evaluators.
- Crash when parsing indented XML in one thread and merging it with other documents parsed in another thread.
- Setting the base attribute in lxml.objectify from a unicode string failed.
• Fixes following changes in Python 3.0.1.
• Minor fixes for Python 3.

Other changes

• The global error log (which is copied into the exception log) is now local to a thread, which fixes some race conditions.
• More robust error handling on serialisation.

2.2beta2 (2009-01-25)

Bugs fixed

• Potential memory leak on exception handling. This was due to a problem in Cython, not lxml itself.
• iter_links (and related link-rewriting functions) in lxml.html would interpret CSS like url("link") incorrectly (treating the quotation marks as part of the link).
• Failing import on systems that have an io module.

2.1.5 (2009-01-06)

Bugs fixed

• Potential memory leak on exception handling. This was due to a problem in Cython, not lxml itself.
• Failing import on systems that have an io module.

2.2beta1 (2008-12-12)

Features added

• Allow lxml.html.diff.htmldiff to accept Element objects, not just HTML strings.

Bugs fixed

• Crash when using an XPath evaluator in multiple threads.
• Fixed missing whitespace before Link:... in lxml.html.diff.

Other changes

• Export lxml.html.parse.
2.1.4 (2008-12-12)

Bugs fixed

- Crash when using an XPath evaluator in multiple threads.

2.0.11 (2008-12-12)

Bugs fixed

- Crash when using an XPath evaluator in multiple threads.

2.2alpha1 (2008-11-23)

Features added

- Support for XSLT result tree fragments in XPath/XSLT extension functions.
- QName objects have new properties `namespace` and `localname`.
- New options for exclusive C14N and C14N without comments.
- Instantiating a custom Element classes creates a new Element.

Bugs fixed

- XSLT didn’t inherit the parse options of the input document.
- 0-bytes could slip through the API when used inside of Unicode strings.
- With `lxml.html.clean.autolink`, links with balanced parenthesis, that end in a parenthesis, will be linked in their entirety (typical with Wikipedia links).

Other changes

2.1.3 (2008-11-17)

Features added

Bugs fixed

- Ref-count leaks when lxml enters a try-except statement while an outside exception lives in sys.exc_*(). This was due to a problem in Cython, not lxml itself.
- Parser Unicode decoding errors could get swallowed by other exceptions.
- Name/import errors in some Python modules.
- Internal DTD subsets that did not specify a system or public ID were not serialised and did not appear in the docinfo property of ElementTrees.
- Fix a pre-Py3k warning when parsing from a gzip file in Py2.6.
- Test suite fixes for libxml2 2.7.
- Resolver.resolve_string() did not work for non-ASCII byte strings.
- Resolver.resolve_file() was broken.
- Overriding the parser encoding didn’t work for many encodings.

Other changes

2.0.10 (2008-11-17)

Bugs fixed

- Ref-count leaks when lxml enters a try-except statement while an outside exception lives in sys.exc_*(). This was due to a problem in Cython, not lxml itself.

2.1.2 (2008-09-05)

Features added

- lxml.etree now tries to find the absolute path name of files when parsing from a file-like object. This helps custom resolvers when resolving relative URLs, as libxml2 can prepend them with the path of the source document.

Bugs fixed

- Memory problem when passing documents between threads.
- Target parser did not honour the recover option and raised an exception instead of calling close() on the target.

Other changes

2.0.9 (2008-09-05)

Bugs fixed

- Memory problem when passing documents between threads.
- Target parser did not honour the recover option and raised an exception instead of calling close() on the target.
2.1.1 (2008-07-24)

Features added

Bugs fixed

- Crash when parsing XSLT stylesheets in a thread and using them in another.
- Encoding problem when including text with ElementInclude under Python 3.

Other changes

2.0.8 (2008-07-24)

Features added

- `lxml.html.rewrite_links()` strips links to work around documents with whitespace in URL attributes.

Bugs fixed

- Crash when parsing XSLT stylesheets in a thread and using them in another.
- CSS selector parser dropped remaining expression after a function with parameters.

Other changes

2.1 (2008-07-09)

Features added

- Smart strings can be switched off in XPath (`smart_strings` keyword option).
- `lxml.html.rewrite_links()` strips links to work around documents with whitespace in URL attributes.

Bugs fixed

- Custom resolvers were not used for XMLSchema includes/imports and XInclude processing.
- CSS selector parser dropped remaining expression after a function with parameters.

Other changes

- `objectify.enableRecursiveStr()` was removed, use `objectify.enable_recursive_str()` instead
• Speed-up when running XSLTs on documents from other threads

2.0.7 (2008-06-20)

Features added

• Pickling ElementTree objects in lxml.objectify.

Bugs fixed

• Descending dot-separated classes in CSS selectors were not resolved correctly.
• ElementTree.parse() didn’t handle target parser result.
• Potential threading problem in XInclude.
• Crash in Element class lookup classes when the __init__() method of the super class is not called from Python subclasses.

Other changes

• Non-ASCII characters in attribute values are no longer escaped on serialisation.

2.1beta3 (2008-06-19)

Features added

• Major overhaul of tools/xpathgrep.py script.
• Pickling ElementTree objects in lxml.objectify.
• Support for parsing from file-like objects that return unicode strings.
• New function etree.cleanup_namespaces(el) that removes unused namespace declarations from a (sub)tree (experimental).
• XSLT results support the buffer protocol in Python 3.
• Polymorphic functions in lxml.html that accept either a tree or a parsable string will return either a UTF-8 encoded byte string, a unicode string or a tree, based on the type of the input. Previously, the result was always a byte string or a tree.
• Support for Python 2.6 and 3.0 beta.
• File name handling now uses a heuristic to convert between byte strings (usually filenames) and unicode strings (usually URLs).
• Parsing from a plain file object frees the GIL under Python 2.x.
• Running iterparse() on a plain file (or filename) frees the GIL on reading under Python 2.x.
• Conversion functions html_to_xhtml() and xhtml_to_html() in lxml.html (experimental).
• Most features in lxml.html work for XHTML namespaced tag names (experimental).

Bugs fixed

• ElementTree.parse() didn’t handle target parser result.
• Crash in Element class lookup classes when the __init__() method of the super class is not called from Python subclasses.
• A number of problems related to unicode/byte string conversion of filenames and error messages were fixed.
• Building on MacOS-X now passes the “flat_namespace” option to the C compiler, which reportedly prevents build quirks and crashes on this platform.
• Windows build was broken.
• Rare crash when serialising to a file object with certain encodings.

Other changes

• Non-ASCII characters in attribute values are no longer escaped on serialisation.
• Passing non-ASCII byte strings or invalid unicode strings as .tag, namespaces, etc. will result in a ValueError instead of an AssertionError (just like the tag well-formedness check).
• Up to several times faster attribute access (i.e. tree traversal) in lxml.objectify.

2.0.6 (2008-05-31)

Features added

Bugs fixed

• Incorrect evaluation of el.find("tag[child]").
• Windows build was broken.
• Moving a subtree from a document created in one thread into a document of another thread could crash when the rest of the source document is deleted while the subtree is still in use.
• Rare crash when serialising to a file object with certain encodings.

Other changes

• lxml should now build without problems on MacOS-X.
2.1beta2 (2008-05-02)

Features added

- All parse functions in lxml.html take a `parser` keyword argument.
- lxml.html has a new parser class `XHTMLParser` and a module attribute `xhtml_parser` that provide XML parsers that are pre-configured for the lxml.html package.

Bugs fixed

- Moving a subtree from a document created in one thread into a document of another thread could crash when the rest of the source document is deleted while the subtree is still in use.
- Passing an `nsmap` when creating an Element will no longer strip redundantly defined namespace URIs. This prevented the definition of more than one prefix for a namespace on the same Element.

Other changes

- If the default namespace is redundantly defined with a prefix on the same Element, the prefix will now be preferred for subelements and attributes. This allows users to work around a problem in libxml2 where attributes from the default namespace could serialise without a prefix even when they appear on an Element with a different namespace (i.e. they would end up in the wrong namespace).

2.0.5 (2008-05-01)

Features added

Bugs fixed

- Resolving to a filename in custom resolvers didn’t work.
- lxml did not honour libxslt’s second error state “STOPPED”, which let some XSLT errors pass silently.
- Memory leak in Schematron with libxml2 >= 2.6.31.

Other changes

2.1beta1 (2008-04-15)

Features added

- Error logging in Schematron (requires libxml2 2.6.32 or later).
- Parser option `strip_cdata` for normalising or keeping CDATA sections. Defaults to `True` as before, thus replacing CDATA sections by their text content.
- `CDATA()` factory to wrap string content as CDATA section.
Bugs fixed

- Resolving to a filename in custom resolvers didn’t work.
- lxml did not honour libxslt’s second error state “STOPPED”, which let some XSLT errors pass silently.
- Memory leak in Schematron with libxml2 >= 2.6.31.
- lxml.etree accepted non well-formed namespace prefix names.

Other changes

- Major cleanup in internal moveNodeToDocument() function, which takes care of namespace cleanup when moving elements between different namespace contexts.
- New Elements created through the makeelement() method of an HTML parser or through lxml.html now end up in a new HTML document (doctype HTML 4.01 Transitional) instead of a generic XML document. This mostly impacts the serialisation and the availability of a DTD context.

2.0.4 (2008-04-13)

Features added

Bugs fixed

- Hanging thread in conjunction with GTK threading.
- Crash bug in iterparse when moving elements into other documents.
- HTML elements’ .cssselect() method was broken.
- ElementTree.find*() didn’t accept QName objects.

Other changes

2.1alpha1 (2008-03-27)

Features added

- New event types ‘comment’ and ‘pi’ in iterparse().
- XSLTAccessControl instances have a property options that returns a dict of access configuration options.
- Constant instances DENY_ALL and DENY_WRITE on XSLTAccessControl class.
- Extension elements for XSLT (experimental!)
- Element .base property returns the xml:base or HTML base URL of an Element.
- docinfo.URL property is writable.
Bugs fixed

- Default encoding for plain text serialisation was different from that of XML serialisation (UTF-8 instead of ASCII).

Other changes

- Minor API speed-ups.
- The benchmark suite now uses tail text in the trees, which makes the absolute numbers incomparable to previous results.
- Generating the HTML documentation now requires Pygments, which is used to enable syntax highlighting for the doctest examples.

Most long-time deprecated functions and methods were removed:

  - etree.clearErrorLog(), use etree.clear_error_log()
  - etree.useGlobalPythonLog(), use etree.use_global_python_log()
  - etree.ElementClassLookup.setFallback(), use etree.ElementClassLookup.set_fallback()
  - etree.getDefaultParser(), use etree.get_default_parser()
  - etree.set_DefaultParser(), use etree.set_default_parser()
  - etree.setElementClassLookup(), use etree.set_element_class_lookup()

Note that parser.setElementClassLookup() has not been removed yet, although parser.set_element_class_lookup() should be used instead.

  - xpath_evaluator.registerNamespace(), use xpath_evaluator.register_namespace()
  - xpath_evaluator.registerNamespaces(), use xpath_evaluator.register_namespaces()
  - objectify.setPytypeAttributeTag, use objectify.set_pytype_attribute_tag
  - objectify.set_DefaultParser(), use objectify.set_default_parser()

2.0.3 (2008-03-26)

Features added

- soupparser.parse() allows passing keyword arguments on to BeautifulSoup.
- fromstring() method in lxml.html.soupparser.

Bugs fixed

- lxml.html.diff didn’t treat empty tags properly (e.g., <br>).
- Handle entity replacements correctly in target parser.
- Crash when using iterparse() with XML Schema validation.
• The BeautifulSoup parser (soupparser.py) did not replace entities, which made them turn up in text content.

• Attribute assignment of custom PyTypes in objectify could fail to correctly serialise the value to a string.

Other changes

• lxml.html.ElementSoup was replaced by a new module lxml.html.soupparser with a more consistent API. The old module remains for compatibility with ElementTree’s own ElementSoup module.

• Setting the XSLT_CONFIG and XML2_CONFIG environment variables at build time will let setup.py pick up the xml2-config and xslt-config scripts from the supplied path name.

• Passing --with-xml2-config=/path/to/xml2-config to setup.py will override the xml2-config script that is used to determine the C compiler options. The same applies for the --with-xslt-config option.

2.0.2 (2008-02-22)

Features added

• Support passing base_url to file parser functions to override the filename of the file(-like) object.

Bugs fixed

• The prefix for objectify’s pytype namespace was missing from the set of default prefixes.

• Memory leak in Schematron (fixed only for libxml2 2.6.31+).

• Error type names in RelaxNG were reported incorrectly.

• Slice deletion bug fixed in objectify.

Other changes

• Enabled doctests for some Python modules (especially lxml.html).

• Add a method argument to lxml.html.tostring() (method="xml" for XHTML output).

• Make it clearer that methods like lxml.html.fromstring() take a base_url argument.

2.0.1 (2008-02-13)

Features added

• Child iteration in lxml.pyclasslookup.

• Loads of new docstrings reflect the signature of functions and methods to make them visible in API docs and help()
Bugs fixed

- The module `lxml.html.builder` was duplicated as `lxml.htmlbuilder`.
- Form elements would return None for `form.fields.keys()` if there was an unnamed input field. Now unnamed input fields are completely ignored.
- Setting an element slice in objectify could insert slice-overlapping elements at the wrong position.

Other changes

- The generated API documentation was cleaned up and disburdened from non-public classes etc.
- The previously public module `lxml.html.setmixin` was renamed to `lxml.html._setmixin` as it is not an official part of lxml. If you want to use it, feel free to copy it over to your own source base.
- Passing `--with-xslt-config=/path/to/xslt-config` to setup.py will override the `xslt-config` script that is used to determine the C compiler options.

2.0 (2008-02-01)

Features added

- Passing the `unicode` type as `encoding` to `tostring()` will serialise to unicode. The `tounicode()` function is now deprecated.
- `XMLSchema()` and `RelaxNG()` can parse from `StringIO`.
- `makeparser()` function in `lxml.objectify` to create a new parser with the usual objectify setup.
- Plain ASCII XPath string results are no longer forced into unicode objects as in 2.0beta1, but are returned as plain strings as before.
- All XPath string results are 'smart' objects that have a `getparent()` method to retrieve their parent Element.
- `with_tail` option in serialiser functions.
- More accurate exception messages in validator creation.
- Parse-time XML schema validation (`schema parser keyword`).
- XPath string results of the `text()` function and attribute selection make their Element container accessible through a `getparent()` method. As a side-effect, they are now always unicode objects (even ASCII strings).
- XSLT objects are usable in any thread - at the cost of a deep copy if they were not created in that thread.
- Invalid entity names and character references will be rejected by the `Entity()` factory.
- `entity.text` returns the textual representation of the entity, e.g. `&amp;`. 
- New properties `position` and `code` on `ParseError` exception (as in ET 1.3)
- Rich comparison of `element.attrib` proxies.
- ElementTree compatible `TreeBuilder` class.
• Use default prefixes for some common XML namespaces.

• lxml.html.clean.Cleaner now allows for a host_whitelist, and two overridable methods: allow_embedded_url(el, url) and the more general allow_element(el).

• Extended slicing of Elements as in element[1:-1:2], both in etree and in objectify.

• Resolvers can now provide a base_url keyword argument when resolving a document as string data.

• When using lxml.doctestcompare you can give the doctest option NOPARSE_MARKUP (like # doctest: +NOPARSE_MARKUP) to suppress the special checking for one test.

• Separate feed_error_log property for the feed parser interface. The normal parser interface and iterparse continue to use error_log.

• The normal parsers and the feed parser interface are now separated and can be used concurrently on the same parser instance.

• fromstringlist() and tostringlist() functions as in ElementTree 1.3

• iterparse() accepts an html boolean keyword argument for parsing with the HTML parser (note that this interface may be subject to change).

• Parsers accept an encoding keyword argument that overrides the encoding of the parsed documents.

• New C-API function hasChild() to test for children.

• annotate() function in objectify can annotate with Python types and XSI types in one step. Accompanied by xsiannotate() and pyannotate().

• ET.write(), tostring() and tounicode() now accept a keyword argument method that can be one of 'xml' (or None), 'html' or 'text' to serialise as XML, HTML or plain text content.

• iterfind() method on Elements returns an iterator equivalent to.findall()

• itertext() method on Elements

• Setting a QName object as value of the .text property or as an attribute will resolve its prefix in the respective context.

• ElementTree-like parser target interface as described in http://effbot.org/elementtree/elementtree-xmlparser.htm

• ElementTree-like feed parser interface on XMLParser and HTMLParser (feed() and close() methods)

• Reimplemented objectify.E for better performance and improved integration with objectify. Provides extended type support based on registered PyTypes.

• XSLT objects now support deep copying.

• New makeSubElement() C-API function that allows creating a new subelement straight with text, tail and attributes.

• XPath extension functions can now access the current context node (context.context_node) and use a context dictionary (context.eval_context) from the context provided in their first parameter.

• HTML tag soup parser based on BeautifulSoup in lxml.html.ElementSoup

• New module lxml.doctestcompare by Ian Bicking for writing simplified doctests based on XML/HTML output. Use by importing lxml.usedoctest or lxml.html.usedoctest from within a doctest.

• New module lxml.cssselect by Ian Bicking for selecting Elements with CSS selectors.
New package **lxml.html** written by Ian Bicking for advanced HTML treatment.

Namespace class setup is now local to the `ElementNamespaceClassLookup` instance and no longer global.

Schematron validation (incomplete in libxml2)

Additional `stringify` argument to `objectify.PyType()` takes a conversion function to strings to support setting text values from arbitrary types.

Entity support through an `Entity` factory and element classes. XML parsers now have a `resolve_entities` keyword argument that can be set to False to keep entities in the document.

`column` field on error log entries to accompany the `line` field

Error specific messages in XPath parsing and evaluation NOTE: for evaluation errors, you will now get an `XPathEvalError` instead of an `XPathSyntaxError`. To catch both, you can except on `XPathError`.

The regular expression functions in XPath now support passing a node-set instead of a string.

Extended type annotation in `objectify`: new `xsiannotate()` function.

EXSLT RegExp support in standard XPath (not only XSLT).

**Bugs fixed**

- Missing import in `lxml.html.clean`.
- Some Python 2.4-isms prevented `lxml` from building/running under Python 2.3.
- XPath on ElementTrees could crash when selecting the virtual root node of the ElementTree.
- Compilation --without-threading was buggy in alpha5/6.
- Memory leak in the `parse()` function.
- Minor bugs in XSLT error message formatting.
- Result document memory leak in target parser.
- Target parser failed to report comments.
- In the `lxml.html.iter_links` method, links in `<object>` tags weren’t recognized. (Note: plugin-specific link parameters still aren’t recognized.) Also, the `<embed>` tag, though not standard, is now included in `lxml.html.defs.special_inline_tags`.
- Using custom resolvers on XSLT stylesheets parsed from a string could request ill-formed URLs.
- With `lxml.doctestcompare` if you do `<tag xmlns="...">` in your output, it will then be namespace-neutral (before the ellipsis was treated as a real namespace).
- `AttributeError` in feed parser on parse errors
- XML feed parser setup problem
- Type annotation for unicode strings in `DataElement()`
- `lxml` failed to serialise namespace declarations of elements other than the root node of a tree
- Race condition in XSLT where the resolver context leaked between concurrent XSLT calls
• lxml.etree did not check tag/attribute names
• The XML parser did not report undefined entities as error
• The text in exceptions raised by XML parsers, validators and XPath evaluators now reports the first error that occurred instead of the last
• Passing ” as XPath namespace prefix did not raise an error
• Thread safety in XPath evaluators

Other changes

• Exceptions carry only the part of the error log that is related to the operation that caused the error.
• XMLSchema() and RelaxNG() now enforce passing the source file/filename through the file keyword argument.
• The test suite now skips most doctests under Python 2.3.
• make clean no longer removes the .c files (use make realclean instead)
• Minor performance tweaks for Element instantiation and subelement creation
• Various places in the XPath, XSLT and iteration APIs now require keyword-only arguments.
• The argument order in element.itersiblings() was changed to match the order used in all other iteration methods. The second argument (‘preceding’) is now a keyword-only argument.
• The getiterator() method on Elements and ElementTrees was reverted to return an iterator as it did in lxml 1.x. The ET API specification allows it to return either a sequence or an iterator, and it traditionally returned a sequence in ET and an iterator in lxml. However, it is now deprecated in favour of the iter() method, which should be used in new code wherever possible.
• The ‘pretty printed’ serialisation of ElementTree objects now inserts newlines at the root level between processing instructions, comments and the root tag.
• A ‘pretty printed’ serialisation is now terminated with a newline.
• Second argument to lxml.etree.Extension() helper is no longer required, third argument is now a keyword-only argument ns.
• lxml.html.tostring takes an encoding argument.
• The module source files were renamed to “lxml.*.pyx”, such as “lxml.etree.pyx”. This was changed for consistency with the way Pyrex commonly handles package imports. The main effect is that classes now know about their fully qualified class name, including the package name of their module.
• Keyword-only arguments in some API functions, especially in the parsers and serialisers.
• Tag name validation in lxml.etree (and lxml.html) now distinguishes between HTML tags and XML tags based on the parser that was used to parse or create them. HTML tags no longer reject any non-ASCII characters in tag names but only spaces and the special characters <>&/’”.
• lxml.etree now emits a warning if you use XPath with libxml2 2.6.27 (which can crash on certain XPath errors)
• Type annotation in objectify now preserves the already annotated type by default to prevent loosing type information that is already there.
• element.getiterator() returns a list, use element.iter() to retrieve an iterator (ElementTree 1.3 compatible behaviour)
• objectify.PyType for None is now called “NoneType”
• el.getiterator() renamed to el.iter(), following ElementTree 1.3 - original name is still available as alias
• In the public C-API, findOrBuildNodeNs() was replaced by the more generic findOrBuildNodeNsPrefix
• Major refactoring in XPath/XSLT extension function code
• Network access in parsers disabled by default

1.3.6 (2007-10-29)

Bugs fixed
• Backported decref crash fix from 2.0
• Well hidden free-while-in-use crash bug in ObjectPath

Other changes
• The test suites now run gc.collect() in the tearDown() methods. While this makes them take a lot longer to run, it also makes it easier to link a specific test to garbage collection problems that would otherwise appear in later tests.

1.3.5 (2007-10-22)

Features added

Bugs fixed
• lxml.etree could crash when adding more than 10000 namespaces to a document
• lxml failed to serialise namespace declarations of elements other than the root node of a tree

1.3.4 (2007-08-30)

Features added
• The ElementMaker in lxml.builder now accepts the keyword arguments namespace and nsmap to set a namespace and nsmap for the Elements it creates.
• The docinfo on ElementTree objects has new properties internalDTD and externalDTD that return a DTD object for the internal or external subset of the document respectively.
• Serialising an ElementTree now includes any internal DTD subsets that are part of the document, as well as comments and PIs that are siblings of the root node.

Bugs fixed

• Parsing with the no_network option could fail

Other changes

• lxml now raises a TagNameWarning about tag names containing ‘:’ instead of an Error as 1.3.3 did. The reason is that a number of projects currently misuse the previous lack of tag name validation to generate namespace prefixes without declaring namespaces. Apart from the danger of generating broken XML this way, it also breaks most of the namespace-aware tools in XML, including XPath, XSLT and validation. lxml 1.3.x will continue to support this bug with a Warning, while lxml 2.0 will be strict about well-formed tag names (not only regarding ‘:’).

• Serialising an Element no longer includes its comment and PI siblings (only ElementTree serialisation includes them).

1.3.3 (2007-07-26)

Features added

• ElementTree compatible parser ETCompatXMLParser strips processing instructions and comments while parsing XML

• Parsers now support stripping PIs (keyword argument ‘remove_pis’)

• etree.fromstring() now supports parsing both HTML and XML, depending on the parser you pass.

• Support base_url keyword argument in HTML() and XML()

Bugs fixed

• Parsing from Python Unicode strings failed on some platforms

• Element() did not raise an exception on tag names containing ‘:’

• Element.getiterator(tag) did not accept Comment and ProcessingInstruction as tags. It also accepts Element now.

1.3.2 (2007-07-03)

Features added

Bugs fixed

• “deallocating None” crash bug


1.3.1 (2007-07-02)

Features added

- objectify.DataElement now supports setting values from existing data elements (not just plain Python types) and reuses defined namespaces etc.
- E-factory support for lxml.objectify(objectify.E)

Bugs fixed

- Better way to prevent crashes in Element proxy cleanup code
- objectify.DataElement didn’t set up None value correctly
- objectify.DataElement didn’t check the value against the provided type hints
- Reference-counting bug in Element.attrib.pop()

1.3 (2007-06-24)

Features added

- Module lxml.pyclasslookup module implements an Element class lookup scheme that can access the entire tree in read-only mode to help determining a suitable Element class
- Parsers take a remove_comments keyword argument that skips over comments
- parse() function in objectify, corresponding to XML() etc.
- Element.addnext(el) and Element.addprevious(el) methods to support adding processing instructions and comments around the root node
- Element.attrib was missing clear() and pop() methods
- Extended type annotation in objectify: cleaner annotation namespace setup plus new deannotate() function
- Support for custom Element class instantiation in lxml.sax: passing a makeelement function to the ElementTreeContentHandler will reuse the lookup context of that function
- "." represents empty ObjectPath (identity)
- Element.values() to accompany the existing .keys() and .items()
- collectAttributes() C-function to build a list of attribute keys/values/items for a libxml2 node
- DTD validator class (like RelaxNG and XMLSchema)
- HTML generator helpers by Fredrik Lundh in lxml.htmlbuilder
- ElementMaker XML generator by Fredrik Lundh in lxml.builder.E
- Support for pickling objectify.ObjectifiedElement objects to XML
- update() method on Element.attrib
• Optimised replacement for libxml2’s `_xmlReconsiliateNs()`. This allows lxml a better handling of namespaces when moving elements between documents.

**Bugs fixed**

• Removing Elements from a tree could make them loose their namespace declarations
• `ElementInclude` didn’t honour base URL of original document
• Replacing the children slice of an Element would cut off the tails of the original children
• `Element.getiterator(tag)` did not accept `Comment` and `ProcessingInstruction` as tags
• API functions now check incoming strings for XML conformity. Zero bytes or low ASCII characters are no longer accepted (AssertionError).
• XSLT parsing failed to pass resolver context on to imported documents
• passing “” as namespace prefix in nsmap could be passed through to libxml2
• Objectify couldn’t handle prefixed XSD type names in `xsi:type`
• More ET compatible behaviour when writing out XML declarations or not
• More robust error handling in `iterparse()`
• Documents lost their top-level PIs and comments on serialisation
• lxml.sax failed on comments and PIs. Comments are now properly ignored and PIs are copied.
• Possible memory leaks in namespace handling when moving elements between documents

**Other changes**

• major restructuring in the documentation

1.2.1 (2007-02-27)

**Bugs fixed**

• Build fixes for MS compiler
• Item assignments to special names like `element["text"]` failed
• Renamed `ObjectifiedDataElement.__setText()` to `_setText()` to make it easier to access
• The pattern for attribute names in `ObjectPath` was too restrictive
1.2 (2007-02-20)

Features added

- Rich comparison of QName objects
- Support for regular expressions in benchmark selection
- get/set emulation (not .attrib!) for attributes on processing instructions
- ElementInclude Python module for ElementTree compatible XInclude processing that honours custom resolvers registered with the source document
- ElementTree.parser property holds the parser used to parse the document
- setup.py has been refactored for greater readability and flexibility
- --rpath flag to setup.py to induce automatic linking-in of dynamic library runtime search paths has been renamed to --auto-rpath. This makes it possible to pass an --rpath directly to distutils; previously this was being shadowed.

Bugs fixed

- Element instantiation now uses locks to prevent race conditions with threads
- ElementTree.write() did not raise an exception when the file was not writable
- Error handling could crash under Python <= 2.4.1 - fixed by disabling thread support in these environments
- Element.find*() did not accept QName objects as path

Other changes

- code cleanup: redundant _NodeBase super class merged into _Element class Note: although the impact should be zero in most cases, this change breaks the compatibility of the public C-API

1.1.2 (2006-10-30)

Features added

- Data elements in objectify support repr(), which is now used by dump()
- Source distribution now ships with a patched Pyrex
- New C-API function makeElement() to create new elements with text, tail, attributes and namespaces
- Reuse original parser flags for XInclude
- Simplified support for handling XSLT processing instructions
Bugs fixed

- Parser resources were not freed before the next parser run
- Open files and XML strings returned by Python resolvers were not closed/freed
- Crash in the IDDict returned by XMLDTDID
- Copying Comments and ProcessingInstructionsID failed
- Memory leak for external URLs in _XSLTProcessingInstruction.parseXSL()
- Memory leak when garbage collecting tailed root elements
- HTML script/style content was not propagated to .text
- Show text xincluded between text nodes correctly in .text and .tail
- 'integer * objectify.StringElement' operation was not supported

1.1.1 (2006-09-21)

Features added

- XSLT profiling support (profile_run keyword)
- countchildren() method on objectify.ObjectifiedElement
- Support custom elements for tree nodes in lxml.objectify

Bugs fixed

- lxml.objectify failed to support long data values (e.g., “123L”)
- Error messages from XSLT did not reach XSLT.error_log
- Factories objectify.Element() and objectify.DataElement() were missing attrib and nsmap keyword arguments
- Changing the default parser in lxml.objectify did not update the factories Element() and DataElement()
- Let lxml.objectify.Element() always generate tree elements (not data elements)
- Build under Windows failed (’0’ bug in patched Pyrex version)

1.1 (2006-09-13)

Features added

- Comments and processing instructions return ’<!-- coment -->’ and ’<?pi-target content?>’ for repr()
- Parsers are now the preferred (and default) place where element class lookup schemes should be registered. Namespace lookup is no longer supported by default.
- Support for Python 2.5 beta
- Unlock the GIL for deep copying documents and for XPath()
- New `compact` keyword argument for parsing read-only documents
- Support for parser options in `iterparse()`
- The `namespace` axis is supported in XPath and returns (prefix, URI) tuples
- The XPath expression "/" now returns an empty list instead of raising an exception
- XML-Object API on top of lxml (lxml.objectify)
- Customizable Element class lookup:
  - different pre-implemented lookup mechanisms
  - support for externally provided lookup functions
- Support for processing instructions (ET-like, not compatible)
- Public C-level API for independent extension modules
- Module level `iterwalk()` function as 'iterparse' for trees
- Module level `iterparse()` function similar to ElementTree (see documentation for differences)
- Element.nsmap property returns a mapping of all namespace prefixes known at the Element to their namespace URI
- Reentrant threading support in RelaxNG, XMLSchema and XSLT
- Threading support in parsers and serializers:
  - All in-memory operations (tostring, parse(StringIO), etc.) free the GIL
  - File operations (on file names) free the GIL
  - Reading from file-like objects frees the GIL and reacquires it for reading
  - Serialisation to file-like objects is single-threaded (high lock overhead)
- Element iteration over XPath axes:
  - Element.iterdescendants() iterates over the descendants of an element
  - Element.iterancestors() iterates over the ancestors of an element (from parent to parent)
  - Element.itersiblings() iterates over either the following or preceding siblings of an element
  - Element.iterchildren() iterates over the children of an element in either direction
  - All iterators support the `tag` keyword argument to restrict the generated elements
- Element.getnext() and Element.getprevious() return the direct siblings of an element

**Bugs fixed**

- filenames with local 8-bit encoding were not supported
- 1.1beta did not compile under Python 2.3
• ignore unknown 'pyval' attribute values in objectify
• objectify.ObjectifiedElement.addattr() failed to accept Elements and Lists
• objectify.ObjectPath.setattr() failed to accept Elements and Lists
• XPathSyntaxError now inherits from XPathError
• Threading race conditions in RelaxNG and XMLSchema
• Crash when mixing elements from XSLT results into other trees, concurrent XSLT is only allowed when the stylesheet was parsed in the main thread
• The EXSLT regexp:match function now works as defined (except for some differences in the regular expression syntax)
• Setting element.text to '' returned None on request, not the empty string
• iterparse() could crash on long XML files
• Creating documents no longer copies the parser for later URL resolving. For performance reasons, only a reference is kept. Resolver updates on the parser will now be reflected by documents that were parsed before the change. Although this should rarely become visible, it is a behavioral change from 1.0.

1.0.4 (2006-09-09)

Features added

• List-like Element.extend() method

Bugs fixed

• Crash in tail handling in Element.replace()

1.0.3 (2006-08-08)

Features added

• Element.replace(old, new) method to replace a subelement by another one

Bugs fixed

• Crash when mixing elements from XSLT results into other trees
• Copying/deepcopying did not work for ElementTree objects
• Setting an attribute to a non-string value did not raise an exception
• Element.remove() deleted the tail text from the removed Element
1.0.2 (2006-06-27)

Features added

- Support for setting a custom default Element class as opposed to namespace specific classes (which still override the default class)

Bugs fixed

- Rare exceptions in Python list functions were not handled
- Parsing accepted unicode strings with XML encoding declaration in certain cases
- Parsing 8-bit encoded strings from StringIO objects raised an exception
- Module function initThread() was removed - useless (and never worked)
- XSLT and parser exception messages include the error line number

1.0.1 (2006-06-09)

Features added

- Repeated calls to Element.attrib now efficiently return the same instance

Bugs fixed

- Document deallocation could crash in certain garbage collection scenarios
- Extension function calls in XSLT variable declarations could break the stylesheet and crash on repeated calls
- Deep copying Elements could loose namespaces declared in parents
- Deep copying Elements did not copy tail
- Parsing file(-like) objects failed to load external entities
- Parsing 8-bit strings from file(-like) objects raised an exception
- xsl:include failed when the stylesheet was parsed from a file-like object
- lxml.sax.ElementTreeProducer did not call startDocument() / endDocument()
- MSVC compiler complained about long strings (supports only 2048 bytes)
Features added

- `Element.getiterator()` and the `findall()` methods support finding arbitrary elements from a namespace (pattern `{namespace}`*)
- Another speedup in tree iteration code
- General speedup of Python Element object creation and deallocation
- Writing C14N no longer serializes in memory (reduced memory footprint)
- `PyErrorLog` for error logging through the Python `logging` module
- `Element.getroottree()` returns an `ElementTree` for the root node of the document that contains the element.
- `ElementTree.getpath(element)` returns a simple, absolute XPath expression to find the element in the tree structure
- Error logs have a `last_error` attribute for convenience
- Comment texts can be changed through the API
- Formatted output via `pretty_print` keyword in serialization functions
- XSLT can block access to file system and network via `XSLTAccessControl`
- `ElementTree.write()` no longer serializes in memory (reduced memory footprint)
- Speedup of `Element.findall(tag)` and `Element.getiterator(tag)`
- Support for writing the XML representation of Elements and ElementTrees to Python unicode strings via `etree.tounicode()`
- Support for writing XSLT results to Python unicode strings via `unicode()`
- Parsing a unicode string no longer copies the string (reduced memory footprint)
- Parsing file-like objects reads chunks rather than the whole file (reduced memory footprint)
- Parsing `StringIO` objects from the start avoids copying the string (reduced memory footprint)
- Read-only ‘docinfo’ attribute in `ElementTree` class holds DOCTYPE information, original encoding and XML version as seen by the parser
- `etree` module can be compiled without `libxslt` by commenting out the line `include "xslt.pxi"` near the end of the `etree.pyx` source file
- Better error messages in parser exceptions
- Error reporting also works in XSLT
- Support for custom document loaders (URI resolvers) in parsers and XSLT, resolvers are registered at parser level
- Implementation of `exslt:regexp` for XSLT based on the Python `re` module, enabled by default, can be switched off with `regexp=False` keyword argument
- Support for `exslt` extensions (libexslt) and `libxslt` extra functions (node-set, document, write, output)
Substantial speedup in XPath.evaluate()

HTMLParser for parsing (broken) HTML

XMLDTDID function parses XML into tuple (root node, ID dict) based on xml:id implementation of libxml2 (as opposed to ET compatible XMLID)

Bugs fixed

- Memory leak in Element.__setitem__
- Memory leak in Element.attrib.items() and Element.attrib.values()
- Memory leak in XPath extension functions
- Memory leak in unicode related setup code
- Element now raises ValueError on empty tag names
- Namespace fixing after moving elements between documents could fail if the source document was freed too early
- Setting namespace-less tag names on namespaced elements (`'ns\t' -> 't') didn’t reset the namespace
- Unknown constants from newer libxml2 versions could raise exceptions in the error handlers
- lxml.etree compiles much faster
- On libxml2 <= 2.6.22, parsing strings with encoding declaration could fail in certain cases
- Document reference in ElementTree objects was not updated when the root element was moved to a different document
- Running absolute XPath expressions on an Element now evaluates against the root tree
- Evaluating absolute XPath expressions (/*) on an ElementTree could fail
- Crashes when calling XSLT, RelaxNG, etc. with uninitialized ElementTree objects
- Removed public function initThreadLogging(), replaced by more general initThread() which fixes a number of setup problems in threads
- Memory leak when using iconv encoders in tostring/write
- Deep copying Elements and ElementTrees maintains the document information
- Serialization functions raise LookupError for unknown encodings
- Memory deallocation crash resulting from deep copying elements
- Some ElementTree methods could crash if the root node was not initialized (neither file nor element passed to the constructor)
- Element/SubElement failed to set attribute namespaces from passed attrib dictionary
- tostring() adds an XML declaration for non-ASCII encodings
- tostring() failed to serialize encodings that contain 0-bytes
- ElementTree.xpath() and XPathDocumentEvaluator were not using the ElementTree root node as reference point
• Calling `document('')` in XSLT failed to return the stylesheet

**0.9.2 (2006-05-10)**

**Features added**

- Speedup for `Element.makeelement()`: the new element reuses the original `libxml2` document instead of creating a new empty one
- Speedup for `reversed()` iteration over element children (Py2.4+ only)
- `ElementTree` compatible `QName` class
- RelaxNG and XMLSchema accept any `Element`, not only `ElementTrees`

**Bugs fixed**

- `str(xslt_result)` was broken for XSLT output other than UTF-8
- Memory leak if `write_c14n` fails to write the file after conversion
- Crash in XMLSchema and RelaxNG when passing non-schema documents
- Memory leak in RelaxNG() when RelaxNGParseError is raised

**0.9.1 (2006-03-30)**

**Features added**

- `lxml.sax.ElementTreeContentHandler` checks closing elements and raises `SaxError` on mismatch
- `lxml.sax.ElementTreeContentHandler` supports namespace-less SAX events (StartElement,EndElement) and defaults to empty attributes (keyword argument)
- Speedup for repeatedly accessing element tag names
- Minor API performance improvements

**Bugs fixed**

- Memory deallocation bug when using XSLT output method “html”
- `sax.py` was handling UTF-8 encoded tag names where it shouldn’t
- `lxml.tests` package will no longer be installed (is still in source tar)
0.9 (2006-03-20)

Features added

- Error logging API for libxml2 error messages
- Various performance improvements
- Benchmark script for lxml, ElementTree and cElementTree
- Support for registering extension functions through new FunctionNamespace class (see doc/extensions.txt)
- ETXPath class for XPath expressions in ElementTree notation (‘//{ns}tag’)
- Support for variables in XPath expressions (also in XPath class)
- XPath class for compiled XPath expressions
- XMLID module level function (ElementTree compatible)
- XMLParser API for customized libxml2 parser configuration
- Support for custom Element classes through new Namespace API (see doc/namespace_extensions.txt)
- Common exception base class LxmlError for module exceptions
- real iterator support in iter(Element), Element.getiterator()
- XSLT objects are callable, result trees support str()
- Added MANIFEST.in for easier creation of RPM files.
- ’getparent’ method on elements allows navigation to an element’s parent element.
- Python core compatible SAX tree builder and SAX event generator. See doc/sax.txt for more information.

Bugs fixed

- Segfaults and memory leaks in various API functions of Element
- Segfault in XSLT.tostring()
- ElementTree objects no longer interfere, Elements can be root of different ElementTrees at the same time
- document(“”) works in XSLT documents read from files (in-memory documents cannot support this due to libxslt deficiencies)

0.8 (2005-11-03)

Features added

- Support for copy.deepcopy() on elements. copy.copy() works also, but does the same thing, and does not create a shallow copy, as that makes no sense in the context of libxml2 trees. This means a potential incompatibility with ElementTree, but there’s more chance that it works than if copy.copy() isn’t supported at all.
• Increased compatibility with (c)ElementTree; `.parse()` on ElementTree is supported and parsing of gzipped XML files works.

• implemented index() on elements, allowing one to find the index of a SubElement.

Bugs fixed

• Use xslt-config instead of xml2-config to find out libxml2 directories to take into account a case where libxslt is installed in a different directory than libxml2.

• Eliminate crash condition in iteration when text nodes are changed.

• Passing ’None’ to tostring() does not result in a segfault anymore, but an AssertionError.

• Some test fixes for Windows.

• Raise XMLSyntaxError and XPathSyntaxError instead of plain python syntax errors. This should be less confusing.

• Fixed error with uncaught exception in Pyrex code.

• Calling lxml.etree.fromstring("") throws XMLSyntaxError instead of a segfault.

• `has_key()` works on attrib. ’in’ tests also work correctly on attrib.

• INSTALL.txt was saying 2.2.16 instead of 2.6.16 as a supported libxml2 version, as it should.

• Passing a UTF-8 encoded string to the XML() function would fail; fixed.

0.7 (2005-06-15)

Features added

• parameters (XPath expressions) can be passed to XSLT using keyword parameters.

• Simple XInclude support. Calling the xinclude() method on a tree will process any XInclude statements in the document.

• XMLSchema support. Use the XMLSchema class or the convenience xmlschema() method on a tree to do XML Schema (XSD) validation.

• Added convenience xsll() method on tree. This is less efficient than the XSLT object, but makes it easier to write quick code.

• Added convenience relaxng() method on tree. This is less efficient than the RelaxNG object, but makes it easier to write quick code.

• Make it possible to use XPathEvaluator with elements as well. The XPathEvaluator in this case will retain the element so multiple XPath queries can be made against one element efficiently. This replaces the second argument to the .evaluate() method that existed previously.

• Allow registerNamespace() to be called on an XPathEvaluator, after creation, to add additional namespaces. Also allow registerNamespaces(), which does the same for a namespace dictionary.

• Add ’prefix’ attribute to element to be able to read prefix information. This is entirely read-only.

• It is possible to supply an extra nsmap keyword parameter to the Element() and SubElement() constructors,
which supplies a prefix to namespace URI mapping. This will create namespace prefix declarations on these elements and these prefixes will show up in XML serialization.

Bugs fixed

- Killed yet another memory management related bug: trees created using newDoc would not get a libxml2-level dictionary, which caused problems when deallocating these documents later if they contained a node that came from a document with a dictionary.
- Moving namespaced elements between documents was problematic as references to the original document would remain. This has been fixed by applying xmlReconciliateNs() after each move operation.
- Can pass None to `dump()` without segfaults.
- tostring() works properly for non-root elements as well.
- Cleaned out the tostring() method so it should handle encoding correctly.
- Cleaned out the ElementTree.write() method so it should handle encoding correctly. Writing directly to a file should also be faster, as there is no need to go through a Python string in that case. Made sure the test cases test both serializing to StringIO as well as serializing to a real file.

0.6 (2005-05-14)

Features added

- Changed setup.py so that library_dirs is also guessed. This should help with compilation on the Mac OS X platform, where otherwise the wrong library (shipping with the OS) could be picked up.
- Tweaked setup.py so that it picks up the version from version.txt.

Bugs fixed

- Do the right thing when handling namespaced attributes.
- fix bug where tostring() moved nodes into new documents. tostring() had very nasty side-effects before this fix, sorry!

0.5.1 (2005-04-09)

- Python 2.2 compatibility fixes.
- unicode fixes in Element() and Comment() as well as XML(); unicode input wasn’t properly being UTF-8 encoded.

0.5 (2005-04-08)

Initial public release.
Appendix B

Generated API documentation
Package lxml

Modules

- **ElementInclude**: Limited XInclude support for the ElementTree package.  
  *(Section B, p. 251)*
- **builder**: The Element factory for generating XML documents.  
  *(Section B, p. 253)*
- **cssselect**: CSS Selectors based on XPath.  
  *(Section B, p. 277)*
- **doctestcompare**: lxml-based doctest output comparison.  
  *(Section B, p. 282)*
- **etree**: The lxml.etree module implements the extended ElementTree API for XML.  
  *(Section B, p. 286)*
- **html**: The lxml.html tool set for HTML handling.  
  *(Section B, p. 418)*
  - **ElementSoup**: Legacy interface to the BeautifulSoup HTML parser.  
    *(Section B, p. 423)*
  - **setmixin** *(Section ??, p. ??)*
  - **builder**: A set of HTML generator tags for building HTML documents.  
    *(Section B, p. 424)*
  - **clean**: A cleanup tool for HTML.  
    *(Section B, p. 427)*
  - **defs** *(Section B, p. 431)*
  - **diff** *(Section B, p. 433)*
  - **formfill** *(Section B, p. 434)*
  - **html5parser**: An interface to html5lib that mimics the lxml.html interface.  
    *(Section B, p. 436)*
  - **soupparser**: External interface to the BeautifulSoup HTML parser.  
    *(Section B, p. 439)*
  - **usedoctest**: Doctest module for HTML comparison.  
    *(Section B, p. 440)*
- **includes** *(Section B, p. 441)*
- **isoschematron**: The lxml.isoschematron package implements ISO Schematron support on top of the pure-xslt 'skeleton' implementation.  
  *(Section B, p. 442)*
- **objectify**: The lxml.objectify module implements a Python object API for XML. It is based on lxml.etree.  
  *(Section B, p. 446)*
- **pyclasslookup** *(Section B, p. 482)*
- **sax**: SAX-based adapter to copy trees from/to the Python standard library.  
  *(Section B, p. 483)*
- **usedoctest**: Doctest module for XML comparison.  
  *(Section B, p. 490)*

Functions

```
get_include()
```

Returns a list of header include paths (for lxml itself, libxml2 and libxslt) needed to compile C code against lxml if it was built with statically linked libraries.
## Variables

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>package</strong></td>
<td>Value: None</td>
</tr>
</tbody>
</table>
**Module lxml.ElementInclude**

Limited XInclude support for the ElementTree package.

While lxml.etree has full support for XInclude (see `etree.ElementTree.xinclude()`), this module provides a simpler, pure Python, ElementTree compatible implementation that supports a simple form of custom URL resolvers.

**Functions**

```python
default_loader(href, parse, encoding=None)
include(elem, loader=None, base_url=None)
```

**Variables**

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>XINCLUDE</td>
<td>Value: <code>{http://www.w3.org/2001/XInclude}</code></td>
</tr>
<tr>
<td>XINCLUDE_INCLUDE</td>
<td>Value: <code>{http://www.w3.org/2001/XInclude}include</code></td>
</tr>
<tr>
<td>XINCLUDE_FALLBACK</td>
<td>Value: <code>{http://www.w3.org/2001/XInclude}fallback</code></td>
</tr>
<tr>
<td><strong>package</strong></td>
<td>Value: <code>'lxml'</code></td>
</tr>
</tbody>
</table>

**Class FatalIncludeError**

```
object
| exceptions.BaseException
| exceptions.Exception
| lxml.etree.Error
| lxml.etree.LxmlError
object
| exceptions.BaseException
| exceptions.Exception
| exceptions.StandardError
| exceptions.SyntaxError
| lxml.etree.LxmlSyntaxError
| lxml.ElementInclude.FatalIncludeError
```
Class FatalIncludeError

Methods

**Inherited from lxml.etree.LxmlError (Section B)**

__init__()

**Inherited from exceptions.SyntaxError**

__new__(), __str__()

**Inherited from exceptions.BaseException**

__delattr__(), __getattr__(), __getitem__(), __getslice__(), __reduce__(), __repr__(),
__setattr__(), __setstate__(), __unicode__()

**Inherited from object**

__format__(), __hash__(), __reduce_ex__(), __sizeof__(), __subclasshook__()

Properties

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inherited from exceptions.SyntaxError</td>
<td></td>
</tr>
<tr>
<td>filename, lineno, msg, offset, print_file_and_line, text</td>
<td></td>
</tr>
<tr>
<td>Inherited from exceptions.BaseException</td>
<td></td>
</tr>
<tr>
<td>args, message</td>
<td></td>
</tr>
<tr>
<td>Inherited from object</td>
<td></td>
</tr>
<tr>
<td><strong>class</strong></td>
<td></td>
</tr>
</tbody>
</table>

Class Variables

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inherited from lxml.etree.LxmlSyntaxError (Section B)</td>
<td></td>
</tr>
<tr>
<td><strong>qualname</strong></td>
<td></td>
</tr>
</tbody>
</table>
Module lxml.builder

The `Element` factory for generating XML documents.

Functions

```
callable(f)
```

Variables

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>E</code></td>
<td>Value: <code>ElementMaker()</code></td>
</tr>
<tr>
<td><code>__package__</code></td>
<td>Value: <code>'lxml'</code></td>
</tr>
</tbody>
</table>

Class `str`

```
object
<__subclasses__>

basestring
str
```

**Known Subclasses:** `lxml.etree._ElementStringResult`, `lxml.html.diff.token`  

`str(object='') -> string`

Return a nice string representation of the object. If the argument is a string, the return value is the same object.

Methods

```
__add__(x, y)
```

`x+y`

```
__contains__(x, y)
```

`y in x`
Class `str`
Module `lxml.builder`

<table>
<thead>
<tr>
<th>Method</th>
<th>Definition</th>
<th>Return Value</th>
<th>Overrides</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>__eq__(x, y)</code></td>
<td><code>x==y</code></td>
<td></td>
<td></td>
</tr>
<tr>
<td><code>__format__</code>(S, format_spec)</td>
<td>Return a formatted version of S as described by format_spec.</td>
<td>Return Value string</td>
<td>object.<strong>format</strong></td>
</tr>
<tr>
<td><code>__ge__(x, y)</code></td>
<td><code>x&gt;=y</code></td>
<td></td>
<td></td>
</tr>
<tr>
<td><code>__getattribute__(...)</code></td>
<td><code>x.__getattribute__('name') &lt;==&gt; x.name</code></td>
<td>overrides: object.<strong>getattribute</strong></td>
<td></td>
</tr>
<tr>
<td><code>__getitem__(x, y)</code></td>
<td><code>x[y]</code></td>
<td></td>
<td></td>
</tr>
<tr>
<td><code>__getnewargs__(...)</code></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><code>__getslice__(x, i, j)</code></td>
<td><code>x[i:j]</code></td>
<td>Use of negative indices is not supported.</td>
<td></td>
</tr>
<tr>
<td><code>__gt__(x, y)</code></td>
<td><code>x&gt;y</code></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Class `str`

<table>
<thead>
<tr>
<th>Method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>__hash__</code>(x)</td>
<td>hash(x) Overrides: object.<strong>hash</strong></td>
</tr>
<tr>
<td><code>__le__</code>(x, y)</td>
<td>x&lt;=y</td>
</tr>
<tr>
<td><code>__len__</code>(x)</td>
<td>len(x)</td>
</tr>
<tr>
<td><code>__lt__</code>(x, y)</td>
<td>x&lt;y</td>
</tr>
<tr>
<td><code>__mod__</code>(x, y)</td>
<td>x%y</td>
</tr>
<tr>
<td><code>__mul__</code>(x, n)</td>
<td>x*n</td>
</tr>
<tr>
<td><code>__ne__</code>(x, y)</td>
<td>x!=y</td>
</tr>
</tbody>
</table>
| `__new__`(T, S, ...) | **Return Value**

- a new object with type S, a subtype of T

Overrides: object.__new__

<table>
<thead>
<tr>
<th>Method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>__repr__</code>(x)</td>
<td>repr(x) Overrides: object.<strong>repr</strong></td>
</tr>
</tbody>
</table>
### Class `str`

<table>
<thead>
<tr>
<th>Method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>__rmod__(x, y)</code></td>
<td>Returns <code>y % x</code></td>
</tr>
<tr>
<td><code>__rmul__(x, n)</code></td>
<td>Returns <code>n * x</code></td>
</tr>
<tr>
<td><code>__sizeof__(S)</code></td>
<td>Returns the size of object <code>S</code> in memory, in bytes. Overrides: <code>object.__sizeof__</code></td>
</tr>
<tr>
<td><code>__str__(x)</code></td>
<td>Returns <code>str(x)</code> Overrides: <code>object.__str__</code></td>
</tr>
<tr>
<td><code>capitalize(S)</code></td>
<td>Returns a copy of the string <code>S</code> with only its first character capitalized.</td>
</tr>
<tr>
<td><code>center(S, width, fillchar=...)</code></td>
<td>Returns <code>S</code> centered in a string of length <code>width</code>. Padding is done using the specified fill character (default is a space).</td>
</tr>
<tr>
<td><code>count(S, sub, start=..., end=...)</code></td>
<td>Returns the number of non-overlapping occurrences of substring <code>sub</code> in string <code>S[start:end]</code>. Optional arguments <code>start</code> and <code>end</code> are interpreted as in slice notation.</td>
</tr>
</tbody>
</table>
**decode**(*S, encoding=\ldots, errors=\ldots*)

Decodes *S* using the codec registered for encoding. encoding defaults to the default encoding. errors may be given to set a different error handling scheme. Default is 'strict' meaning that encoding errors raise a UnicodeDecodeError. Other possible values are 'ignore' and 'replace' as well as any other name registered with codecs.register_error that is able to handle UnicodeDecodeErrors. **Return Value**

object

**encode**(*S, encoding=\ldots, errors=\ldots*)

Encodes *S* using the codec registered for encoding. encoding defaults to the default encoding. errors may be given to set a different error handling scheme. Default is 'strict' meaning that encoding errors raise a UnicodeEncodeError. Other possible values are 'ignore', 'replace' and 'xmlcharrefreplace' as well as any other name registered with codecs.register_error that is able to handle UnicodeEncodeErrors. **Return Value**

object

**endswith**(*S, suffix, start=\ldots, end=\ldots*)

Return True if *S* ends with the specified suffix, False otherwise. With optional start, test *S* beginning at that position. With optional end, stop comparing *S* at that position. suffix can also be a tuple of strings to try. **Return Value**

bool

**expandtabs**(*S, tabsize=\ldots*)

Return a copy of *S* where all tab characters are expanded using spaces. If tabsize is not given, a tab size of 8 characters is assumed. **Return Value**

string

**find**(*S, sub, start=\ldots, end=\ldots*)

Return the lowest index in *S* where substring sub is found, such that sub is contained within *S*[start:end]. Optional arguments start and end are interpreted as in slice notation.

Return -1 on failure. **Return Value**

int
<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
<th>Return Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>format(S, *args, **kwargs)</code></td>
<td>Return a formatted version of S, using substitutions from args and kwargs. The substitutions are identified by braces ('{'} and '}').</td>
<td>string</td>
</tr>
<tr>
<td><code>index(S, sub, start=..., end=...)</code></td>
<td>Like S.find() but raise ValueError when the substring is not found.</td>
<td>int</td>
</tr>
<tr>
<td><code>isalnum(S)</code></td>
<td>Return True if all characters in S are alphanumeric and there is at least one character in S, False otherwise.</td>
<td>bool</td>
</tr>
<tr>
<td><code>isalpha(S)</code></td>
<td>Return True if all characters in S are alphabetic and there is at least one character in S, False otherwise.</td>
<td>bool</td>
</tr>
<tr>
<td><code>isdigit(S)</code></td>
<td>Return True if all characters in S are digits and there is at least one character in S, False otherwise.</td>
<td>bool</td>
</tr>
<tr>
<td><code>islower(S)</code></td>
<td>Return True if all cased characters in S are lowercase and there is at least one cased character in S, False otherwise.</td>
<td>bool</td>
</tr>
</tbody>
</table>
**isspace(S)**

Return True if all characters in S are whitespace and there is at least one character in S, False otherwise. **Return Value**

bool

**istitle(S)**

Return True if S is a titlecased string and there is at least one character in S, i.e. uppercase characters may only follow uncased characters and lowercase characters only cased ones. Return False otherwise. **Return Value**

bool

**isupper(S)**

Return True if all cased characters in S are uppercase and there is at least one cased character in S, False otherwise. **Return Value**

bool

**join(S, iterable)**

Return a string which is the concatenation of the strings in the iterable. The separator between elements is S. **Return Value**

string

**ljust(S, width, fillchar=...)**

Return S left-justified in a string of length width. Padding is done using the specified fill character (default is a space). **Return Value**

string

**lower(S)**

Return a copy of the string S converted to lowercase. **Return Value**

string
### lstrip(S, chars=...)  
Return a copy of the string S with leading whitespace removed. If chars is given and not None, remove characters in chars instead. If chars is unicode, S will be converted to unicode before stripping.  
**Return Value**
- string or unicode

### partition(S, sep)  
Search for the separator sep in S, and return the part before it, the separator itself, and the part after it. If the separator is not found, return S and two empty strings.  
**Return Value**
- (head, sep, tail)

### replace(S, old, new, count=...)  
Return a copy of string S with all occurrences of substring old replaced by new. If the optional argument count is given, only the first count occurrences are replaced.  
**Return Value**
- string

### rfind(S, sub, start=..., end=...)  
Return the highest index in S where substring sub is found, such that sub is contained within S[start:end]. Optional arguments start and end are interpreted as in slice notation.  
- Return -1 on failure.  
**Return Value**
- int

### rindex(S, sub, start=..., end=...)  
Like S.rfind() but raise ValueError when the substring is not found.  
**Return Value**
- int
<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
<th>Return Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>rjust(S, width, fillchar=...)</code></td>
<td>Return S right-justified in a string of length width. Padding is done using the specified fill character (default is a space)</td>
<td>string</td>
</tr>
<tr>
<td><code>rpartition(S, sep)</code></td>
<td>Search for the separator sep in S, starting at the end of S, and return the part before it, the separator itself, and the part after it. If the separator is not found, return two empty strings and S.</td>
<td>(head, sep, tail)</td>
</tr>
<tr>
<td><code>rsplit(S, sep=..., maxsplit=...)</code></td>
<td>Return a list of the words in the string S, using sep as the delimiter string, starting at the end of the string and working to the front. If maxsplit is given, at most maxsplit splits are done. If sep is not specified or is None, any whitespace string is a separator.</td>
<td>list of strings</td>
</tr>
<tr>
<td><code>rstrip(S, chars=...)</code></td>
<td>Return a copy of the string S with trailing whitespace removed. If chars is given and not None, remove characters in chars instead. If chars is unicode, S will be converted to unicode before stripping</td>
<td>string or unicode</td>
</tr>
<tr>
<td><code>split(S, sep=..., maxsplit=...)</code></td>
<td>Return a list of the words in the string S, using sep as the delimiter string. If maxsplit is given, at most maxsplit splits are done. If sep is not specified or is None, any whitespace string is a separator and empty strings are removed from the result.</td>
<td>list of strings</td>
</tr>
<tr>
<td>Function</td>
<td>Description</td>
<td>Return Value</td>
</tr>
<tr>
<td>-------------------</td>
<td>------------------------------------------------------------------------------</td>
<td>------------------</td>
</tr>
<tr>
<td><code>splitlines(S, keepends=False)</code></td>
<td>Return a list of the lines in S, breaking at line boundaries. Line breaks are not included in the resulting list unless keepends is given and true.</td>
<td>list of strings</td>
</tr>
<tr>
<td><code>startswith(S, prefix, start=..., end=...)</code></td>
<td>Return True if S starts with the specified prefix, False otherwise. With optional start, test S beginning at that position. With optional end, stop comparing S at that position. prefix can also be a tuple of strings to try.</td>
<td>bool</td>
</tr>
<tr>
<td><code>strip(S, chars=...)</code></td>
<td>Return a copy of the string S with leading and trailing whitespace removed. If chars is given and not None, remove characters in chars instead. If chars is unicode, S will be converted to unicode before stripping</td>
<td>string or unicode</td>
</tr>
<tr>
<td><code>swapcase(S)</code></td>
<td>Return a copy of the string S with uppercase characters converted to lowercase and vice versa.</td>
<td>string</td>
</tr>
<tr>
<td><code>title(S)</code></td>
<td>Return a titlecased version of S, i.e. words start with uppercase characters, all remaining cased characters have lowercase.</td>
<td>string</td>
</tr>
</tbody>
</table>
translate(S, table, deletechars=.)

Return a copy of the string S, where all characters occurring in the optional argument deletechars are removed, and the remaining characters have been mapped through the given translation table, which must be a string of length 256 or None. If the table argument is None, no translation is applied and the operation simply removes the characters in deletechars. **Return Value**

string

upper(S)

Return a copy of the string S converted to uppercase. **Return Value**

string

zfill(S, width)

Pad a numeric string S with zeros on the left, to fill a field of the specified width. The string S is never truncated. **Return Value**

string

**Inherited from object**

__delattr__(), __init__(), __reduce__(), __reduce_ex__(), __setattr__(), __subclasshook__()

**Properties**

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inherited from object</td>
<td></td>
</tr>
<tr>
<td><strong>class</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Class str**

```
object     ""
basestring ""
str
```

**Known Subclasses:** lxml.etree._ElementStringResult, lxml.html.diff.token

str(object='') -> string

Return a nice string representation of the object. If the argument is a string, the return value is the same object.
### Methods

<table>
<thead>
<tr>
<th>Method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>__add__</code></td>
<td>x + y</td>
</tr>
<tr>
<td><code>__contains__</code></td>
<td>y in x</td>
</tr>
<tr>
<td><code>__eq__</code></td>
<td>x == y</td>
</tr>
<tr>
<td><code>__format__</code></td>
<td>Return a formatted version of S as described by format_spec. <strong>Return Value</strong></td>
</tr>
<tr>
<td></td>
<td>string</td>
</tr>
<tr>
<td></td>
<td>Return Value: string</td>
</tr>
<tr>
<td></td>
<td>Overrides: object.<strong>format</strong></td>
</tr>
<tr>
<td><code>__ge__</code></td>
<td>x &gt;= y</td>
</tr>
<tr>
<td><code>__getattribute__</code></td>
<td>x.<strong>getattribute</strong>('name') &lt;==&gt; x.name Overrides: object.<strong>getattribute</strong></td>
</tr>
<tr>
<td><code>__getitem__</code></td>
<td>x[y]</td>
</tr>
<tr>
<td><code>__getnewargs__</code></td>
<td>..</td>
</tr>
</tbody>
</table>


The `__getslice__` method allows slicing of an object:

```python
x[i:j]
```

Use of negative indices is not supported.

The `__gt__` method compares two objects:

```python
x > y
```

The `__hash__` method returns the hash value of an object:

```python
hash(x) Overrides: object.__hash__
```

The `__le__` method checks if one object is less than or equal to another:

```python
x <= y
```

The `__len__` method returns the length of an object:

```python
len(x)
```

The `__lt__` method checks if one object is less than another:

```python
x < y
```

The `__mod__` method performs modulo operation:

```python
x % y
```

The `__mul__` method performs multiplication:

```python
x * n
```
### Class str

<table>
<thead>
<tr>
<th>Method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>__ne__(x, y)</code></td>
<td>x!=y</td>
</tr>
</tbody>
</table>
| `__new__(T, S, ...)` | **Return Value**
| | a new object with type S, a subtype of T
| | Overrides: object.__new__                                                   |
| `__repr__(x)` | repr(x) Overrides: object.__repr__                                          |
| `__rmod__(x, y)` | y%x                                                                        |
| `__rmul__(x, n)` | n*x                                                                        |
| `__sizeof__(S)` | size of object in memory, in bytes **Return Value**
| | size of S in memory, in bytes                                               |
| | Overrides: object.__sizeof__                                                |
| `__str__(x)` | str(x) Overrides: object.__str__                                            |
| `capitalize(S)` | Return a copy of the string S with only its first character capitalized. **Return Value**
| | string                                                                     |
center\((S, width, fillchar=\ldots)\)

Return \(S\) centered in a string of length \(width\). Padding is done using the specified fill character (default is a space). **Return Value**

```
string
```

count\((S, sub, start=\ldots, end=\ldots)\)

Return the number of non-overlapping occurrences of substring \(sub\) in string \(S[\text{start:end}]\). Optional arguments \(start\) and \(end\) are interpreted as in slice notation. **Return Value**

```
int
```

decode\((S, encoding=\ldots, errors=\ldots)\)

Decodes \(S\) using the codec registered for \(encoding\). \(encoding\) defaults to the default encoding. \(errors\) may be given to set a different error handling scheme. Default is 'strict' meaning that encoding errors raise a UnicodeDecodeError. Other possible values are 'ignore' and 'replace' as well as any other name registered with codecs.register_error that is able to handle UnicodeDecodeErrors. **Return Value**

```
object
```

ecode\((S, encoding=\ldots, errors=\ldots)\)

Encodes \(S\) using the codec registered for \(encoding\). \(encoding\) defaults to the default encoding. \(errors\) may be given to set a different error handling scheme. Default is 'strict' meaning that encoding errors raise a UnicodeEncodeError. Other possible values are 'ignore', 'replace' and 'xmlcharrefreplace' as well as any other name registered with codecs.register_error that is able to handle UnicodeEncodeErrors. **Return Value**

```
object
```

endswith\((S, suffix, start=\ldots, end=\ldots)\)

Return True if \(S\) ends with the specified \(suffix\), False otherwise. With optional \(start\), test \(S\) beginning at that position. With optional \(end\), stop comparing \(S\) at that position. \(suffix\) can also be a tuple of strings to try. **Return Value**

```
bool
```
**expandtabs**(*S, tabsize=...*)

Return a copy of S where all tab characters are expanded using spaces. If tabsize is not given, a tab size of 8 characters is assumed.  **Return Value**

string

**find**(*S, sub, start=..., end=...)*)

Return the lowest index in S where substring sub is found, such that sub is contained within S[start:end]. Optional arguments start and end are interpreted as in slice notation.

Return -1 on failure.  **Return Value**

int

**format**(*S, *args, **kwargs*)

Return a formatted version of S, using substitutions from args and kwargs. The substitutions are identified by braces ('{'} and '{').  **Return Value**

string

**index**(*S, sub, start=..., end=...)*)

Like S.find() but raise ValueError when the substring is not found.  **Return Value**

int

**isalnum**(*S*)

Return True if all characters in S are alphanumeric and there is at least one character in S, False otherwise.  **Return Value**

bool

**isalpha**(*S*)

Return True if all characters in S are alphabetic and there is at least one character in S, False otherwise.  **Return Value**

bool
### `isdigit(S)`

Return True if all characters in S are digits and there is at least one character in S, False otherwise. **Return Value**
- `bool`

### `islower(S)`

Return True if all cased characters in S are lowercase and there is at least one cased character in S, False otherwise. **Return Value**
- `bool`

### `isspace(S)`

Return True if all characters in S are whitespace and there is at least one character in S, False otherwise. **Return Value**
- `bool`

### `istitle(S)`

Return True if S is a titlecased string and there is at least one character in S, i.e. uppercase characters may only follow uncased characters and lowercase characters only cased ones. Return False otherwise. **Return Value**
- `bool`

### `isupper(S)`

Return True if all cased characters in S are uppercase and there is at least one cased character in S, False otherwise. **Return Value**
- `bool`

### `join(S, iterable)`

Return a string which is the concatenation of the strings in the iterable. The separator between elements is S. **Return Value**
- `string`
<table>
<thead>
<tr>
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<th>Return Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>ljust(S, width, fillchar=...)</code></td>
<td>Return S left-justified in a string of length width. Padding is done using the specified fill character (default is a space).</td>
<td>string</td>
</tr>
<tr>
<td><code>lower(S)</code></td>
<td>Return a copy of the string S converted to lowercase.</td>
<td>string</td>
</tr>
<tr>
<td><code>lstrip(S, chars=...)</code></td>
<td>Return a copy of the string S with leading whitespace removed. If chars is given and not None, remove characters in chars instead. If chars is unicode, S will be converted to unicode before stripping.</td>
<td>string or unicode</td>
</tr>
<tr>
<td><code>partition(S, sep)</code></td>
<td>Search for the separator sep in S, and return the part before it, the separator itself, and the part after it. If the separator is not found, return S and two empty strings.</td>
<td>(head, sep, tail)</td>
</tr>
<tr>
<td><code>replace(S, old, new, count=...)</code></td>
<td>Return a copy of string S with all occurrences of substring old replaced by new. If the optional argument count is given, only the first count occurrences are replaced.</td>
<td>string</td>
</tr>
<tr>
<td><code>rfind(S, sub, start=..., end=...)</code></td>
<td>Return the highest index in S where substring sub is found, such that sub is contained within S[start:end]. Optional arguments start and end are interpreted as in slice notation.</td>
<td>int</td>
</tr>
</tbody>
</table>
### rindex(S, sub, start=..., end=...)  

Like S.rfind() but raise ValueError when the substring is not found. **Return Value**  

- int

### rjust(S, width, fillchar=...)  

Return S right-justified in a string of length width. Padding is done using the specified fill character (default is a space) **Return Value**  

- string

### rpartition(S, sep)  

Search for the separator sep in S, starting at the end of S, and return the part before it, the separator itself, and the part after it. If the separator is not found, return two empty strings and S. **Return Value**  

- (head, sep, tail)

### rsplit(S, sep=..., maxsplit=...)  

Return a list of the words in the string S, using sep as the delimiter string, starting at the end of the string and working to the front. If maxsplit is given, at most maxsplit splits are done. If sep is not specified or is None, any whitespace string is a separator. **Return Value**  

- list of strings

### rstrip(S, chars=...)  

Return a copy of the string S with trailing whitespace removed. If chars is given and not None, remove characters in chars instead. If chars is unicode, S will be converted to unicode before stripping. **Return Value**  

- string or unicode
### split

```
\texttt{split(S, sep=\ldots, maxsplit=\ldots)}
```

Return a list of the words in the string \(S\), using \(sep\) as the delimiter string. If
maxsplit is given, at most maxsplit splits are done. If \(sep\) is not specified or is
None, any whitespace string is a separator and empty strings are removed from
the result. \textbf{Return Value}
- list of strings

### splitlines

```
\texttt{splitlines(S, keepends=False)}
```

Return a list of the lines in \(S\), breaking at line boundaries. Line breaks are not
included in the resulting list unless keepends is given and true. \textbf{Return Value}
- list of strings

### startswith

```
\texttt{startswith(S, prefix, start=\ldots, end=\ldots)}
```

Return True if \(S\) starts with the specified \(prefix\), False otherwise. With optional
start, test \(S\) beginning at that position. With optional end, stop comparing \(S\) at
that position. \(prefix\) can also be a tuple of strings to try. \textbf{Return Value}
- bool

### strip

```
\texttt{strip(S, chars=\ldots)}
```

Return a copy of the string \(S\) with leading and trailing whitespace removed. If
chars is given and not None, remove characters in chars instead. If chars is
unicode, \(S\) will be converted to unicode before stripping \textbf{Return Value}
- string or unicode

### swapcase

```
\texttt{swapcase(S)}
```

Return a copy of the string \(S\) with uppercase characters converted to lowercase
and vice versa. \textbf{Return Value}
- string

### title

```
\texttt{title(S)}
```

Return a titlecased version of \(S\), i.e. words start with uppercase characters, all
remaining cased characters have lowercase. \textbf{Return Value}
- string
translate(S, table, deletechars=...)  

Return a copy of the string S, where all characters occurring in the optional argument deletechars are removed, and the remaining characters have been mapped through the given translation table, which must be a string of length 256 or None. If the table argument is None, no translation is applied and the operation simply removes the characters in deletechars. **Return Value** string

upper(S)  

Return a copy of the string S converted to uppercase. **Return Value** string

zfill(S, width)  

Pad a numeric string S with zeros on the left, to fill a field of the specified width. The string S is never truncated. **Return Value** string

*Inherited from object*  

__delattr__(), __init__(), __reduce__(), __reduce_ex__(), __setattr__(), __subclasshook__()

**Properties**

<table>
<thead>
<tr>
<th>Name</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Inherited from object</td>
<td></td>
</tr>
<tr>
<td><em>class</em>_</td>
<td></td>
</tr>
</tbody>
</table>

**Class ElementMaker**

object  

```
| lxml.builder.ElementMaker|
```

Element generator factory.

Unlike the ordinary Element factory, the E factory allows you to pass in more than just a tag and some optional attributes; you can also pass in text and other elements. The text is added as either text or tail attributes, and elements are inserted at the right spot. Some small examples:

```python
>>> from lxml import etree as ET
>>> from lxml.builder import E
```
>>> ET.tostring(E("tag"))
'<tag/>
>>> ET.tostring(E("tag", "text"))
'<tag>text</tag>
>>> ET.tostring(E("tag", "text", key="value"))
'<tag key="value">text</tag>
>>> ET.tostring(E("tag", E("subtag", "text"), "tail"))
'<tag><subtag>text</subtag>tail</tag>

For simple tags, the factory also allows you to write ```E.tag(...)``` instead of ```E('tag', ...)```:

>>> ET.tostring(E.tag())
'<tag/>
>>> ET.tostring(E.tag("text"))
'<tag>text</tag>
>>> ET.tostring(E.tag(E.subtag("text"), "tail"))
'<tag><subtag>text</subtag>tail</tag>

Here's a somewhat larger example; this shows how to generate HTML documents, using a mix of prepared factory functions for inline elements, nested ```E.tag``` calls, and embedded XHTML fragments:

```python
def CLASS(v):
    # helper function, 'class' is a reserved word
    return {'class': v}

page = (E.html(E.head(E.title("This is a sample document"))
                , E.body(E.h1("Hello!", CLASS("title")),
                        E.p("This is a paragraph with ", B("bold"), " text in it!"
                            , E.p("This is another paragraph, with a ",
                                A("link", href="http://www.python.org"), ".")
                                , E.p("Here are some reserered characters: <spam&egg>."),
                                ET.XML("<p>And finally, here is an embedded XHTML fragment"))
                )
          )
```

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print ET.tostring(page)

Here's a prettyprinted version of the output from the above script:

<html>
<head>
<title>This is a sample document</title>
</head>
<body>
<h1 class="title">Hello!</h1>
<p>This is a paragraph with &lt;b&gt;bold&lt;/b&gt; text in it!</p>
<p>This is another paragraph, with &lt;a href="http://www.python.org"&gt;link&lt;/a&gt;.
Here are some reserved characters: &lt;spam&amp;egg&gt;.</p>
<p>And finally, here is an embedded XHTML fragment.</p>
</body>
</html>

For namespace support, you can pass a namespace map (nsmap) and/or a specific target namespace to the ElementMaker class:

>>> E = ElementMaker(namespace="http://my.ns/")
>>> print(ET.tostring( E.test ))
<test xmlns="http://my.ns/"/>

>>> E = ElementMaker(namespace="http://my.ns/", nsmap={'p':'http://my.ns/'});
>>> print(ET.tostring( E.test ))
<p:test xmlns:p="http://my.ns/"/>

Methods

__init__(self, typemap=None, namespace=None, nsmap=None, makeelement=None)

x.__init__(...) initializes x; see help(type(x)) for signature Overrides:
object.__init__ (inherited documentation)

__call__(self, tag, *children, **attrib)

__getattr__(self, tag)

Inherited from object

__delattr__(), __format__(), __getattribute__(), __hash__(), __new__(), __reduce__(),
__reduce_ex__(), __repr__(), __setattr__(), __sizeof__(), __str__(), __subclasshook__()

Properties

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<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inherited from object</td>
<td></td>
</tr>
<tr>
<td><strong>class</strong></td>
<td></td>
</tr>
</tbody>
</table>
Module lxml.cssselect

CSS Selectors based on XPath.

This module supports selecting XML/HTML tags based on CSS selectors. See the CSSSelector class for details.

This is a thin wrapper around cssselect 0.7 or later.

Class SelectorSyntaxError

Parsing a selector that does not match the grammar.

Methods

Inherited from exceptions_SYNTAXERROR

__init__(), __new__(), __str__()

Inherited from exceptions_BASE_EXCEPTION

__delattr__(), __getattr__(), __getitem__(), __getslice__(), __reduce__(), __repr__(),
__setattr__(), __setstate__(), __unicode__()

Inherited from object

__format__(), __hash__(), __reduce_ex__(), __sizeof__(), __subclasshook__()
Properties

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inherited from exceptions.SyntaxError</td>
<td>filename, lineno, msg, offset, print_file_and_line, text</td>
</tr>
<tr>
<td>Inherited from exceptions.BaseException</td>
<td>args, message</td>
</tr>
<tr>
<td>Inherited from object</td>
<td><strong>class</strong></td>
</tr>
</tbody>
</table>

Class ExpressionError

Unknown or unsupported selector (eg. pseudo-class).

Methods

Inherited from exceptions.RuntimeError

__init__(), __new__() 

Inherited from exceptions.BaseException

__delattr__(), __getattr__(), __getitem__(), __getslice__(), __reduce__(), __repr__(), 
__setattr__(), __setstate__(), __str__(), __unicode__() 

Inherited from object

__format__(), __hash__(), __reduce_ex__(), __sizeof__(), __subclasshook__()
Class SelectorError

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inherited from exceptions.BaseException</td>
<td>args, message</td>
</tr>
<tr>
<td>Inherited from object</td>
<td><strong>class</strong></td>
</tr>
</tbody>
</table>

Methods

Inherited from exceptions.Exception

__init__(), __new__()

Inherited from exceptions.BaseException

__delattr__(), __getattr__(), __getattribute__(), __getitem__(), __getslice__(), __reduce__(), __reduce_ex__(), __repr__(), __setattr__(), __sizeof__(), __str__(), __subclasshook__(), __unicode__()

Inherited from object

__format__(), __hash__(), __reduce_ex__(), __sizeof__(), __subclasshook__()

Properties

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<td>args, message</td>
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<td><strong>class</strong></td>
</tr>
</tbody>
</table>

Known Subclasses: csselect.xpath.ExpressionError, csselect.parser.SelectorSyntaxError

Common parent for `SelectorSyntaxError` and `ExpressionError`.

You can just use `except SelectorError:` when calling `GenericTranslator.css_to_xpath` and handle both exceptions types.
A CSS selector.

Usage:

```python
>>> from lxml import etree, cssselect
>>> select = cssselect.CSSSelector("a tag > child")

>>> root = etree.XML("<a><b><c/><tag><child>TEXT</child></tag></b></a>")
[ el.tag for el in select(root) ]
[‘child’]
```

To use CSS namespaces, you need to pass a prefix-to-namespace mapping as `namespaces` keyword argument:

```python
>>> rdfns = ‘http://www.w3.org/1999/02/22-rdf-syntax-ns#’
>>> select_ns = cssselect.CSSSelector(‘root > rdf|Description’,
... namespaces={‘rdf’: rdfns})

>>> rdf = etree.XML((
... ‘<root xmlns:rdf="%s">’
... ‘<rdf:Description>blah</rdf:Description>’
... ’</root>’) % rdfns)
[‘{http://www.w3.org/1999/02/22-rdf-syntax-ns#}Description’, ‘blah’]
```

Methods

```python
__init__(self, css, namespaces=None, translator=‘xml’)

x.__init__(...) initializes x; see help(type(x)) for signature  Overrides:
object.__init__ extit(inherited documentation)
```

```python
__repr__(self)

repr(x) Overrides: object.__repr__ extit(inherited documentation)
```

**Inherited from lxml.etree.XPath(Section B)**

```python
__call__(), __new__()
```
Class CSSSelector

Module lxml.cssselect

**Inherited from lxml.etree._XPathEvaluatorBase**

evaluate()

**Inherited from object**

__delattr__(), __format__(), __getattribute__(), __hash__(), __reduce__(), __reduce_ex__(), __setattr__(), __sizeof__(), __str__(), __subclasshook__()

**Properties**

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inherited from lxml.etree.XPath (Section B)</td>
<td>path</td>
</tr>
<tr>
<td>Inherited from lxml.etree._XPathEvaluatorBase</td>
<td>error_log</td>
</tr>
<tr>
<td>Inherited from object</td>
<td><strong>class</strong></td>
</tr>
</tbody>
</table>
Module lxml.doctestcompare

lxml-based doctest output comparison.

Note: normally, you should just import the lxml.usedoctest and lxml.html.usedoctest modules from within a doctest, instead of this one:

```python
>>> import lxml.usedoctest # for XML output

>>> import lxml.html.usedoctest # for HTML output
```

To use this module directly, you must call lxmdoctest.install(), which will cause doctest to use this in all subsequent calls.

This changes the way output is checked and comparisons are made for XML or HTML-like content.

XML or HTML content is noticed because the example starts with `<` (it’s HTML if it starts with `<html`). You can also use the PARSE_HTML and PARSE_XML flags to force parsing.

Some rough wildcard-like things are allowed. Whitespace is generally ignored (except in attributes). In text (attributes and text in the body) you can use `...` as a wildcard. In an example it also matches any trailing tags in the element, though it does not match leading tags. You may create a tag `<any>` or include an any attribute in the tag. An any tag matches any tag, while the attribute matches any and all attributes.

When a match fails, the reformatted example and gotten text is displayed (indented), and a rough diff-like output is given. Anything marked with `-` is in the output but wasn’t supposed to be, and similarly `+` means its in the example but wasn’t in the output.

You can disable parsing on one line with `# doctest:+NOPARSE_MARKUP`

Functions

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>install</strong>(html=False)</td>
<td>Install doctestcompare for all future doctests. If html is true, then by default the HTML parser will be used; otherwise the XML parser is used.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>temp_install</strong>(html=False, del_module=None)</td>
<td>Use this inside a doctest to enable this checker for this doctest only. If html is true, then by default the HTML parser will be used; otherwise the XML parser is used.</td>
</tr>
</tbody>
</table>
Variables

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PARSE_HTML</td>
<td>Value: 1024</td>
</tr>
<tr>
<td>PARSE_XML</td>
<td>Value: 2048</td>
</tr>
<tr>
<td>NOPARSE_MARKUP</td>
<td>Value: 4096</td>
</tr>
</tbody>
</table>

Class LXMLOutputChecker

doctest.OutputChecker

xml.doctestcompare.LXMLOutputChecker

Known Subclasses: xml.doctestcompare.LHTMLOutputChecker

Methods

```python
get_default_parser(self)
```

```python
check_output(self, want, got, optionflags)
```

Return True iff the actual output from an example (got) matches the expected output (want). These strings are always considered to match if they are identical; but depending on what option flags the test runner is using, several non-exact match types are also possible. See the documentation for TestRunner for more information about option flags. Overrides: doctest.OutputChecker.check_output (inherited documentation)

```python
get_parser(self, want, got, optionflags)
```

```python
compare_docs(self, want, got)
```

```python
text_compare(self, want, got, strip)
```

```python
tag_compare(self, want, got)
```

```python
output_difference(self, example, got, optionflags)
```

Return a string describing the differences between the expected output for a given example (example) and the actual output (got). optionflags is the set of option flags used to compare want and got. Overrides: doctest.OutputChecker.output_difference (inherited documentation)

```python
html_empty_tag(self, el, html=True)
```
Class LHTMLOutputChecker

Module lxml.doctestcompare

<table>
<thead>
<tr>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>format_doc(self, doc, html, indent, prefix=' ')</td>
</tr>
<tr>
<td>format_text(self, text, strip=True)</td>
</tr>
<tr>
<td>format_tag(self, el)</td>
</tr>
<tr>
<td>format_end_tag(self, el)</td>
</tr>
<tr>
<td>collect_diff(self, want, got, html, indent)</td>
</tr>
<tr>
<td>collect_diff_tag(self, want, got)</td>
</tr>
<tr>
<td>collect_diff_end_tag(self, want, got)</td>
</tr>
<tr>
<td>collect_diff_text(self, want, got, strip=True)</td>
</tr>
</tbody>
</table>

Class Variables

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>empty_tags</td>
<td>Value: ('param', 'img', 'area', 'br', 'basefont', 'input', 'base...</td>
</tr>
</tbody>
</table>

Class LHTMLOutputChecker

doctest.OutputChecker

lxml.doctestcompare.LXMLOutputChecker

lxml.doctestcompare.LHTMLOutputChecker

Methods

<table>
<thead>
<tr>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>get_default_parser(self)</td>
</tr>
<tr>
<td>Overrides: lxml.doctestcompare.LXMLOutputChecker.get_default_parser</td>
</tr>
</tbody>
</table>

Inherited from lxml.doctestcompare.LXMLOutputChecker (Section B)

check_output(), collect_diff(), collect_diff_end_tag(), collect_diff_tag(), collect_diff_text(), compare_docs(), format_doc(), format_end_tag(), format_tag(), format_text(), get_parser(), html_empty_tag(), output_difference(), tag_compare(), text_compare()
<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inherited from lxml.doctestcompare.LXMLOutputChecker (Section B)</td>
<td></td>
</tr>
<tr>
<td>empty_tags</td>
<td></td>
</tr>
</tbody>
</table>
Module lxml.etree

The lxml.etree module implements the extended ElementTree API for XML. Version: 3.4.4

Functions

<table>
<thead>
<tr>
<th>Function</th>
<th>Comment(text=None)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Comment element factory. This factory function creates a special element that will be serialized as an XML comment.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Function</th>
<th>Element(_tag, attrib=None, nsmap=None, **_extra)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Element factory. This function returns an object implementing the Element interface. Also look at the _Element.makeelement() and _BaseParser.makeelement() methods, which provide a faster way to create an Element within a specific document or parser context.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Function</th>
<th>ElementTree(element=None, file=None, parser=None)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ElementTree wrapper class.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Function</th>
<th>Entity(name)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Entity factory. This factory function creates a special element that will be serialized as an XML entity reference or character reference. Note, however, that entities will not be automatically declared in the document. A document that uses entity references requires a DTD to define the entities.</td>
</tr>
</tbody>
</table>
**Extension**(module, function_mapping=None, ns=None)

Build a dictionary of extension functions from the functions defined in a module or the methods of an object.

As second argument, you can pass an additional mapping of attribute names to XPath function names, or a list of function names that should be taken.

The **ns** keyword argument accepts a namespace URI for the XPath functions.

**FunctionNamespace**(ns_uri)

Retrieve the function namespace object associated with the given URI.

Creates a new one if it does not yet exist. A function namespace can only be used to register extension functions.

**HTML**(text, parser=None, base_url=None)

Parses an HTML document from a string constant. Returns the root node (or the result returned by a parser target). This function can be used to embed “HTML literals” in Python code.

To override the parser with a different **HTMLParser** you can pass it to the **parser** keyword argument.

The **base_url** keyword argument allows to set the original base URL of the document to support relative Paths when looking up external entities (DTD, XInclude, ...).

**PI**(target, text=None)

ProcessingInstruction element factory. This factory function creates a special element that will be serialized as an XML processing instruction.

**ProcessingInstruction**(target, text=None)

ProcessingInstruction element factory. This factory function creates a special element that will be serialized as an XML processing instruction.
SubElement(_parent, _tag, attrib=None, nsmap=None, **_extra)

Subelement factory. This function creates an element instance, and appends it to an existing element.

XML(text, parser=None, base_url=None)

Parses an XML document or fragment from a string constant. Returns the root node (or the result returned by a parser target). This function can be used to embed “XML literals” in Python code, like in

```python
>>> root = XML("<root><test/></root>")
```

```python
>>> print(root.tag)
root
```

To override the parser with a different XMLParser you can pass it to the parser keyword argument.

The base_url keyword argument allows to set the original base URL of the document to support relative Paths when looking up external entities (DTD, XInclude, ...).

XMLDTDID(text, parser=None, base_url=None)

Parse the text and return a tuple (root node, ID dictionary). The root node is the same as returned by the XML() function. The dictionary contains string-element pairs. The dictionary keys are the values of ID attributes as defined by the DTD. The elements referenced by the ID are stored as dictionary values.

Note that you must not modify the XML tree if you use the ID dictionary. The results are undefined.

XMLID(text, parser=None, base_url=None)

Parse the text and return a tuple (root node, ID dictionary). The root node is the same as returned by the XML() function. The dictionary contains string-element pairs. The dictionary keys are the values of ‘id’ attributes. The elements referenced by the ID are stored as dictionary values.
**XPathEvaluator**(etree_or_element, namespaces=None, extensions=None, regexp=True, smart_strings=True)

Creates an XPath evaluator for an ElementTree or an Element.

The resulting object can be called with an XPath expression as argument and XPath variables provided as keyword arguments.

Additional namespace declarations can be passed with the 'namespace' keyword argument. EXSLT regular expression support can be disabled with the 'regexp' boolean keyword (defaults to True). Smart strings will be returned for string results unless you pass smart_strings=False.

**cleanup_namespaces**(tree_or_element)

Remove all namespace declarations from a subtree that are not used by any of the elements or attributes in that tree.

**clear_error_log**( )

Clear the global error log. Note that this log is already bound to a fixed size.

Note: since lxml 2.2, the global error log is local to a thread and this function will only clear the global error log of the current thread.

**dump**(elem, pretty_print=True, with_tail=True)

Writes an element tree or element structure to sys.stdout. This function should be used for debugging only.

**fromstring**(text, parser=None, base_url=None)

Parses an XML document or fragment from a string. Returns the root node (or the result returned by a parser target).

To override the default parser with a different parser you can pass it to the parser keyword argument.

The base_url keyword argument allows to set the original base URL of the document to support relative Paths when looking up external entities (DTD, XInclude, ...).
### fromstringlist

```python
fromstringlist(strings, parser=None)
```

Parses an XML document from a sequence of strings. Returns the root node (or the result returned by a parser target).

To override the default parser with a different parser you can pass it to the `parser` keyword argument.

### get_default_parser

```python
get_default_parser()
```

### iselement

```python
iselement(element)
```

Checks if an object appears to be a valid element object.

### parse

```python
parse(source, parser=None, base_url=None)
```

Return an ElementTree object loaded with source elements. If no parser is provided as second argument, the default parser is used.

The `source` can be any of the following:

- a file name/path
- a file object
- a file-like object
- a URL using the HTTP or FTP protocol

To parse from a string, use the `fromstring()` function instead.

Note that it is generally faster to parse from a file path or URL than from an open file object or file-like object. Transparent decompression from gzip compressed sources is supported (unless explicitly disabled in libxml2).

The `base_url` keyword allows setting a URL for the document when parsing from a file-like object. This is needed when looking up external entities (DTD, XInclude, ...) with relative paths.
parseid(source, parser=None)

Parses the source into a tuple containing an ElementTree object and an ID dictionary. If no parser is provided as second argument, the default parser is used.

Note that you must not modify the XML tree if you use the ID dictionary. The results are undefined.

register_namespace(...)

Registers a namespace prefix that newly created Elements in that namespace will use. The registry is global, and any existing mapping for either the given prefix or the namespace URI will be removed.

set_default_parser(parser=None)

Set a default parser for the current thread. This parser is used globally whenever no parser is supplied to the various parse functions of the lxml API. If this function is called without a parser (or if it is None), the default parser is reset to the original configuration.

Note that the pre-installed default parser is not thread-safe. Avoid the default parser in multi-threaded environments. You can create a separate parser for each thread explicitly or use a parser pool.

set_element_class_lookup(lookup=None)

Set the global default element class lookup method.
**strip_attributes(tree_or_element, *attribute_names)**

Delete all attributes with the provided attribute names from an Element (or ElementTree) and its descendants.

Attribute names can contain wildcards as in `_Element.iter`.

Example usage:

```python
strip_attributes(root_element,
               'simpleattr',
               '{http://some/ns}attrname',
               '{http://other/ns}*')
```

**strip_elements(tree_or_element, with_tail=True, *tag_names)**

Delete all elements with the provided tag names from a tree or subtree. This will remove the elements and their entire subtree, including all their attributes, text content and descendants. It will also remove the tail text of the element unless you explicitly set the `with_tail` keyword argument option to False.

Tag names can contain wildcards as in `_Element.iter`.

Note that this will not delete the element (or ElementTree root element) that you passed even if it matches. It will only treat its descendants. If you want to include the root element, check its tag name directly before even calling this function.

Example usage:

```python
strip_elements(some_element,
               'simpletagname', # non-namespaced tag
               '{http://some/ns}tagname', # namespaced tag
               '{http://some/other/ns}*’ # any tag from a namespace
               lxml.etree.Comment # comments
           )
```
Delete all elements with the provided tag names from a tree or subtree. This will remove the elements and their attributes, but not their text/tail content or descendants. Instead, it will merge the text content and children of the element into its parent.

Tag names can contain wildcards as in _Element.iter.

Note that this will not delete the element (or ElementTree root element) that you passed even if it matches. It will only treat its descendants.

Example usage:

```python
strip_tags(some_element,
    'simpletagname',   # non-namespaced tag
    '{http://some/ns}tagname',  # namespaced tag
    '{http://some/other/ns}*'   # any tag from a namespace
    Comment                   # comments (including their text!)
)
```
```python
tostring(element_or_tree, encoding=None, method=\"xml\", xml_declaration=None, pretty_print=False, with_tail=True, standalone=None, doctype=None, exclusive=False, with_comments=True, inclusive_ns_prefixes=None)
```

Serialize an element to an encoded string representation of its XML tree.

Defaults to ASCII encoding without XML declaration. This behaviour can be configured with the keyword arguments 'encoding' (string) and 'xml_declaration' (bool). Note that changing the encoding to a non UTF-8 compatible encoding will enable a declaration by default.

You can also serialise to a Unicode string without declaration by passing the `unicode` function as encoding (or `str` in Py3), or the name 'unicode'. This changes the return value from a byte string to an unencoded unicode string.

The keyword argument 'pretty_print' (bool) enables formatted XML.

The keyword argument 'method' selects the output method: 'xml', 'html', plain 'text' (text content without tags) or 'c14n'. Default is 'xml'.

The `exclusive` and `with_comments` arguments are only used with C14N output, where they request exclusive and uncommented C14N serialisation respectively.

Passing a boolean value to the `standalone` option will output an XML declaration with the corresponding `standalone` flag.

The `doctype` option allows passing in a plain string that will be serialised before the XML tree. Note that passing in non well-formed content here will make the XML output non well-formed. Also, an existing doctype in the document tree will not be removed when serialising an ElementTree instance.

You can prevent the tail text of the element from being serialised by passing the boolean `with_tail` option. This has no impact on the tail text of children, which will always be serialised.

```python
tostringlist(element_or_tree, *args, **kwargs)
```

Serialize an element to an encoded string representation of its XML tree, stored in a list of partial strings.

This is purely for ElementTree 1.3 compatibility. The result is a single string wrapped in a list.
**tounicode(element_or_tree, method="xml", pretty_print=False, with_tail=True, doctype=None)**

Serialize an element to the Python unicode representation of its XML tree.

Note that the result does not carry an XML encoding declaration and is therefore not necessarily suited for serialization to byte streams without further treatment.

The boolean keyword argument 'pretty_print' enables formatted XML.

The keyword argument 'method' selects the output method: 'xml', 'html' or plain 'text'.

You can prevent the tail text of the element from being serialised by passing the boolean with_tail option. This has no impact on the tail text of children, which will always be serialised. **Deprecated:** use tostring(el, encoding='unicode') instead.

**use_global_python_log(log)**

Replace the global error log by an etree.PyErrorLog that uses the standard Python logging package.

Note that this disables access to the global error log from exceptions. Parsers, XSLT etc. will continue to provide their normal local error log.

Note: prior to lxml 2.2, this changed the error log globally. Since lxml 2.2, the global error log is local to a thread and this function will only set the global error log of the current thread.

### Variables

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEBUG</td>
<td>Value: 1</td>
</tr>
<tr>
<td>LIBXML_COMPILED_VERS-</td>
<td>Value: (2, 9, 1)</td>
</tr>
<tr>
<td>VERSION</td>
<td>Value: (2, 9, 1)</td>
</tr>
<tr>
<td>LIBXML_VERSION</td>
<td>Value: (2, 9, 1)</td>
</tr>
<tr>
<td>LIBXSLT_COMPILED_VER-</td>
<td>Value: (1, 1, 28)</td>
</tr>
<tr>
<td>VERSION</td>
<td>Value: (1, 1, 28)</td>
</tr>
<tr>
<td>LIBXSLT_VERSION</td>
<td>Value: (1, 1, 28)</td>
</tr>
<tr>
<td>LXML_VERSION</td>
<td>Value: (3, 4, 4, 0)</td>
</tr>
</tbody>
</table>
Class `AttributeBasedElementClassLookup`  

```python
object
```
```
xml.etree.ElementClassLookup
```
```
xml.etree.FallbackElementClassLookup
```
```
xml.etree.AttributeBasedElementClassLookup
```

`AttributeBasedElementClassLookup` accepts an attribute of an Element and looks up the value in a class dictionary.

**Arguments:**
- attribute name - `{ns}name` style string
- class mapping - Python dict mapping attribute values to Element classes
- fallback - optional fallback lookup mechanism

A None key in the class mapping will be checked if the attribute is missing.

**Methods**

```python
__init__(self, attribute_name, class_mapping, fallback=None)
```

x.__init__(...) initializes x; see help(type(x)) for signature  
Overrides:
object.__init__

```python
__new__(T, S, ...)
```

**Return Value**
- a new object with type S, a subtype of T

Overrides: object.__new__

*Inherited from lxml.etree.FallbackElementClassLookup (Section B)*

```python
set_fallback()
```

*Inherited from object*

```python
__delattr__, __format__, __getattr__, __hash__, __reduce__, __reduce_ex__, __repr__, __setattr__, __sizeof__, __str__, __subclasshook__
```

**Properties**

*continued on next page*
Class C14NError

object

extceptions.BaseException

extceptions.Exception

lxml.etree.Error

lxml.etree.LxmlError

lxml.etree.C14NError

Error during C14N serialisation.

Methods

Inherited from lxml.etree.LxmlError (Section B)

__init__()  

Inherited from exceptions.Exception

__new__()  

Inherited from exceptions.BaseException

__delattr__(), __getattribute__(), __getitem__(), __getslice__(), __reduce__(), __repr__(),
__setattr__(), __setstate__(), __str__(), __unicode__()

Inherited from object

__format__(), __hash__(), __reduce_ex__(), __sizeof__(), __subclasshook__()

Properties

Name | Description
---|---
Inherited from exceptions.BaseException
args, message

continued on next page
Class CDATA

```
object

lxml.etree.CDATA
```

CDATA(data)

CDATA factory. This factory creates an opaque data object that can be used to set Element text. The usual way to use it:

```python
>>> el = Element('content')
>>> el.text = CDATA('a string')

>>> print(el.text)
a string
```

Methods

```
__new__(T, S, ...)
```

Return Value

a new object with type S, a subtype of T

Overrides: object.__new__

Inherited from object

```
__delattr__(), __format__(), __getattribute__(), __hash__(), __init__(), __reduce__(),
__reduce_ex__(), __repr__(), __setattr__(), __sizeof__(), __str__(), __subclasshook__()
```

Properties

```
Name | Description
--- | ---
_Inherited from object_ | |
__class__ | 
```

Class Variables

```
Name | Description
--- | ---
__qualname__ | Value: 'C14NError'
```

298
Class `CommentBase`

object

`lxml.etree._Element`

??._ContentOnlyElement

`lxml.etree._Comment`

`lxml.etree.CommentBase`

**Known Subclasses:** `lxml.html.HtmlComment`

All custom Comment classes must inherit from this one.

To create an XML Comment instance, use the `Comment()` factory.

Subclasses *must not* override `__init__` or `__new__` as it is absolutely undefined when these objects will be created or destroyed. All persistent state of Comments must be stored in the underlying XML. If you really need to initialize the object after creation, you can implement an `_init_(self)` method that will be called after object creation.

**Methods**

```python
__init__(...)
```

`x.__init__(...) initializes x; see help(type(x))` for signature

Overrides: `object.__init__`

```python
__new__(T, S, ...)
```

**Return Value**

a new object with type S, a subtype of T

Overrides: `object.__new__`

Inherited from `lxml.etree._Comment`

`__repr__()`

Inherited from `??._ContentOnlyElement`

`__delitem__(), __getitem__(), __len__(), __setitem__(), append(), get(), insert(), items(), keys(), set(), values()`

Inherited from `lxml.etree._Element`

`__contains__(), __copy__(), __deepcopy__(), __iter__(), __nonzero__(), __reversed__(), addnext(), addprevious(), clear(), extend(), find(), findall(), findtext(), getchildren(),`
Class `CustomElementClassLookup`  

Inherited from `object`

- `__delattr__()`  
- `__format__()  
- `__getattribute__()`  
- `__hash__()`  
- `__reduce__()`  
- `__reduce_ex__()`  
- `__setattr__()`  
- `__sizeof__()`  
- `__str__()`  
- `__subclasshook__()`

Properties

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>tag</code></td>
<td>Inherited from <code>lxml.etree._Comment</code></td>
</tr>
<tr>
<td><code>attrib, text</code></td>
<td>Inherited from <code>object</code></td>
</tr>
<tr>
<td><code>base, nsmap, prefix, sourceline, tail</code></td>
<td>Inherited from <code>lxml.etree._Element</code></td>
</tr>
</tbody>
</table>

Class `CustomElementClassLookup`

```
object  
| lxml.etree.ElementClassLookup  
| lxml.etree.FallbackElementClassLookup  
| lxml.etree.CustomElementClassLookup  
```

Known Subclasses: `lxml.html.HtmlElementClassLookup`

CustomElementClassLookup(self, fallback=None) Element class lookup based on a subclass method.

You can inherit from this class and override the method:

```
lookup(self, type, doc, namespace, name)
```

to lookup the element class for a node. Arguments of the method:  
* type: one of 'element', 'comment', 'PI', 'entity'  
* doc: document that the node is in  
* namespace: namespace URI of the node (or None for comments/PIS/entities)  
* name: name of the element/entity. None for comments, target for PIs

If you return None from this method, the fallback will be called.
Methods

```python
__new__(T, S, ...)
```

**Return Value**

A new object with type S, a subtype of T

Overrides: object.__new__

```python
lookup(self, type, doc, namespace, name)
```

*Inherited from lxml.etree.FallbackElementClassLookup (Section B)*

```python
__init__(), set_fallback()
```

*Inherited from object*

```python
__delattr__(), __format__(), __getattr__(), __hash__(), __reduce__(), __reduce_ex__(), __repr__(), __setattr__(), __sizeof__(), __str__(), __subclasshook__()
```

Properties

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
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</tr>
<tr>
<td>fallback</td>
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</tr>
<tr>
<td></td>
<td><em>Inherited from object</em></td>
</tr>
<tr>
<td><strong>class</strong></td>
<td></td>
</tr>
</tbody>
</table>

Class DTD

```
object  lxml.etree._Validator  lxml.etree.DTD
```

DTD(self, file=None, external_id=None) A DTD validator.

Can load from filesystem directly given a filename or file-like object. Alternatively, pass the keyword parameter `external_id` to load from a catalog.
Methods

```python
__call__(self, etree)
```

Validate doc using the DTD.
Returns true if the document is valid, false if not.

```python
__init__(self, file=None, external_id=None)
```

x.__init__(...) initializes x; see help(type(x)) for signature   Overrides: object.__init__

```python
__new__(T, S, ...)
```

Return Value
a new object with type S, a subtype of T
Overrides: object.__new__

```

```
```
```
```
```
```

Inherited from lxml.etree._Validator

assertValid(), assert_(), validate()

Inherited from object

__delattr__(), __format__(), __getattribute__(), __hash__(), __reduce__(), __reduce_ex__(),
__repr__(), __setattr__(), __sizeof__(), __str__(), __subclasshook__()

Properties

<table>
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<tr>
<td>external_id</td>
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<tr>
<td>name</td>
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</tr>
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<td>system_url</td>
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</tr>
</tbody>
</table>

Inherited from lxml.etree._Validator

error_log

Inherited from object

continued on next page
Class DTDError

object

exceptions.BaseException

exceptions.Exception

lxml.etree.Error

lxml.etree.LxmlError

lxml.etree.DTDError

**Known Subclasses:** lxml.etree.DTDParseError, lxml.etree.DTDValidateError

Base class for DTD errors.

**Methods**

*Inherited from lxml.etree.LxmlError (Section B)*

__init__()

*Inherited from exceptions.Exception*

__new__()

*Inherited from exceptions.BaseException*

__delattr__(), __getattr__(), __getitem__(), __getslice__(), __reduce__(), __repr__(),
__setattr__(), __setstate__(), __str__(), __unicode__()

*Inherited from object*

__format__(), __hash__(), __reduce_ex__(), __sizeof__(), __subclasshook__()

**Properties**

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td><strong>class</strong></td>
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Class Variables

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>qualname</strong></td>
<td>Value: 'DTDError'</td>
</tr>
</tbody>
</table>

Class DTDParseError

object

exceptions.BaseException

exceptions.Exception

lxml.etree.Error

lxml.etree.LxmlError

lxml.etree.DTDError

lxml.etree.DTDParseError

Error while parsing a DTD.

Methods

*Inherited from lxml.etree.LxmlError (Section B)*

__init__()  

*Inherited from exceptions.Exception*

__new__()  

*Inherited from exceptions.BaseException*

__delattr__(), __getattr__(), __getitem__(), __getslice__(), __reduce__(), __repr__(), __setattr__(), __setstate__(), __str__(), __unicode__()

*Inherited from object*

__format__(), __hash__(), __reduce_ex__(), __sizeof__(), __subclasshook__()

Properties

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
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<tbody>
<tr>
<td>Inherited from exceptions.BaseException</td>
<td>args, message</td>
</tr>
<tr>
<td>Inherited from object</td>
<td></td>
</tr>
</tbody>
</table>
Class `DTDValidateError`

Error while validating an XML document with a DTD.

Methods

Inherited from `lxml.etree.LxmlError` (Section B)

- `__init__()`

Inherited from `exceptions.Exception`

- `__new__()`

Inherited from `exceptions.BaseException`

- `__delattr__()`, `__getattr__()`, `__getitem__()`, `__getslice__()`, `__reduce__()`, `__repr__()`, `__setattr__()`, `__setstate__()`, `__str__()`, `__unicode__()`

Inherited from `object`

- `__format__()`, `__hash__()`, `__reduce_ex__()`, `__sizeof__()`, `__subclasshook__()`

Properties
Class DocumentInvalid

object

exceptions.BaseException

exceptions.Exception

lxml.etree.Error

lxml.etree.LxmlError

lxml.etree.DocumentInvalid

Validation error.

Raised by all document validators when their `assertValid(tree)` method fails.

Methods

Inherited from lxml.etree.LxmlError (Section B)

`__init__()`

Inherited from exceptions.Exception

`__new__()`

Inherited from exceptions.BaseException

`__delattr__(), __getattr__(), __getitem__(), __getslice__(), __reduce__(), __repr__(), __setattr__(), __setstate__(), __str__(), __unicode__()`

Inherited from object

`__format__(), __hash__(), __reduce_ex__(), __sizeof__(), __subclasshook__()`
Class ETCompatXMLParser

An XML parser with an ElementTree compatible default setup.

See the XMLParser class for details.

This parser has `remove_comments` and `remove_pis` enabled by default and thus ignores comments and processing instructions.

Properties

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>args, message</code></td>
<td>Inherited from exceptions.BaseException</td>
</tr>
<tr>
<td><code>__class__</code></td>
<td>Inherited from object</td>
</tr>
</tbody>
</table>

Class Variables

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>__qualname__</code></td>
<td>Value: ‘DocumentInvalid’</td>
</tr>
</tbody>
</table>

Class ETCompatXMLParser

An XML parser with an ElementTree compatible default setup.

See the XMLParser class for details.

This parser has `remove_comments` and `remove_pis` enabled by default and thus ignores comments and processing instructions.
Class ETCompatXMLParser

Methods

```
__init__(self, encoding=None, attribute_defaults=False, dtd_validation=False, load_did=False, no_network=True, ns_clean=False, recover=False, schema=None, huge_tree=False, remove_blank_text=False, resolve_entities=True, remove_comments=True, remove_pis=True, strip_cdata=True, target=None, compact=True)
```

```
x.__init__(...) initializes x; see help(type(x)) for signature  Overrides: object.__init__
```

```
__new__(T, S, ...)
```

**Return Value**
a new object with type S, a subtype of T

Overrides: object.__new__

*Inherited from lxml.etree._FeedParser*

close(), feed()

*Inherited from ??._BaseParser*

copy(), makeelement(), setElementClassLookup(), set_element_class_lookup()

*Inherited from object*

__delattr__(), __format__(), __getattribute__(), __hash__(), __reduce__(), __reduce_ex__(),
__repr__(), __setattr__(), __sizeof__(), __str__(), __subclasshook__()

Properties

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inherited from lxml.etree._FeedParser</td>
<td>feed_error_log</td>
</tr>
<tr>
<td>Inherited from ??._BaseParser</td>
<td>error_log, resolvers, target, version</td>
</tr>
<tr>
<td>Inherited from object</td>
<td><strong>class</strong></td>
</tr>
</tbody>
</table>
Class ETXPath

object —
lxml.etree._XPathEvaluatorBase —
lxml.etree.XPath —
lxml.etree.ETXPath

ETXPath(self, path, extensions=None, regexp=True, smart_strings=True) Special XPath class that supports the ElementTree {uri} notation for namespaces.

Note that this class does not accept the namespace keyword argument. All namespaces must be passed as part of the path string. Smart strings will be returned for string results unless you pass smart_strings=False.

Methods

```python
@functools.wraps(XPath.__init__)
def __init__(self, path, extensions=None, regexp=True, smart_strings=True): ...
```

Overrides: object.__init__

```python
__new__(T, S, ...)
```

Return Value

a new object with type S, a subtype of T

Overrides: object.__new__

Inherited from lxml.etree.XPath (Section B)

__call__(), __repr__()

Inherited from lxml.etree._XPathEvaluatorBase

evaluate()

Inherited from object

__delattr__(), __format__(), __getattribute__(), __hash__(), __reduce__(), __reduce_ex__(), __setattr__(), __sizeof__(), __str__(), __subclasshook__()

Properties

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<td>Inherited from lxml.etree.XPath (Section B)</td>
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<tr>
<td>Name</td>
<td>Description</td>
</tr>
<tr>
<td>------</td>
<td>-------------</td>
</tr>
<tr>
<td>Inherited from lxml.etree._XPathEvaluatorBase</td>
<td>error_log</td>
</tr>
<tr>
<td>Inherited from object</td>
<td><strong>class</strong></td>
</tr>
</tbody>
</table>

**Class ElementBase**

```
object --> lxml.etree._Element --> lxml.etree.ElementBase
```

**Known Subclasses:** lxml.objectify.ObjectifiedElement, lxml.html.HtmlElement

`ElementBase(*children, attrib=None, nsmap=None, **_extra)`

The public Element class. All custom Element classes must inherit from this one. To create an Element, use the `Element()` factory.

**BIG FAT WARNING:** Subclasses **must not** override `__init__` or `__new__` as it is absolutely undefined when these objects will be created or destroyed. All persistent state of Elements must be stored in the underlying XML. If you really need to initialize the object after creation, you can implement an `__init__(self)` method that will be called directly after object creation.

Subclasses of this class can be instantiated to create a new Element. By default, the tag name will be the class name and the namespace will be empty. You can modify this with the following class attributes:

- **TAG** - the tag name, possibly containing a namespace in Clark notation
- **NAMESPACE** - the default namespace URI, unless provided as part of the TAG attribute.
- **HTML** - flag if the class is an HTML tag, as opposed to an XML tag. This only applies to un-namespaced tags and defaults to false (i.e. XML).
- **PARSER** - the parser that provides the configuration for the newly created document. Providing an HTML parser here will default to creating an HTML element.

In user code, the latter three are commonly inherited in class hierarchies that implement a common namespace.

**Methods**

```
__init__(attrib=None, nsmap=None, *children, **_extra)
x.__init__(...) initializes x; see help(type(x)) for signature  Overrides: object.__init__
```
__new__(T, S, ...)  
Return Value  
a new object with type S, a subtype of T  
Overrides: object.__new__

Inherited from lxml.etree._Element

__contains__(), __copy__(), __deepcopy__(), __delitem__(), __getitem__(), __iter__(),  
__len__(), __nonzero__(), __repr__(), __reversed__(), __setitem__(), addnext(), ad-  
dprevious(), append(), clear(), extend(), find(), findall(), get(), getchild-  
dren(), getiterator(), getnext(), getparent(), getprevious(), getroottree(), index(), in-  
sert(), items(), iter(), iterancestors(), iterchildren(), iterchildren(), iterate-  
descendants(), iternext(), keys(), makeelement(), remove(), replace(), set(), values(), xpath()

Inherited from object

__delattr__(), __format__(), __getattribute__(), __hash__(), __reduce__(), __reduce_ex__(),  
__setattr__(), __sizeof__(), __str__(), __subclasshook__()

Properties

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inherited from lxml.etree._Element</td>
<td>attrib, base, nsmap, prefix, sourceline, tag, tail, text</td>
</tr>
<tr>
<td>Inherited from object</td>
<td><strong>class</strong></td>
</tr>
</tbody>
</table>

Class ElementClassLookup

object  
lxml.etree.ElementClassLookup

Known Subclasses: lxml.objectify.ObjectifyElementClassLookup, lxml.etree.FallbackElementClassLookup, lxml.etree.ElementDefaultClassLookup

ElementClassLookup(self) Superclass of Element class lookups.

Methods

__new__(T, S, ...)  
Return Value  
a new object with type S, a subtype of T  
Overrides: object.__new__

Inherited from object
Class ElementDefaultClassLookup

Inherited from object

__class__

Class ElementDefaultClassLookup

object

lxml.etree.ElementClassLookup

lxml.etree.ElementDefaultClassLookup

ElementDefaultClassLookup(self, element=None, comment=None, pi=None, entity=None) Element class lookup scheme that always returns the default Element class.

The keyword arguments element, comment, pi and entity accept the respective Element classes.

Methods

__init__(self, element=None, comment=None, pi=None, entity=None)

x.__init__(...) initializes x; see help(type(x)) for signature  Overrides: object.__init__

__new__(T, S, ...)

Return Value

a new object with type S, a subtype of T

Overrides: object.__new__

Inherited from object

__delattr__(), __format__(), __getattribute__(), __hash__(), __init__(), __reduce__(), __reduce_ex__(), __repr__(), __setattr__(), __sizeof__(), __str__(), __subclasshook__()

Properties

continued on next page
Class ElementNamespaceClassLookup

object

lxml.etree.ElementClassLookup

lxml.etree.FallbackElementClassLookup

lxml.etree.ElementNamespaceClassLookup

ElementNamespaceClassLookup(self, fallback=None)

Element class lookup scheme that searches the Element class in the Namespace registry.

Methods

_init__(self, fallback=None)

x.__init__(...) initializes x; see help(type(x)) for signature  Overrides: object.__init__

__new__(T, S, ...)

Return Value

  a new object with type S, a subtype of T

Overrides: object.__new__

get_namespace(self, ns_uri)

Retrieve the namespace object associated with the given URI. Pass None for the empty namespace.

Creates a new namespace object if it does not yet exist.
Inherited from lxml.etree.FallbackElementClassLookup(Section B)

set_fallback()

Inherited from object

_delattr_(), _format_(), _getattribute_(), _hash_(), _reduce_(), _reduce_ex_(),
_repr_(), _setattr_(), _sizeof_(), _str_(), _subclasshook_()

Properties

<table>
<thead>
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<th>Description</th>
</tr>
</thead>
<tbody>
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</tr>
<tr>
<td>fallback</td>
<td></td>
</tr>
<tr>
<td>Inherited from object</td>
<td></td>
</tr>
<tr>
<td><strong>class</strong></td>
<td></td>
</tr>
</tbody>
</table>

Class EntityBase

object

lxml.etree._Element

??.__ContentOnlyElement

lxml.etree._Entity

lxml.etree.EntityBase

Known Subclasses: lxml.html.HtmlEntity

All custom Entity classes must inherit from this one.

To create an XML Entity instance, use the Entity() factory.

Subclasses must not override __init__ or __new__ as it is absolutely undefined when these objects will be created or destroyed. All persistent state of Entities must be stored in the underlying XML. If you really need to initialize the object after creation, you can implement an _init(self) method that will be called after object creation.

Methods

__init__(...)  

x.__init__(...) initializes x; see help(type(x)) for signature. Overrides:

object.__init__
Class Error

Module lxml.etree

__new__(T, S, ...)  

Return Value

a new object with type S, a subtype of T

Overrides: object.__new__

Inherited from lxml.etree._Entity

__repr__()  

Inherited from ??.__ContentOnlyElement

__delitem__(), __getitem__(), __len__(), __setitem__(), append(), get(), insert(), items(), keys(), set(), values()

Inherited from lxml.etree._Element

__contains__(), __copy__(), __deepcopy__(), __iter__(), __nonzero__(), __reversed__(), addnext(), addprevious(), clear(), extend(), find(), findall(), findtext(), getchildren(), getiterator(), getnext(), getparent(), getprevious(), getroottree(), index(), iter(), iterancestors(), itercchildren(), iterdescendants(), iterfind(), itersiblings(), itertree(), makeelement(), remove(), replace(), xpath()

Inherited from object

__delattr__(), __format__(), __getattribute__(), __hash__(), __reduce__(), __reduce_ex__(), __setattr__(), __sizeof__(), __str__(), __subclasshook__()

Properties

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
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</table>
| **Inherited from lxml.etree._Entity**
name, tag, text |
| **Inherited from ??.__ContentOnlyElement**
attrib |
| **Inherited from lxml.etree._Element**
base, nsmap, prefix, sourceline, tail |
| **Inherited from object**
__class__ |

Class Error

object

exceptions.BaseException

exceptions.Exception

lxml.etree.Error
Known Subclasses: lxml.etree.LxmlError

Methods

Inherited from exceptions.Exception

__init__(), __new__()

Inherited from exceptions.BaseException

__delattr__(), __getattribute__(), __getitem__(), __getslice__(), __reduce__(), __repr__(), __setattr__(), __setstate__(), __str__(), __unicode__()

Inherited from object

__format__(), __hash__(), __reduce_ex__(), __sizeof__(), __subclasshook__()

Properties

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inherited from exceptions.BaseException</td>
<td></td>
</tr>
<tr>
<td>args, message</td>
<td></td>
</tr>
<tr>
<td>Inherited from object</td>
<td></td>
</tr>
<tr>
<td><strong>class</strong></td>
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</tr>
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</table>

Class Variables

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>qualname</strong></td>
<td>Value: ‘Error’</td>
</tr>
</tbody>
</table>

Class ErrorDomains

```python
object __
```
```
lxml.etree.ErrorDomains
```
Libxml2 error domains

Methods

Inherited from object

__delattr__(), __format__(), __getattribute__(), __hash__(), __init__(), __new__(), __reduce__(), __reduce_ex__(), __repr__(), __setattr__(), __sizeof__(), __str__(), __subclasshook__()
### Class ErrorDomains

#### Properties

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>class</strong></td>
<td>Inherited from object</td>
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</tbody>
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#### Class Variables

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<tr>
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<td>CATALOG</td>
<td>Value: 20</td>
</tr>
<tr>
<td>CHECK</td>
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<tr>
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<td>Value: 15</td>
</tr>
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<td>SCHEMASV</td>
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<tr>
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<td>Value: 22</td>
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</table>
Class ErrorLevels

object lxml.etree.ErrorLevels

Libxml2 error levels

Methods

_Inherited from object_

__delattr__(), __format__(), __getattribute__(), __hash__(), __init__(), __new__(),
__reduce__(), __reduce_ex__(), __repr__(), __setattr__(), __sizeof__(), __str__(),
__subclasshook__()

Properties

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
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Class Variables

<table>
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<th>Name</th>
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Class ErrorTypes

object lxml.etree.ErrorTypes

Libxml2 error types

Methods

_Inherited from object_

__delattr__(), __format__(), __getattribute__(), __hash__(), __init__(), __new__(),
__reduce__(), __reduce_ex__(), __repr__(), __setattr__(), __sizeof__(), __str__(),

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Class ErrorTypes

__subclasshook__()  

Properties  

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Class FallbackElementClassLookup

object

lxml.etree.ElementClassLookup

lxml.etree.FallbackElementClassLookup


FallbackElementClassLookup(self, fallback=None)

Superclass of Element class lookups with additional fallback.

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Class HTMLParser

Methods

```python
__init__(self, fallback=None)
```
x.__init__(...) initializes x; see help(type(x)) for signature  Overrides: object.__init__

```python
__new__(T, S, ...)
```
Return Value
a new object with type S, a subtype of T
Overrides: object.__new__

```python
set_fallback(self, lookup)
```

Sets the fallback scheme for this lookup method.

Inherited from object

```python
__delattr__(), __format__(), __getattribute__(), __hash__(), __reduce__(), __reduce_ex__(), __repr__(), __setattribute__(), __sizeof__(), __str__(), __subclasshook__()
```

Properties

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Inherited from object

```python
__class__
```

Class HTMLParser

object

```python
??._BaseParser
```

```python
lxml.etree._FeedParser
```

```python
lxml.etree.HTMLParser
```

**Known Subclasses:** lxml.etree.HTMLPullParser, lxml.html.HTMLParser

HTMLParser(self, encoding=None, remove_blank_text=False, remove_comments=False, remove_pis=False, strip_cdata=True, no_network=True, target=None, XMLSchema schema=None, recover=True, compact=True)
The HTML parser.

This parser allows reading HTML into a normal XML tree. By default, it can read broken (non-well-formed) HTML, depending on the capabilities of libxml2. Use the ‘recover’ option to switch this off.

Available boolean keyword arguments:

- recover - try hard to parse through broken HTML (default: True)
- no_network - prevent network access for related files (default: True)
- remove_blank_text - discard empty text nodes that are ignorable (i.e. not actual text content)
- remove_comments - discard comments
- remove_pis - discard processing instructions
- strip_cdata - replace CDATA sections by normal text content (default: True)
- compact - save memory for short text content (default: True)

Other keyword arguments:

- encoding - override the document encoding
- target - a parser target object that will receive the parse events
- schema - an XMLSchema to validate against

Note that you should avoid sharing parsers between threads for performance reasons.

Methods

```python
__init__(self, encoding=None, remove_blank_text=False,
         remove_comments=False, remove_pis=False, strip_cdata=True,
         no_network=True, target=None, XMLSchema schema=None, recover=True,
         compact=True)
```

x.__init__(...) initializes x; see help(type(x)) for signature  Overrides: object.__init__

```python
__new__(T, S, ...)
```

Return Value

a new object with type S, a subtype of T  Overrides: object.__new__

Inherited from lxml.etree._FeedParser

close(), feed()
Class LxmlError

Inherited from lxml.etree._BaseParser

copy(), makeelement(), setElementClassLookup(), set_element_class_lookup()

Inherited from object

__delattr__(), __format__(), __getattribute__(), __hash__(), __reduce__(), __reduce_ex__(), __repr__(), __setattr__(), __sizeof__(), __str__(), __subclasshook__()

Properties

<table>
<thead>
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</tr>
<tr>
<td>feed_error_log</td>
<td></td>
</tr>
<tr>
<td>Inherited from lxml.etree._BaseParser</td>
<td></td>
</tr>
<tr>
<td>error_log, resolvers, target, version</td>
<td></td>
</tr>
<tr>
<td>Inherited from object</td>
<td></td>
</tr>
<tr>
<td><strong>class</strong></td>
<td></td>
</tr>
</tbody>
</table>

Class LxmlError

object

exceptions.BaseException

exceptions.Exception

lxml.etree.Error

lxml.etree.LxmlError


Main exception base class for lxml. All other exceptions inherit from this one.

Methods

__init__(...)

x.__init__(...) initializes x; see help(type(x)) for signature  Overrides: object.__init__ exitit(inherited documentation)

Inherited from exceptions.Exception

__new__()
**Class LxmlRegistryError**

Inherited from exceptions.BaseException

```
__delattr__(), __getattribute__(), __getitem__(), __getslice__(), __reduce__(), __repr__(),
__setattr__(), __setstate__(), __str__(), __unicode__()
```

Inherited from object

```
__format__(), __hash__(), __reduce_ex__(), __sizeof__(), __subclasshook__()
```

### Properties

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
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<tbody>
<tr>
<td>Inherited from exceptions.BaseException</td>
<td>args, message</td>
</tr>
<tr>
<td>Inherited from object</td>
<td><strong>class</strong></td>
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### Class Variables

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>qualname</strong></td>
<td>Value: 'LxmlError'</td>
</tr>
</tbody>
</table>

**Class LxmlRegistryError**

```
object

exceptions.BaseException

exceptions.Exception

lxml.etree.Error

lxml.etree.LxmlError

lxml.etree.LxmlRegistryError
```

**Known Subclasses:** lxml.etree.NamespaceRegistryError

Base class of lxml registry errors.

**Methods**

**Inherited from lxml.etree.LxmlError (Section B)**

```
__init__()
```

**Inherited from exceptions.Exception**

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Class LxmlSyntaxError

Inherited from exceptions.BaseException

```
__delattr__(), __getattr__(), __getitem__(), __getslice__(), __reduce__(), __repr__(), __setattr__(), __setstate__(), __str__(), __unicode__()
```

Inherited from object

```
__format__(), __hash__(), __reduce_ex__(), __sizeof__(), __subclasshook__()
```

Properties

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
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<tbody>
<tr>
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<tr>
<td>args, message</td>
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<tr>
<td>Inherited from object</td>
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<td><strong>class</strong></td>
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Class Variables

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<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>qualname</strong></td>
<td>Value: 'LxmlRegistryError'</td>
</tr>
</tbody>
</table>

Class LxmlSyntaxError

Object

exceptions.BaseException

exceptions.Exception

lxml.etree.Error

lxml.etree.LxmlError
**Known Subclasses:** lxml.etree.ParseError, lxml.etree.XPathSyntaxError, lxml.ElementInclude.FatalIncludeError

Base class for all syntax errors.

**Methods**

*Inherited from lxml.etree.LxmlError (Section B)*

- \_init\_()

*Inherited from exceptions.SyntaxError*

- \_new\_(), \_str\_()

*Inherited from exceptions.BaseException*

- \_delattr\_(), \_getattribute\_(), \_getitem\_(), \_getslice\_(), \_reduce\_(), \_repr\_(), \_setattr\_(), \_setstate\_(), \_unicode\_()

*Inherited from object*

- \_format\_(), \_hash\_(), \_reduce_ex\_(), \_sizeof\_(), \_subclasshook\_()

**Properties**

<table>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>filename, lineno, msg, offset, print_file_and_line, text</td>
<td></td>
</tr>
</tbody>
</table>
Class NamespaceRegistryError

Error registering a namespace extension.

Methods

*Inherited from lxml.etree.LxmlError (Section B)*

`__init__()`

*Inherited from exceptions.Exception*

`__new__()`

*Inherited from exceptions.BaseException*

`__delattr__(), __getattr__( ), __getitem__( ), __getslice__( ), __reduce__( ), __repr__( ), __setattr__( ), __setstate__( ), __str__( ), __unicode__( )`

*Inherited from object*

`__format__( ), __hash__( ), __reduce_ex__( ), __sizeof__( ), __subclasshook__( )`

Properties

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Inherited from exceptions.BaseException</em></td>
<td>args, message</td>
</tr>
<tr>
<td><em>Inherited from object</em></td>
<td><strong>class</strong></td>
</tr>
</tbody>
</table>

Class Variables

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Class PIBase

object

lxml.etree._Element

??._ContentOnlyElement

lxml.etree._ProcessingInstruction

lxml.etree.PIBase

Known Subclasses: lxml.etree._XSLTProcessingInstruction, lxml.html.HtmlProcessingInstruction

All custom Processing Instruction classes must inherit from this one.

To create an XML ProcessingInstruction instance, use the PI() factory.

Subclasses must not override __init__ or __new__ as it is absolutely undefined when these objects will be created or destroyed. All persistent state of PIs must be stored in the underlying XML. If you really need to initialize the object after creation, you can implement an _init(self) method that will be called after object creation.

Methods

_init__(...)  
x._init__(...) initializes x; see help(type(x)) for signature  Overrides: object._init__

__new__(T, S, ...)

Return Value

a new object with type S, a subtype of T

Overrides: object.__new__

_Inherited from lxml.etree._ProcessingInstruction_

__repr__(), get()  

_Inherited from ??._ContentOnlyElement_

__delitem__(), __getitem__(), __len__(), __setitem__(), append(), insert(), items(), keys(), set(), values()
Inherited from lxml.etree._Element

__contains__(), __copy__(), __deepcopy__(), __iter__(), __nonzero__(), __reversed__(),
addnext(), addprevious(), clear(), extend(), find(), findall(), findtext(), getchildren(),
getiterator(), getnext(), getparent(), getprevious(), getroottree(), index(), iter(), iter-
ancestors(), iterchildren(), iterdescendants(), iterfind(), itersiblings(), itertext(), ma-
keelement(), remove(), replace(), xpath()

Inherited from object

__delattr__(), __format__(), __getattribute__(), __hash__(), __reduce__(), __reduce_ex__(),
__setattr__(), __sizeof__(), __str__(), __subclasshook__()

Properties

<table>
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<tr>
<th>Name</th>
<th>Description</th>
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<tr>
<td>Inherited from ??.__ContentOnlyElement text</td>
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</tr>
<tr>
<td>Inherited from lxml.etree._Element base, nsmap, prefix, sourceline,</td>
<td></td>
</tr>
<tr>
<td>tail</td>
<td></td>
</tr>
<tr>
<td>Inherited from object <strong>class</strong></td>
<td></td>
</tr>
</tbody>
</table>
Class ParseError

object

exceptions.BaseException

exceptions.Exception

lxml.etree.Error

lxml.etree.LxmlError

object

exceptions.BaseException

exceptions.Exception

exceptions.StandardError

exceptions.SyntaxError

lxml.etree.LxmlSyntaxError

lxml.etree.ParseError

Known Subclasses: lxml.etree.XMLSyntaxError

Syntax error while parsing an XML document.

For compatibility with ElementTree 1.3 and later.

Methods

__init__(...)

x.__init__(...) initializes x; see help(type(x)) for signature

Overrides:

object.__init__ extit(inherited documentation)

Inherited from exceptions.SyntaxError

__new__(), __str__()

Inherited from exceptions.BaseException

__delattr__(), __getattribute__(), __getitem__(), __getslice__(), __reduce__(), __repr__(),
__setattr__(), __setstate__(), __unicode__()

Inherited from object
Class ParserBasedElementClassLookup Module lxml.etree

__format__(), __hash__(), __reduce_ex__(), __sizeof__(), __subclasshook__()

Properties

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>Inherited from exceptions.SyntaxError</td>
<td>filename, lineno, msg, offset, print_file_and_line, text</td>
</tr>
<tr>
<td>Inherited from exceptions.BaseException</td>
<td>args, message</td>
</tr>
<tr>
<td>Inherited from object</td>
<td><strong>class</strong></td>
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Class Variables

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>qualname</em>_</td>
<td>Value: 'ParseError'</td>
</tr>
</tbody>
</table>

Class ParserBasedElementClassLookup

object

lxml.etree.ElementClassLookup

lxml.etree.FallbackElementClassLookup

lxml.etree.ParserBasedElementClassLookup

ParserBasedElementClassLookup(self, fallback=None) Element class lookup based on the XML parser.

Methods

__new__(T, S, ...)

Return Value

a new object with type S, a subtype of T

Overrides: object.__new__

Inherited from lxml.etree.FallbackElementClassLookup(Section B)

__init__(), set_fallback()

Inherited from object

__delattr__(), __format__(), __getattribute__(), __hash__(), __reduce__(), __reduce_ex__(),
__repr__(), __setattr__(), __sizeof__(), __str__(), __subclasshook__()
Properties

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inherited from lxml.etree.FallbackElementClassLookup (Section B)</strong></td>
<td>fallback</td>
</tr>
<tr>
<td><strong>Inherited from object</strong></td>
<td><em>class</em></td>
</tr>
</tbody>
</table>

**Class ParserError**

object

exceptions.BaseException

exceptions.Exception

lxml.etree.Error

lxml.etree.LxmlError

lxml.etree.ParserError

Internal lxml parser error.

Methods

**Inherited from lxml.etree.LxmlError(Section B)**

__init__()  

**Inherited from exceptions.Exception**

__new__()  

**Inherited from exceptions.BaseException**

__delattr__(), __getattribute__(), __getitem__(), __getslice__(), __reduce__(), __repr__(), __setattr__(), __setstate__(), __str__(), __unicode__()

**Inherited from object**

__format__(), __hash__(), __reduce_ex__(), __sizeof__(), __subclasshook__()

Properties

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inherited from exceptions.BaseException</strong></td>
<td>args, message</td>
</tr>
</tbody>
</table>

continued on next page
Class PyErrorLog

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>class</strong></td>
<td>Inherited from object</td>
</tr>
</tbody>
</table>

Class Variables

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>qualname</strong></td>
<td>Value: ’ParserError’</td>
</tr>
</tbody>
</table>

Class PyErrorLog

object └── lxml.etree._BaseErrorLog └── lxml.etree.PyErrorLog

PyErrorLog(self, logger_name=None, logger=None)  A global error log that connects to the Python stdlib logging package.

The constructor accepts an optional logger name or a readily instantiated logger instance.

If you want to change the mapping between libxml2’s ErrorLevels and Python logging levels, you can modify the level_map dictionary from a subclass.

The default mapping is:

```python
ErrorLevels.WARNING = logging.WARNING
ErrorLevels.ERROR = logging.ERROR
ErrorLevels.FATAL = logging.CRITICAL
```

You can also override the method receive() that takes a LogEntry object and calls self.log(log_entry, format_string, arg1, arg2, ...) with appropriate data.

Methods

```python
__init__(self, logger_name=None, logger=None)

x.__init__(...) initializes x; see help(type(x)) for signature
Overrides: object.__init__
```

```python
__new__(T, S, ...)

Return Value
  a new object with type S, a subtype of T
Overrides: object.__new__
```
copy(...)  

Dummy method that returns an empty error log. Overrides: lxml.etree._BaseErrorLog.copy

log(self, log_entry, message, *args)

Called by the .receive() method to log a _LogEntry instance to the Python logging system. This handles the error level mapping.

In the default implementation, the message argument receives a complete log line, and there are no further args. To change the message format, it is best to override the .receive() method instead of this one.

receive(self, log_entry)

Receive a _LogEntry instance from the logging system. Calls the .log() method with appropriate parameters:

    self.log(log_entry, repr(log_entry))

You can override this method to provide your own log output format. Overrides: lxml.etree._BaseErrorLog.receive

Inherited from lxml.etree._BaseErrorLog

__repr__()  

Inherited from object

__delattr__(), __format__(), __getattribute__(), __hash__(), __reduce__(), __reduce_ex__(), __setattr__(), __sizeof__(), __str__(), __subclasshook__()

Properties

<table>
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<th>Description</th>
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<tbody>
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<td>Inherited from lxml.etree._BaseErrorLog</td>
</tr>
<tr>
<td>last_error</td>
<td>Inherited from object</td>
</tr>
<tr>
<td><strong>class</strong></td>
<td></td>
</tr>
</tbody>
</table>
Class PythonElementClassLookup

object  lxml.etree.ElementClassLookup  lxml.etree.FallbackElementClassLookup  lxml.etree.PythonElementClassLookup

PythonElementClassLookup(self, fallback=None) Element class lookup based on a subclass method.

This class lookup scheme allows access to the entire XML tree in read-only mode. To use it, re-implement the lookup(self, doc, root) method in a subclass:

```python
from lxml import etree, pyclasslookup

class MyElementClass(etree.ElementBase):
    honkey = True

class MyLookup(pyclasslookup.PythonElementClassLookup):
    def lookup(self, doc, root):
        if root.tag == "sometag":
            return MyElementClass
        else:
            for child in root:
                if child.tag == "someothertag":
                    return MyElementClass
            # delegate to default
            return None
```

If you return None from this method, the fallback will be called.

The first argument is the opaque document instance that contains the Element. The second argument is a lightweight Element proxy implementation that is only valid during the lookup. Do not try to keep a reference to it. Once the lookup is done, the proxy will be invalid.

Also, you cannot wrap such a read-only Element in an ElementTree, and you must take care not to keep a reference to them outside of the lookup() method.

Note that the API of the Element objects is not complete. It is purely read-only and does not support all features of the normal lxml.etree API (such as XPath, extended slicing or some iteration methods).

See http://codespeak.net/lxml/element_classes.html
Methods

```
__new__(T, S, ...)  
```

**Return Value**

a new object with type S, a subtype of T

Overrides: object.__new__

```
lookup(self, doc, element)
```

Override this method to implement your own lookup scheme.

*Inherited from lxml.etree.FallbackElementClassLookup* (Section B)

```
__init__(), set_fallback()
```

*Inherited from object*

```
__delattr__(), __format__(), __getattribute__(), __hash__(), __reduce__(), __reduce_ex__(),
__repr__(), __setattr__(), __sizeof__(), __str__(), __subclasshook__()
```

Properties

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<tr>
<td><code>__class__</code></td>
<td>Inherited from object</td>
</tr>
</tbody>
</table>

Class QName

```
object lxml.etree.QName
```

QName(text_or_uri_or_element, tag=None)

QName wrapper for qualified XML names.

Pass a tag name by itself or a namespace URI and a tag name to create a qualified name. Alternatively, pass an Element to extract its tag name.

The `text` property holds the qualified name in `{namespace}tagname` notation. The `namespace` and `localname` properties hold the respective parts of the tag name.

You can pass QName objects wherever a tag name is expected. Also, setting Element text from a QName will resolve the namespace prefix and set a qualified text value. This is helpful in XML languages like SOAP or XML-Schema that use prefixed tag names in their text content.
Methods

```python
__eq__(x, y)

x==y
```

```python
__ge__(x, y)

x>=y
```

```python
__gt__(x, y)

x>y
```

```python
__hash__(x)

hash(x)  Overrides: object.__hash__
```

```python
__init__(text_or_uri_or_element, tag=None)

x.__init__(...) initializes x; see help(type(x)) for signature  Overrides: object.__init__
```

```python
__le__(x, y)

x<=y
```

```python
__lt__(x, y)

x<y
```

```python
__ne__(x, y)

x!=y
```
Class RelaxNG

__new__(T, S, ...)  
Return Value
    a new object with type S, a subtype of T  
Overrides: object.__new__

__str__(x)

str(x)  Overrides: object.__str__

Inherited from object

__delattr__(), __format__(), __getattribute__(), __reduce__(), __reduce_ex__(), __repr__(),
__setattr__(), __sizeof__(), __subclasshook__()

Properties

<table>
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<th>Name</th>
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<td>localname</td>
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<tr>
<td>namespace</td>
<td></td>
</tr>
<tr>
<td>text</td>
<td></td>
</tr>
<tr>
<td>Inherited from object</td>
<td></td>
</tr>
<tr>
<td><strong>class</strong></td>
<td></td>
</tr>
</tbody>
</table>

Class RelaxNG

object

lxml.etree._Validator

lxml.etree.RelaxNG

RelaxNG(self, etree=None, file=None) Turn a document into a Relax NG validator.

Either pass a schema as Element or ElementTree, or pass a file or filename through the file keyword argument.

Methods

__call__(self, etree)

Validate doc using Relax NG.

Returns true if document is valid, false if not.
Class RelaxNGError

Module lxml.etree

__init__(self, etree=None, file=None)

x.__init__(...) initializes x; see help(type(x)) for signature  Overrides: object.__init__

__new__(T, S, ...)

Return Value
   a new object with type S, a subtype of T
   Overrides: object.__new__

Inherited from lxml.etree._Validator

assertValid(), assert_(), validate()

Inherited from object

__delattr__(), __format__(), __getattribute__(), __hash__(), __reduce__(), __reduce_ex__(),
__repr__(), __setattr__(), __sizeof__(), __str__(), __subclasshook__()

Properties

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
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<tbody>
<tr>
<td>Inherited from lxml.etree._Validator</td>
<td>error_log</td>
</tr>
<tr>
<td>Inherited from object</td>
<td><strong>class</strong></td>
</tr>
</tbody>
</table>

Class RelaxNGError

object

exceptions.BaseException

exceptions.Exception

lxml.etree.Error

lxml.etree.LxmlError

lxml.etree.RelaxNGError

Known Subclasses: lxml.etree.RelaxNGParseError, lxml.etree.RelaxNGValidateError

Base class for RelaxNG errors.
Class RelaxNGErrorTypes

Methods

Inherited from lxml.etree.LxmlError (Section B)

__init__()

Inherited from exceptions.Exception

__new__()

Inherited from exceptions.BaseException

__delattr__(), __getattr__(), __getitem__(), __getslice__(), __reduce__(), __repr__(),
__setattr__(), __setstate__(), __str__(), __unicode__()

Inherited from object

__format__(), __hash__(), __reduce_ex__(), __sizeof__(), __subclasshook__()

Properties

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>Inherited from exceptions.BaseException</td>
<td></td>
</tr>
<tr>
<td>args, message</td>
<td></td>
</tr>
<tr>
<td>Inherited from object</td>
<td></td>
</tr>
<tr>
<td><strong>class</strong></td>
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Class Variables

<table>
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<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Value: 'RelaxNGError'</td>
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</table>

Class RelaxNGErrorTypes

object

lxml.etree.RelaxNGErrorTypes

Libxml2 RelaxNG error types

Methods

Inherited from object

__delattr__(), __format__(), __getattr__(), __getitem__(), __getslice__(), __reduce__(),
__repr__(), __setattr__(), __sizeof__(), __str__(),
 subclasshook__()
### Class Properties

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
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### Class Variables

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<td>RELAXNG_ERR_LACKDATA</td>
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<td>RELAXNG_ERR_LIST</td>
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<td>RELAXNG_ERR_TYPEVAL</td>
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<td>RELAXNG_ERR_VALUE</td>
<td>Value: 32</td>
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<td>RELAXNG_OK</td>
<td>Value: 0</td>
</tr>
<tr>
<td><strong>qualname</strong></td>
<td>Value: 'RelaxNGErrorTypes'</td>
</tr>
</tbody>
</table>
Class RelaxNGParseError

Error while parsing an XML document as RelaxNG.

Methods

Inherited from lxml.etree.LxmlError (Section B)

___init___()

Inherited from exceptions.Exception

___new___()

Inherited from exceptions.BaseException

___delattr___(), ___getattribute___(), ___getitem___(), ___getslice___(), ___reduce___(), ___repr___(),
___setattr___(), ___setstate___(), ___str___(), ___unicode___()

Inherited from object

___format___(), ___hash___(), ___reduce_ex___(), ___sizeof___(), ___subclasshook___()

Properties

+-----------------+------------------+
<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
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<tr>
<td>Inherited from</td>
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<tr>
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<tr>
<td>args, message</td>
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<tr>
<td>Inherited from</td>
<td></td>
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<tr>
<td>object</td>
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<td><strong>class</strong></td>
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</table>

Class Variables

continued on next page
Class RelaxNGValidateError

Error while validating an XML document with a RelaxNG schema.

Methods

_Inherited from lxml.etree.LxmlError (Section B)_

___init__()  

_Inherited from exceptions.Exception_

___new__()  

_Inherited from exceptions.BaseException_

___delattr___(), ___getattribute___(), ___getitem___(), ___getslice___(), ___reduce___(), ___repr___(), ___setattr___(), ___setstate___(), ___str___(), ___unicode___()  

_Inherited from object_

___format___(), ___hash___(), ___reduce_ex___(), ___sizeof___(), ___subclasshook___()  

Properties

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<td>Inherited from object</td>
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### Class Variables

<table>
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<tr>
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<th>Description</th>
</tr>
</thead>
<tbody>
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</tr>
</tbody>
</table>

### Class Resolver

```python
object
    lxml.etreeResolver
```

This is the base class of all resolvers.

### Methods

**__new__**(T, S, ...)

**Return Value**

- a new object with type S, a subtype of T

Overrides: object.__new__

**resolve**(self, system_url, public_id, context)

Override this method to resolve an external source by system_url and public_id. The third argument is an opaque context object.

Return the result of one of the resolve_*() methods.

**resolve_empty**(self, context)

Return an empty input document.

Pass context as parameter.
resolve_file(self, f, context, base_url=None, close=True)

Return an open file-like object as input document.

Pass open file and context as parameters. You can pass the base URL or filename of the file through the base_url keyword argument. If the close flag is True (the default), the file will be closed after reading.

Note that using resolve_filename() is more efficient, especially in threaded environments.

resolve_filename(self, filename, context)

Return the name of a parsable file as input document.

Pass filename and context as parameters. You can also pass a URL with an HTTP, FTP or file target.

resolve_string(self, string, context, base_url=None)

Return a parsable string as input document.

Pass data string and context as parameters. You can pass the source URL or filename through the base_url keyword argument.

Inherited from object

__delattr__(), __format__(), __getattribute__(), __hash__(), __init__(), __reduce__(), __reduce_ex__(), __repr__(), __setattr__(), __sizeof__(), __str__(), __subclasshook__()

Properties

<table>
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<tr>
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<td>Inherited from object</td>
<td></td>
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<tr>
<td><strong>class</strong></td>
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</tr>
</tbody>
</table>

Class Schematron

object

lxml.etree._Validator

lxml.etree.Schematron
Schematron(self, etree=None, file=None) A Schematron validator.

Pass a root Element or an ElementTree to turn it into a validator. Alternatively, pass a filename as keyword argument 'file' to parse from the file system.

Schematron is a less well known, but very powerful schema language. The main idea is to use the capabilities of XPath to put restrictions on the structure and the content of XML documents. Here is a simple example:

```python
>>> schematron = Schematron(XML(''
... <schema xmlns="http://www.ascc.net/xml/schematron"
... <pattern name="id is the only permitted attribute name">
... <rule context="*">
... <report test="@*[not(name()=='id')]">Attribute
... <name path="@*[not(name()=='id')]"/> is forbidden</name/>
... </report>
... </rule>
... </pattern>
... </schema>
... ''
))

>>> xml = XML(''
... <AAA name="aaa">
... <BBB id="bbb"/>
... <CCC color="ccc"/>
... </AAA>
... ''
)

>>> schematron.validate(xml)
0

>>> xml = XML(''
... <AAA id="aaa">
... <BBB id="bbb"/>
... <CCC/>
... </AAA>
... ''
)

>>> schematron.validate(xml)
1
```

Schematron was added to libxml2 in version 2.6.21. Before version 2.6.32, however, Schematron lacked support for error reporting other than to stderr. This version is therefore required to retrieve validation warnings and errors in lxml.
Class Schematron

Module lxml.etree

Methods

__call__(self, etree)

Validate doc using Schematron.
Returns true if document is valid, false if not.

__init__(self, etree=None, file=None)

x.__init__(...) initializes x; see help(type(x)) for signature
Overrides: object.__init__

__new__(T, S, ...)

Return Value
a new object with type S, a subtype of T
Overrides: object.__new__

Inherited from lxml.etree._Validator

assertValid(), assert_(), validate()

Inherited from object

__delattr__(), __format__(), __getattr__(), __hash__(), __reduce__(), __reduce_ex__(),
__repr__(), __setattr__(), __sizeof__(), __str__(), __subclasshook__()

Properties

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
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<tr>
<td>error_log</td>
<td></td>
</tr>
<tr>
<td>Inherited from object</td>
<td><strong>class</strong></td>
</tr>
</tbody>
</table>
Class SchematronError

object  
exceptions.BaseException  
exceptions.Exception  
lxml.etree.Error  
lxml.etree.LxmlError  
lxml.etree.SchematronError

Known Subclasses: lxml.etree.SchematronParseError, lxml.etree.SchematronValidateError

Base class of all Schematron errors.

Methods

Inherited from lxml.etree.LxmlError (Section B)

__init__()

Inherited from exceptions.Exception

__new__()

Inherited from exceptions.BaseException

__delattr__(), __getattribute__(), __getitem__(), __getslice__(), __reduce__(), __repr__(), 
__setattr__(), __setstate__(), __str__(), __unicode__()

Inherited from object

__format__(), __hash__(), __reduce_ex__(), __sizeof__(), __subclasshook__()

Properties

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inherited from exceptions.BaseException</td>
<td>args, message</td>
</tr>
<tr>
<td>Inherited from object</td>
<td><strong>class</strong></td>
</tr>
</tbody>
</table>

| Class Variables | continued on next page |
Class SchematronParseError

Error while parsing an XML document as Schematron schema.

Methods

_Inherited from lxml.etree.LxmlError (Section B)_

__init__()  

_Inherited from exceptions.Exception_  

__new__()  

_Inherited from exceptions.BaseException_  

__delattr__(), __getattr__(), __getitem__(), __getslice__(), __reduce__(), __repr__(),  

__setattr__(), __setstate__(), __str__(), __unicode__()  

_Inherited from object_  

__format__(), __hash__(), __reduce_ex__(), __sizeof__(), __subclasshook__()  

Properties

<table>
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<tr>
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_Inherited from exceptions.BaseException_  

desc, message

_Inherited from object_  

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Class SchematronValidateError

<table>
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<th>Description</th>
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<tbody>
<tr>
<td><strong>class</strong></td>
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Class Variables

<table>
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<tr>
<th>Name</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td><strong>qualname</strong></td>
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</tr>
</tbody>
</table>

Class SchematronValidateError

object

exceptions.BaseException

exceptions.Exception

lxml.etree.Error

lxml.etree.LxmlError

lxml.etree.SchematronError

lxml.etree.SchematronValidateError

Error while validating an XML document with a Schematron schema.

Methods

Inherited from lxml.etree.LxmlError (Section B)

__init__()  

Inherited from exceptions.Exception

__new__()  

Inherited from exceptions.BaseException

__delattr__(), __getattribute__(), __getitem__(), __getslice__(), __reduce__(), __repr__(),
__setattr__(), __setstate__(), __str__(), __unicode__()

Inherited from object

__format__(), __hash__(), __reduce_ex__(), __sizeof__(), __subclasshook__()

Properties
Class SerialisationError

object

exceptions.BaseException

elements.Exception

lxml.etree.Error

lxml.etree.LxmlError

lxml.etree.SerialisationError

A libxml2 error that occurred during serialisation.

Methods

Inherited from lxml.etree.LxmlError (Section B)

__init__()

Inherited from exceptions.Exception

__new__()

Inherited from exceptions.BaseException

__delattr__(), __getattr__', '__getitem__(), __getslice__(), __reduce__(), __repr__(),

__setattr__(), __setstate__(), __str__(), __unicode__()

Inherited from object

__format__(), __hash__(), __reduce_ex__(), __sizeof__(), __subclasshook__()

Properties

379
Class TreeBuilder

object
 lxml.etree._SaxParserTarget  lxml.etree.TreeBuilder

TreeBuilder(self, element_factory=None, parser=None) Parser target that builds a tree. The final tree is returned by the close() method.

Methods

__init__(self, element_factory=None, parser=None)

x.__init__(...) initializes x; see help(type(x)) for signature  Overrides: object.__init__

__new__(T, S, ...)
Return Value
  a new object with type S, a subtype of T
Overrrides: object.__new__

close(self)
Flushing the builder buffers, and returns the toplevel document element.

comment(self, comment)
**data**(self, data)

Adds text to the current element. The value should be either an 8-bit string containing ASCII text, or a Unicode string.

**end**(self, tag)

Closes the current element.

**pi**(self, target, data)

**start**(self, tag, attrs, nsmap=None)

Opens a new element.

*Inherited from object*

__delattr__(), __format__(), __getattribute__(), __hash__(), __reduce__(), __reduce_ex__(), __repr__(), __setattr__(), __sizeof__(), __str__(), __subclasshook__()

**Properties**

<table>
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<tr>
<th>Name</th>
<th>Description</th>
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<td>Inherited from object</td>
<td></td>
</tr>
<tr>
<td><strong>class</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Class XInclude**

```python
data = lxml.etree.XInclude
```

XInclude(self) XInclude processor.

Create an instance and call it on an Element to run XInclude processing.

**Methods**

```python
__call__(self, node)
```
Class `XIncludeError`  

```python
_\_init\_(self)
```

x.__init__(...) initializes x; see help(type(x)) for signature  
Overrides: object.__init__

```python
_\_new\_(T, S, ...)
```

**Return Value**

a new object with type S, a subtype of T  
Overrides: object.__new__

**Inherited from object**

```python
__delattr__(), __format__(), __getattribute__(), __hash__(), __reduce__(), __reduce_ex__(),
__repr__(), __setattr__(), __sizeof__(), __str__(), __subclasshook__()
```

**Properties**

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<tr>
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<tbody>
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<tr>
<td><em>class</em>_</td>
<td></td>
</tr>
</tbody>
</table>

Class `XIncludeError`

```
object  

exceptions.BaseException  

exceptions.Exception  

lxml.etree.Error  

lxml.etree.LxmlError  

lxml.etree.XIncludeError
```

Error during XInclude processing.

**Methods**

*Inherited from `lxml.etree.LxmlError` (Section B)*

```python
_\_init\_()
```

*Inherited from `exceptions.Exception`*
Class XMLParser

__new__()

Inherited from exceptions.BaseException

__delattr__(), __getattribute__(), __getitem__(), __getslice__(), __reduce__(), __repr__(),
__setattr__(), __setstate__(), __str__(), __unicode__()

Inherited from object

__format__(), __hash__(), __reduce_ex__(), __sizeof__(), __subclasshook__()

Properties

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inherited from exceptions.BaseException</td>
<td>args, message</td>
</tr>
<tr>
<td>Inherited from object</td>
<td><strong>class</strong></td>
</tr>
</tbody>
</table>

Class Variables

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>qualname</strong></td>
<td>Value: ‘XIncludeError’</td>
</tr>
</tbody>
</table>

Class XMLParser

object

??._BaseParser

lxml.etree._FeedParser

lxml.etree.XMLParser

Known Subclasses: lxml.etree.ETCompatXMLParser, lxml.etree.XMLPullParser, lxml.html.XHTMLParser

XMLParser(self, encoding=None, attribute_defaults=False, dtd_validation=False, load_dtd=False,
no_network=True, ns_clean=False, recover=False, XMLSchema schema=None, remove_blank_text=False,
resolve_entities=True, remove_comments=False, remove_pis=False, strip_cdata=True, collect_ids=True,
target=None, compact=True)

The XML parser.

Parsers can be supplied as additional argument to various parse functions of the lxml API. A default parser is always available and can be replaced by a call to the global function 'set_default_parser'. New parsers can be created at any time without a major run-time overhead.

The keyword arguments in the constructor are mainly based on the libxml2 parser configu-
A DTD will also be loaded if DTD validation or attribute default values are requested (unless you additionally provide an XMLSchema from which the default attributes can be read).

Available boolean keyword arguments:

- **attribute_defaults** - inject default attributes from DTD or XMLSchema
- **dtd_validation** - validate against a DTD referenced by the document
- **load_dtd** - use DTD for parsing
- **no_network** - prevent network access for related files (default: True)
- **ns_clean** - clean up redundant namespace declarations
- **recover** - try hard to parse through broken XML
- **remove_blank_text** - discard blank text nodes that appear ignorable
- **remove_comments** - discard comments
- **remove_pis** - discard processing instructions
- **strip_cdata** - replace CDATA sections by normal text content (default: True)
- **compact** - save memory for short text content (default: True)
- **collect_ids** - create a hash table of XML IDs (default: True, always True with DTD validation)
- **resolve_entities** - replace entities by their text value (default: True)
- **huge_tree** - disable security restrictions and support very deep trees and very long text content (only affects libxml2 2.7+)

Other keyword arguments:

- **encoding** - override the document encoding
- **target** - a parser target object that will receive the parse events
- **schema** - an XMLSchema to validate against

Note that you should avoid sharing parsers between threads. While this is not harmful, it is more efficient to use separate parsers. This does not apply to the default parser.
Class XMLParser

Module lxml.etree

Methods

```python
__init__(self, encoding=None, attribute_defaults=False,
         dtd_validation=False, load_dtd=False, no_network=True,
         ns_clean=False, recover=False, XMLSchema schema=None,
         remove_blank_text=False, resolve_entities=True,
         remove_comments=False, remove_pis=False, strip_cdata=True,
         collect_ids=True, target=None, compact=True)
```

x.__init__(...) initializes x; see help(type(x)) for signature  Overrides: object.__init__

```python
__new__(T, S, ...)
```

**Return Value**

a new object with type S, a subtype of T  Overrides: object.__new__

Inherited from lxml.etree._FeedParser

close(), feed()

Inherited from ??._BaseParser

copy(), makeelement(), setElementClassLookup(), set_element_class_lookup()

Inherited from object

__delattr__(), __format__(), __getattribute__(), __hash__(), __reduce__(), __reduce_ex__(), __repr__(), __setattr__(), __sizeof__(), __str__(), __subclasshook__()

Properties

<table>
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<tr>
<th>Name</th>
<th>Description</th>
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<tr>
<td>error_log, resolvers, target, version</td>
<td>Inherited from ??._BaseParser</td>
</tr>
<tr>
<td><strong>class</strong></td>
<td>Inherited from object</td>
</tr>
</tbody>
</table>
Class XMLSchema

object

lxml.etree._Validator

lxml.etree.XMLSchema

XMLSchema(self, etree=None, file=None) Turn a document into an XML Schema validator. Either pass a schema as Element or ElementTree, or pass a file or filename through the file keyword argument.

Passing the attribute_defaults boolean option will make the schema insert default/ fixed attributes into validated documents.

Methods

__call__(self, etree)


Returns true if document is valid, false if not.

__init__(self, etree=None, file=None)

x.__init__(...) initializes x; see help(type(x)) for signature

Overrides:

object.__init__

__new__(T, S, ...)

Return Value

a new object with type S, a subtype of T

Overrides: object.__new__

Inherited from lxml.etree._Validator

assertValid(), assert_(), validate()

Inherited from object

__delattr__(), __format__(), __getattribute__(), __hash__(), __reduce__(), __reduce_ex__(), __repr__(), __setattr__(), __sizeof__(), __str__(), __subclasshook__()

Properties
### Class XMLSchemaError

object

exceptions.BaseException

exceptions.Exception

lxml.etree.Error

lxml.etree.LxmlError

**lxml.etree.XMLSchemaError**

**Known Subclasses:** lxml.etree.XMLSchemaParseError, lxml.etree.XMLSchemaValidateError

Base class of all XML Schema errors

### Methods

**Inherited from lxml.etree.LxmlError (Section B)**

__init__()

**Inherited from exceptions.Exception**

__new__()

**Inherited from exceptions.BaseException**

__delattr__(), __getattr__(), __getitem__(), __getslice__(), __reduce__(), __repr__(),

__setattr__(), __setstate__(), __str__(), __unicode__()

**Inherited from object**

__format__(), __hash__(), __reduce_ex__(), __sizeof__(), __subclasshook__()

### Properties

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>class</strong></td>
<td>Inherited from object</td>
</tr>
<tr>
<td>error_log</td>
<td>Inherited from lxml.etree._Validator</td>
</tr>
</tbody>
</table>

continued on next page
Class `XMLSchemaParseError`

Inherited from `object`

Class Variables

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>qualname</strong></td>
<td>Value: <code>'XMLSchemaError'</code></td>
</tr>
</tbody>
</table>

Class `XMLSchemaParseError`

```
object └── exceptions.BaseException
       └── exceptions.Exception
           └── lxml.etree.Error
               └── lxml.etree.LxmlError
                   └── lxml.etree.XMLSchemaError
                       └── lxml.etree.XMLSchemaParseError
```

Error while parsing an XML document as XML Schema.

Methods

**Inherited from `lxml.etree.LxmlError`**

- `__init__()`

**Inherited from `exceptions.Exception`**

- `__new__()`

**Inherited from `exceptions.BaseException`**

- `__delattr__()`, `__setattr__()`, `__getitem__()`, `__getslice__()`, `__reduce__()`, `__repr__()`, `__setattr__()`, `__setstate__()`, `__str__()``, `__unicode__()`

**Inherited from `object`**

- `__format__()`, `__hash__()`, `__reduce_ex__()`, `__sizeof__()``, `__subclasshook__()`

Properties
### Class Variables

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>qualname</strong></td>
<td>Value: ‘XMLSchemaParseError’</td>
</tr>
</tbody>
</table>

### Class XMLSchemaValidateError


#### Methods

- **Inherited from lxml.etree.LxmlError (Section B)**
  - __init__()

- **Inherited from exceptions.Exception**
  - __new__()

- **Inherited from exceptions.BaseException**
  - __delattr__(), __getattr__(), __getitem__(), __getslice__(), __reduce__(), __repr__(),
    __setattr__(), __setstate__(), __str__(), __unicode__()

- **Inherited from object**
  - __format__(), __hash__(), __reduce_ex__(), __sizeof__(), __subclasshook__()
Class `XMLSyntaxError`  

Inherited from `exceptions.BaseException`

*args, message

Inherited from `object`

__class__

Class Variables

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>qualname</strong></td>
<td>Value: 'XMLSchemaValidateError'</td>
</tr>
</tbody>
</table>

Class `XMLSyntaxError`

Syntax error while parsing an XML document.
Class ETCompatXMLParser

Inherited from lxml.etree.ParseError (Section B)

- __init__()  

Inherited from exceptions_SyntaxError

- __new__(), __str__()

Inherited from exceptions_BaseException

- __delattr__(), __getattr__(), __getitem__(), __getslice__(), __reduce__(), __repr__(),  
  __setattr__(), __setstate__(), __unicode__()

Inherited from object

- __format__(), __hash__(), __reduce_ex__(), __sizeof__(), __subclasshook__()

Properties

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inherited from exceptions_SyntaxError</td>
<td>filename, lineno, msg, offset, print_file_and_line, text</td>
</tr>
<tr>
<td>Inherited from exceptions_BaseException</td>
<td>args, message</td>
</tr>
<tr>
<td>Inherited from object</td>
<td><strong>class</strong></td>
</tr>
</tbody>
</table>

Class Variables

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>qualname</strong></td>
<td>Value: 'XMLSyntaxError'</td>
</tr>
</tbody>
</table>

Class ETCompatXMLParser

object

??._BaseParser

lxml.etree._FeedParser

lxml.etree.XMLParser

lxml.etree.ETCompatXMLParser

ETCompatXMLParser(self, encoding=None, attribute_defaults=False, dtd_validation=False, load_dtd=False, no_network=True, ns_clean=False, recover=False, schema=None, huge_tree=False,
remove_blank_text=False, resolve_entities=True, remove_comments=True, remove_pis=True, strip_cdata=True, target=None, compact=True)

An XML parser with an ElementTree compatible default setup.

See the XMLParser class for details.

This parser has remove_comments and remove_pis enabled by default and thus ignores comments and processing instructions.

Methods

```python
__init__(self, encoding=None, attribute_defaults=False, dtd_validation=False, load_dtd=False, no_network=True, ns_clean=False, recover=False, schema=None, huge_tree=False, remove_blank_text=False, resolve_entities=True, remove_comments=True, remove_pis=True, strip_cdata=True, target=None, compact=True)
```

x.__init__(...) initializes x; see help(type(x)) for signature  
Overrides: object.__init__

```python
__new__(T, S, ...)
```

Return Value

- a new object with type S, a subtype of T

Overrides: object.__new__

Inherited from lxml.etree._FeedParser

- close()
- feed()

Inherited from ??._BaseParser

- copy()
- makeelement()
- setElementClassLookup()
- set_element_class_lookup()

Inherited from object

- __delattr__()
- __format__()
- __getattribute__()
- __hash__()
- __reduce__()
- __reduce_ex__()
- __repr__()
- __setattr__()
- __sizeof__()
- __str__()
- __subclasshook__()

Properties

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inherited from lxml.etree._FeedParser</td>
<td>feed_error_log</td>
</tr>
<tr>
<td>Inherited from ??._BaseParser</td>
<td>error_log, resolvers, target, version</td>
</tr>
<tr>
<td>Inherited from object</td>
<td></td>
</tr>
</tbody>
</table>

continued on next page
Class XPath

```
object

lxml.etree._XPathEvaluatorBase

lxml.etree.XPath

Known Subclasses: lxml.etree.ETXPath, lxml.cssselect.CSSSelector
```

XPath(self, path, namespaces=None, extensions=None, regexp=True, smart_strings=True)

A compiled XPath expression that can be called on Elements and ElementTrees.

Besides the XPath expression, you can pass prefix-namespace mappings and extension functions to the constructor through the keyword arguments namespaces and extensions. EXSLT regular expression support can be disabled with the 'regexp' boolean keyword (defaults to True). Smart strings will be returned for string results unless you pass smart_strings=False.

Methods

```
__call__(self, _etree_or_element, **_variables)

__init__(self, path, namespaces=None, extensions=None, regexp=True, smart_strings=True)

x.__init__(...) initializes x; see help(type(x)) for signature  Overrides: object.__init__

__new__(T, S, ...)

Return Value

    a new object with type S, a subtype of T

Overrides: object.__new__

__repr__(x)

repr(x)  Overrides: object.__repr__

Inherited from lxml.etree._XPathEvaluatorBase

evaluate()
Class XPathDocumentEvaluator

Inherited from object

__delattr__(), __format__(), __getattribute__(), __hash__(), __reduce__(), __reduce_ex__(),
__setattr__(), __sizeof__(), __str__(), __subclasshook__()

Properties

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>path</td>
<td>The literal XPath expression.</td>
</tr>
</tbody>
</table>

Inherited from lxml.etree._XPathEvaluatorBase

error_log

Inherited from object

__class__

Class XPathDocumentEvaluator

object

lxml.etree._XPathEvaluatorBase

lxml.etree.XPathElementEvaluator

lxml.etree.XPathDocumentEvaluator

XPathDocumentEvaluator(self, etree, namespaces=None, extensions=None, regexp=True, smart_strings=True)

Create an XPath evaluator for an ElementTree.

Additional namespace declarations can be passed with the 'namespace' keyword argument. EXSLT regular expression support can be disabled with the 'regexp' boolean keyword (defaults to True). Smart strings will be returned for string results unless you pass smart_strings=False.

Methods

__call__(self, _path, **_variables)

Evaluate an XPath expression on the document.

Variables may be provided as keyword arguments. Note that namespaces are currently not supported for variables. Overrides:
lxml.etree.XPathElementEvaluator.__call__
Class XPathError

object

exceptions.BaseException

exceptions.Exception

lxml.etree.Error

lxml.etree.LxmlError

lxml.etree.XPathError
**Known Subclasses:** lxml.etree.XPathEvalError, lxml.etree.XPathSyntaxError

Base class of all XPath errors.

**Methods**

*Inherited from lxml.etree.LxmlError (Section B)*

   _init_()

*Inherited from exceptions.Exception*

   _new_()

*Inherited from exceptions.BaseException*

   _delattr_(), _getattribute_(), _getitem_(), _getslice_(), _reduce_(), _repr_(),
   _setattr_(), _setstate_(), _str_(), _unicode_()

*Inherited from object*

   _format_(), _hash_(), _reduce_ex_(), _sizeof_(), _subclasshook_()

**Properties**

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inherited from exceptions.BaseException</td>
<td>args, message</td>
</tr>
<tr>
<td>Inherited from object</td>
<td><strong>class</strong></td>
</tr>
</tbody>
</table>

**Class Variables**

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>qualname</strong></td>
<td>Value: 'XPathError'</td>
</tr>
</tbody>
</table>
Class `XPathEvalError`

```
object
| exceptions.BaseException
| exceptions.Exception
| lxml.etree.Error
| lxml.etree.LxmlError
| lxml.etree.XPathError
| lxml.etree.XPathEvalError
```

**Known Subclasses:** lxml.etree.XPathFunctionError, lxml.etree.XPathResultError

Error during XPath evaluation.

**Methods**

*Inherited from lxml.etree.LxmlError (Section B)*

```
__init__()
```

*Inherited from exceptions.Exception*

```
__new__()
```

*Inherited from exceptions.BaseException*

```
__delattr__(), __getattribute__(), __getitem__(), __getslice__(), __reduce__(), __repr__(),
__setattr__(), __setstate__(), __str__(), __unicode__()
```

*Inherited from object*

```
__format__(), __hash__(), __reduce_ex__(), __sizeof__(), __subclasshook__()
```

**Properties**

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inherited from exceptions.BaseException</td>
<td>args, message</td>
</tr>
<tr>
<td>Inherited from object</td>
<td><strong>class</strong></td>
</tr>
</tbody>
</table>

**Class Variables**

397
Class `XPathFunctionError`

object

exceptions.BaseException

exceptions.Exception

lxml.etree.Error

lxml.etree.LxmlError

lxml.etree.XPathError

lxml.etree.XPathEvalError

lxml.etree.XPathFunctionError

Internal error looking up an XPath extension function.

Methods

`Inherited from lxml.etree.LxmlError(Section B)`

`__init__()`

`Inherited from exceptions.Exception`

`__new__()`

`Inherited from exceptions.BaseException`

`__delattr__()`, `__getattr__()`, `__getitem__()`, `__getslice__()`, `__reduce__()`, `__repr__()`,
`__setattr__()`, `__setstate__()`, `__str__()`, `__unicode__()`

`Inherited from object`

`__format__()`, `__hash__()`, `__reduce_ex__()`, `__sizeof__()`, `__subclasshook__()`

Properties

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inherited from exceptions.BaseException</td>
<td>args, message</td>
</tr>
<tr>
<td>Inherited from object</td>
<td></td>
</tr>
</tbody>
</table>

continued on next page
Class **XPathResultError**

Object

```
exceptions.BaseException
  exceptions.Exception
    lxml.etree.Error
    lxml.etree.LxmlError
    lxml.etree.XPathError
    lxml.etree.XPathEvalError
    lxml.etree.XPathResultError
```

Error handling an XPath result.

**Methods**

*Inherited from lxml.etree.LxmlError* (Section B)

- `__init__()`

*Inherited from exceptions.Exception*

- `__new__()`

*Inherited from exceptions.BaseException*

- `__delattr__()`, `__getattribute__()`, `__getitem__()`, `__getslice__()`, `__reduce__()`, `__repr__()`, `__setattr__()`, `__setstate__()`, `__str__()` , `__unicode__()`

*Inherited from object*

- `__format__()`, `__hash__()`, `__reduce_ex__()`, `__sizeof__()`, `__subclasshook__()`
Class XPathResultError

Module lxml.etree

Properties

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inherited from exceptions.BaseException</td>
<td>args, message</td>
</tr>
<tr>
<td>Inherited from object</td>
<td><strong>class</strong></td>
</tr>
</tbody>
</table>

Class Variables

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>qualname</strong></td>
<td>Value: 'XPathResultError'</td>
</tr>
</tbody>
</table>
Class **XPathSyntaxError**

```
object
exceptions.BaseException
exceptions.Exception
lxml.etree.Error
lxml.etree.LxmlError
object
exceptions.BaseException
exceptions.Exception
exceptions.StandardError
exceptions.SyntaxError
lxml.etree.LxmlSyntaxError
object
exceptions.BaseException
exceptions.Exception
lxml.etree.Error
lxml.etree.LxmlError
lxml.etree.XPathError
lxml.etree.XPathSyntaxError
```

**Methods**

*Inherited from lxml.etree.LxmlError* (Section B)

- `__init__()`

*Inherited from exceptions.SyntaxError*

- `__new__()`, `__str__()`
Inherited from exceptions.BaseException

__delattr__(), __getattribute__(), __getitem__(), __getslice__(), __reduce__(), __repr__(),
__setattr__(), __setstate__(), __unicode__()

Inherited from object

__format__(), __hash__(), __reduce_ex__(), __sizeof__(), __subclasshook__()

Properties

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inherited from exceptions.SyntaxError</td>
<td>filename, lineno, msg, offset, print_file_and_line, text</td>
</tr>
<tr>
<td>Inherited from exceptions.BaseException</td>
<td>args, message</td>
</tr>
<tr>
<td>Inherited from object</td>
<td><strong>class</strong></td>
</tr>
</tbody>
</table>

Class Variables

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>qualname</strong></td>
<td>Value: 'XPathSyntaxError'</td>
</tr>
</tbody>
</table>

Class XSLT

```python
object lxml.etree.XSLT

XSLT(self, xslt_input, extensions=None, regexp=True, access_control=None)
```

Turn an XSL document into an XSLT object.

Calling this object on a tree or Element will execute the XSLT:

```python
transform = etree.XSLT(xsl_tree)
result = transform(xml_tree)
```

Keyword arguments of the constructor:

- extensions: a dict mapping (namespace, name) pairs to extension functions or extension elements
- regexp: enable exslt regular expression support in XPath (default: True)
- access_control: access restrictions for network or file system (see XSLTAccessControl)

Keyword arguments of the XSLT call:
Class XSLT

- profile_run: enable XSLT profiling (default: False)

Other keyword arguments of the call are passed to the stylesheet as parameters.

Methods

```python
__call__(self, _input, profile_run=False, **kw)
```

Execute the XSL transformation on a tree or Element.

Pass the `profile_run` option to get profile information about the XSLT. The result of the XSLT will have a property `xslt_profile` that holds an XML tree with profiling data.

```python
__copy__(...)
```

```python
__deepcopy__(...)
```

```python
__init__(self, xslt_input, extensions=None, regexp=True, access_control=None)
```

x.__init__(...) initializes x; see help(type(x)) for signature

Overrides: object.__init__

```python
__new__(T, S, ...)
```

Return Value

a new object with type S, a subtype of T

Overrides: object.__new__

```python
apply(self, _input, profile_run=False, **kw)
```

Deprecated: call the object, not this method.
**set_global_max_depth(max_depth)**

The maximum traversal depth that the stylesheet engine will allow. This does not only count the template recursion depth but also takes the number of variables/parameters into account. The required setting for a run depends on both the stylesheet and the input data.

Example:

```python
XSLT.set_global_max_depth(5000)
```

Note that this is currently a global, module-wide setting because libxslt does not support it at a per-stylesheet level.

**strparam(strval)**

Mark an XSLT string parameter that requires quote escaping before passing it into the transformation. Use it like this:

```python
result = transform(doc, some_strval = XSLT.strparam('it’s "Monty Python’s" ...'))
```

Escaped string parameters can be reused without restriction.

**tostring(self, result_tree)**

Save result doc to string based on stylesheet output method. **Deprecated:** use `str(result_tree)` instead.

### Inherited from object

_Delattr_, _format_, _getattr_, _hash_, _reduce_, _reduce_ex_, _repr_, _setattr_, _sizeof_, _str_, subclasshook_

### Properties

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>error_log</td>
<td>The log of errors and warnings of an XSLT execution.</td>
</tr>
</tbody>
</table>

_Inherited from object_

__class__
Class XSLTAccessControl

```python
object

lxml.etree.XSLTAccessControl
```

XSLTAccessControl(self, read_file=True, write_file=True, create_dir=True, read_network=True,
write_network=True)

Access control for XSLT: reading/writing files, directories and network I/O. Access to a type
of resource is granted or denied by passing any of the following boolean keyword arguments.
All of them default to True to allow access.

- read_file
- write_file
- create_dir
- read_network
- write_network

For convenience, there is also a class member `DENY_ALL` that provides an XSLTAccessControl
instance that is readily configured to deny everything, and a `DENY_WRITE` member that denies
all write access but allows read access.

See XSLT.

Methods

```python
__init__(self, read_file=True, write_file=True, create_dir=True,
read_network=True, write_network=True)
```

x.__init__(...) initializes x; see help(type(x)) for signature Overrides:
object.__init__

```python
__new__(T, S, ...)
```

Return Value

a new object with type S, a subtype of T

Overrides: object.__new__

```python
__repr__(x)
```

repr(x) Overrides: object.__repr__

Inherited from object
__delattr__(), __format__(), __getattribute__(), __hash__(), __reduce__(), __reduce_ex__(),
__setattr__(), __sizeof__(), __str__(), __subclasshook__()

Properties

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>options</td>
<td>The access control configuration as a map of</td>
</tr>
<tr>
<td></td>
<td>options.</td>
</tr>
</tbody>
</table>

_Inherited from object_

__class__

Class Variables

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DENY_ALL</td>
<td>Value: XSLTAccessControl(create_dir=False,</td>
</tr>
<tr>
<td></td>
<td>read_file=False, read...</td>
</tr>
<tr>
<td>DENY_WRITE</td>
<td>Value: XSLTAccessControl(create_dir=False,</td>
</tr>
<tr>
<td></td>
<td>read_file=True, read...</td>
</tr>
</tbody>
</table>

Class XSLTApplyError

object

exceptions.BaseException

exceptions.Exception

lxml.etree.Error

lxml.etree.LxmlError

lxml.etree.XSLTError

lxml.etree.XrLApplyError

Error running an XSL transformation.

Methods

_Inherited from lxml.etree.LxmlError(Section B)_

__init__()
Class XSLTError

Inherited from exceptions.Exception

__new__(self)

Inherited from exceptions.BaseException

__delattr__(), __getattribute__(), __getitem__(), __getslice__(), __reduce__(), __repr__(),
__setattr__(), __setstate__(), __str__(), __unicode__()

Inherited from object

__format__(), __hash__(), __reduce_ex__(), __sizeof__(), __subclasshook__()

Properties

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inherited from exceptions.BaseException</td>
<td>args, message</td>
</tr>
<tr>
<td>Inherited from object</td>
<td><strong>class</strong></td>
</tr>
</tbody>
</table>

Class Variables

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>qualname</strong></td>
<td>Value: ‘XSLTApplyError’</td>
</tr>
</tbody>
</table>

Class XSLTError

object

exceptions.BaseException

exceptions.Exception

lxml.etree.Error

lxml.etree.LxmlError

lxml.etree.XSLTError

Known Subclasses: lxml.etree.XSLTApplyError, lxml.etree.XSLTExtensionError, lxml.etree.XSLTParseError,
lxml.etree.XSLTSaveError

Base class of all XSLT errors.
Class XSLTEntity

Module lxml.etree

Methods

_Inherited from lxml.etree.LxmlError(Section B)_

__init__()

_Inherited from exceptions.Exception_

__new__()

_Inherited from exceptions.BaseException_

__delattr__(), __getattribute__(), __getitem__(), __getslice__(), __reduce__(), __repr__(),
__setattr__(), __setstate__(), __str__(), __unicode__()

_Inherited from object_

__format__(), __hash__(), __reduce_ex__(), __sizeof__(), __subclasshook__()

Properties

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inherited from exceptions.BaseException</td>
<td>args, message</td>
</tr>
<tr>
<td>Inherited from object</td>
<td><strong>class</strong></td>
</tr>
</tbody>
</table>

Class Variables

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>qualname</strong></td>
<td>Value: 'XSLTErrror'</td>
</tr>
</tbody>
</table>

Class XSLTEntity

object

lxml.etree.XSLTEntity

Base class of an XSLT extension element.

Methods

__new__(T, S, ...)

_Return Value_

a new object with type S, a subtype of T

Overrides: object.__new__
apply_templates(self, context, node, output_parent=None, elements_only=False, remove_blank_text=False)

Call this method to retrieve the result of applying templates to an element.

The return value is a list of elements or text strings that were generated by the XSLT processor. If you pass elements_only=True, strings will be discarded from the result list. The option remove_blank_text=True will only discard strings that consist entirely of whitespace (e.g. formatting). These options do not apply to Elements, only to bare string results.

If you pass an Element as output_parent parameter, the result will instead be appended to the element (including attributes etc.) and the return value will be None. This is a safe way to generate content into the output document directly, without having to take care of special values like text or attributes. Note that the string discarding options will be ignored in this case.

execute(self, context, self_node, input_node, output_parent)

Execute this extension element.

Subclasses must override this method. They may append elements to the output_parent element here, or set its text content. To this end, the input_node provides read-only access to the current node in the input document, and the self_node points to the extension element in the stylesheet.

Note that the output_parent parameter may be None if there is no parent element in the current context (e.g. no content was added to the output tree yet).
**process_children**(*self, context, output_parent=None, elements_only=False, remove_blank_text=False*)

Call this method to process the XSLT content of the extension element itself.

The return value is a list of elements or text strings that were generated by the XSLT processor. If you pass `elements_only=True`, strings will be discarded from the result list. The option `remove_blank_text=True` will only discard strings that consist entirely of whitespace (e.g. formatting). These options do not apply to Elements, only to bare string results.

If you pass an Element as `output_parent` parameter, the result will instead be appended to the element (including attributes etc.) and the return value will be `None`. This is a safe way to generate content into the output document directly, without having to take care of special values like text or attributes. Note that the string discarding options will be ignored in this case.

**Inherited from object**

```
__delattr__(), __format__(), __getattribute__(), __hash__(), __init__(), __reduce__(),
__reduce_ex__(), __repr__(), __setattr__(), __sizeof__(), __str__(), __subclasshook__()
```

**Properties**

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inherited from object</td>
<td></td>
</tr>
<tr>
<td><strong>class</strong></td>
<td></td>
</tr>
</tbody>
</table>

Class **XSLTEXTensionError**

```
object

exceptions.BaseException

exceptions.Exception

lxml.etree.Error

lxml.etree.LxmlError

lxml.etree.XSLTError

lxml.etree.XSLTEXTensionError
```

Error registering an XSLT extension.
Methods

*Inherited from lxml.etree.LxmlError (Section B)*

__init__()  

*Inherited from exceptions.Exception*

__new__()  

*Inherited from exceptions.BaseException*

__delattr__(), __getattribute__(), __getitem__(), __getslice__(), __reduce__(), __repr__(),
__setattr__(), __setstate__(), __str__(), __unicode__()

*Inherited from object*

__format__(), __hash__(), __reduce_ex__(), __sizeof__(), __subclasshook__()

Properties

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inherited from exceptions.BaseException</td>
<td>args, message</td>
</tr>
<tr>
<td>Inherited from object</td>
<td><strong>class</strong></td>
</tr>
</tbody>
</table>

Class Variables

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>qualname</strong></td>
<td>Value: 'XSLTExtensionError'</td>
</tr>
</tbody>
</table>

Class XSLTParseError

object    

exceptions.BaseException    

exceptions.Exception    

lxml.etree.Error    

lxml.etree.LxmlError    

lxml.etree.XSLTError    

lxml.etree.XSLTParseError
Error parsing a stylesheet document.

Methods

*Inherited from lxml.etree.LxmlError (Section B)*

__init__()  

*Inherited from exceptions.Exception*

__new__()  

*Inherited from exceptions.BaseException*

__delattr__(), __getattribute__(), __getitem__(), __getslice__(), __reduce__(), __repr__(), __setattr__(), __setstate__(), __str__(), __unicode__()

*Inherited from object*

__format__(), __hash__(), __reduce_ex__(), __sizeof__(), __subclasshook__()

Properties

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>Inherited from exceptions.BaseException</td>
<td>args, message</td>
</tr>
<tr>
<td>Inherited from object</td>
<td><strong>class</strong></td>
</tr>
</tbody>
</table>

Class Variables

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>qualname</strong></td>
<td>Value: ‘XSLTParseError’</td>
</tr>
</tbody>
</table>
Class XSLTSaveError

object

dependencies

exceptions.BaseException

exceptions.Exception

lxml.etree.Error

lxml.etree.LxmlError

lxml.etree.XSLTError

lxml.etree.XSLTSaveError

Error serialising an XSLT result.

Methods

_Inherited from lxml.etree.LxmlError (Section B)_

__init__()  

_Inherited from exceptions.Exception_

__new__()  

_Inherited from exceptions.BaseException_

_delattr__(), _getattribute__(), _getitem__(), _getslice__(), _reduce__(), _repr__(),  

_setattr__(), _setstate__(), _str__(), _unicode__()  

_Inherited from object_

__format__(), __hash__(), __reduce_ex__(), __sizeof__(), __subclasshook__()

Properties

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
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<tbody>
<tr>
<td>Inherited from exceptions.BaseException</td>
<td>args, message</td>
</tr>
<tr>
<td>Inherited from object</td>
<td><strong>class</strong></td>
</tr>
</tbody>
</table>

Class Variables

continued on next page
Class `iterparse`

```python
class iterparse(object):
    lxml.etree.iterparse

iterparse(self, source, events=('<end>'), tag=None, attribute_defaults=False, dtd_validation=False, load_dtd=False, no_network=True, remove_blank_text=False, remove_comments=False, remove_pis=False, encoding=None, html=False, recover=None, huge_tree=False, schema=None)
```

Incremental parser.

Parses XML into a tree and generates tuples (event, element) in a SAX-like fashion. `event` is any of 'start', 'end', 'start-ns', 'end-ns'.

For 'start' and 'end', `element` is the Element that the parser just found opening or closing. For 'start-ns', it is a tuple (prefix, URI) of a new namespace declaration. For 'end-ns', it is simply None. Note that all start and end events are guaranteed to be properly nested.

The keyword argument `events` specifies a sequence of event type names that should be generated. By default, only 'end' events will be generated.

The additional `tag` argument restricts the 'start' and 'end' events to those elements that match the given tag. By default, events are generated for all elements. Note that the 'start-ns' and 'end-ns' events are not impacted by this restriction.

The other keyword arguments in the constructor are mainly based on the libxml2 parser configuration. A DTD will also be loaded if validation or attribute default values are requested.

**Available boolean keyword arguments:**
- `attribute_defaults`: read default attributes from DTD
- `dtd_validation`: validate (if DTD is available)
- `load_dtd`: use DTD for parsing
- `no_network`: prevent network access for related files
- `remove_blank_text`: discard blank text nodes
- `remove_comments`: discard comments
- `remove_pis`: discard processing instructions
- `strip_cdata`: replace CDATA sections by normal text content (default: True)
- `compact`: safe memory for short text content (default: True)
• resolve_entities: replace entities by their text value (default: True)

• **huge_tree**: disable security restrictions and support very deep trees and very long text content (only affects libxml2 2.7+)

• html: parse input as HTML (default: XML)

• **recover**: try hard to parse through broken input (default: True for HTML, False otherwise)

Other keyword arguments:

• encoding: override the document encoding

• schema: an XMLSchema to validate against

Methods

```python
__init__(self, source, events=("end", ), tag=None, attribute_defaults=False, dtd_validation=False, load_dtd=False, no_network=True, remove_blank_text=False, remove_comments=False, remove_pis=False, encoding=None, html=False, recover=None, huge_tree=False, schema=None)
```

x.__init__(...) initializes x; see help(type(x)) for signature  Overrides: object.__init__

```python
__iter__(x)
```

iter(x)

```python
__new__(T, S, ...)
```

**Return Value**

a new object with type S, a subtype of T

Overrides: object.__new__

```python
__next__(...)
```

```python
makeelement(self, _tag, attrib=None, nsmap=None, **extra)
```

Creates a new element associated with this parser.
next(x)

Return Value
the next value, or raise StopIteration

set_element_class_lookup(self, lookup=None)

Set a lookup scheme for element classes generated from this parser.
Reset it by passing None or nothing.

Inherited from object
__delattr__(), __format__(), __getattribute__(), __hash__(), __reduce__(), __reduce_ex__(),
__repr__(), __setattribute__(), __sizeof__(), __str__(), __subclasshook__()

Properties

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>error_log</td>
<td>The error log of the last (or current) parser run.</td>
</tr>
<tr>
<td>resolvers</td>
<td>The custom resolver registry of the last (or current) parser run.</td>
</tr>
<tr>
<td>root</td>
<td></td>
</tr>
<tr>
<td>version</td>
<td>The version of the underlying XML parser.</td>
</tr>
</tbody>
</table>

Inherited from object
__class__

Class iterwalk

object

lxml.etree.iterwalk

iterwalk(self, element_or_tree, events=("end"), tag=None)

A tree walker that generates events from an existing tree as if it was parsing XML data with iterparse().

Methods

__init__(self, element_or_tree, events=("end"), tag=None)

x.__init__(...) initializes x; see help(type(x)) for signature  Overrides:
object.__init__
Class iterwalk Module lxml.etree

__iter__(x)

iter(x)

__new__(T, S, ...)

Return Value
a new object with type S, a subtype of T
Overrides: object.__new__

__next__(...)

next(x)

Return Value
the next value, or raise StopIteration

Inherited from object

__delattr__(), __format__() , __getattr__() , __hash__(), __reduce__(), __reduce_ex__() ,
__repr__(), __setattr__(), __sizeof__(), __str__() , __subclasshook__() 

Properties

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inherited from object</td>
<td></td>
</tr>
<tr>
<td><strong>class</strong></td>
<td></td>
</tr>
</tbody>
</table>
Package lxml.html

The lxml.html tool set for HTML handling.

Modules

- **ElementSoup**: Legacy interface to the BeautifulSoup HTML parser.
  *(Section B, p. 423)*
- **_setmixin** *(Section ??, p. ??)*
- **builder**: A set of HTML generator tags for building HTML documents.
  *(Section B, p. 424)*
- **clean**: A cleanup tool for HTML.
  *(Section B, p. 427)*
- **defs** *(Section B, p. 431)*
- **diff** *(Section B, p. 433)*
- **formfill** *(Section B, p. 434)*
- **html5parser**: An interface to html5lib that mimics the lxml.html interface.
  *(Section B, p. 436)*
- **soupparser**: External interface to the BeautifulSoup HTML parser.
  *(Section B, p. 439)*
- **usedoctest**: Doctest module for HTML comparison.
  *(Section B, p. 440)*

Functions

```python
document_fromstring(html, parser=None, ensure_head_body=False, **kw)
```

```python
fragments_fromstring(html, no_leading_text=False, base_url=None, parser=None, **kw)
```

 Parses several HTML elements, returning a list of elements.

 The first item in the list may be a string (though leading whitespace is removed).
 If no_leading_text is true, then it will be an error if there is leading text, and it
 will always be a list of only elements.

 base_url will set the document’s base_url attribute (and the tree’s docinfo.URL)
Functions

---

**fragment_fromstring** *(html, create_parent=False, base_url=None, parser=None, **kw)*

Parses a single HTML element; it is an error if there is more than one element, or if anything but whitespace precedes or follows the element.

If `create_parent` is true (or is a tag name) then a parent node will be created to encapsulate the HTML in a single element. In this case, leading or trailing text is also allowed, as are multiple elements as result of the parsing.

Passing a `base_url` will set the document’s `base_url` attribute (and the tree’s `docinfo.URL`).

**fromstring** *(html, base_url=None, parser=None, **kw)*

Parse the html, returning a single element/document.

This tries to minimally parse the chunk of text, without knowing if it is a fragment or a document.

`base_url` will set the document’s `base_url` attribute (and the tree’s `docinfo.URL`)

**parse** *(filename_or_url, parser=None, base_url=None, **kw)*

Parse a filename, URL, or file-like object into an HTML document tree. Note: this returns a tree, not an element. Use `parse(...).getroot()` to get the document root.

You can override the base URL with the `base_url` keyword. This is most useful when parsing from a file-like object.
**submit_form**(*form, extra_values=None, open_http=None*)

Helper function to submit a form. Returns a file-like object, as from urllib.urlopen(). This object also has a .geturl() function, which shows the URL if there were any redirects.

You can use this like:

```python
form = doc.forms[0]
form.inputs['foo'].value = 'bar'  # etc
response = form.submit()
doc = parse(response)
doc.make_links_absolute(response.geturl())
```

To change the HTTP requester, pass a function as open_http keyword argument that opens the URL for you. The function must have the following signature:

```python
open_http(method, URL, values)
```

The action is one of 'GET' or 'POST', the URL is the target URL as a string, and the values are a sequence of (name, value) tuples with the form data.
tostring(doc, pretty_print=False, include_meta_content_type=False, encoding=None, method='html', with_tail=True, doctype=None)

Return an HTML string representation of the document.

Note: if include_meta_content_type is true this will create a `<meta http-equiv="Content-Type" ...>` tag in the head; regardless of the value of include_meta_content_type any existing `<meta http-equiv="Content-Type" ...>` tag will be removed.

The encoding argument controls the output encoding (defaults to ASCII, with &\#...; character references for any characters outside of ASCII). Note that you can pass the name 'unicode' as encoding argument to serialise to a Unicode string.

The method argument defines the output method. It defaults to 'html', but can also be 'xml' for xhtml output, or 'text' to serialise to plain text without markup.

To leave out the tail text of the top-level element that is being serialised, pass with_tail=False.

The doctype option allows passing in a plain string that will be serialised before the XML tree. Note that passing in non well-formed content here will make the XML output non well-formed. Also, an existing doctype in the document tree will not be removed when serialising an ElementTree instance.

Example:

```python
>>> from lxml import html
>>> root = html.fragment_fromstring('<p>Hello<br>world!</p>')

>>> html.tostring(root)
'Hello<br>world!'

>>> html.tostring(root, method='html')
'Hello<br>world!'

>>> html.tostring(root, method='xml')
'Hello<br/>'

>>> html.tostring(root, method='text')
'Hello世界各国！'

>>> html.tostring(root, method='text', encoding='unicode')
u'Hello世界各国！'

>>> root = html.fragment_fromstring('<div><p>Hello<br>world!</p>TAIL</div>')

>>> html.tostring(root[0], method='text', encoding='unicode', with_tail=False)
u'Hello世界各国！'

>>> doc = html.document_fromstring('<p>Hello<br>world!</p>')

>>> html.tostring(doc, method='html', encoding='unicode')
'<html><body><p>Hello<br>world!</p></body></html>'
```
**open_in_browser**(*doc, encoding=None*)

Open the HTML document in a web browser, saving it to a temporary file to open it. Note that this does not delete the file after use. This is mainly meant for debugging.

**Element**(*args, **kw*)

Create a new HTML Element.

This can also be used for XHTML documents.

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>find_rel_links</td>
<td>Value: _MethodFunc('find_rel_links', copy=False)</td>
</tr>
<tr>
<td>find_class</td>
<td>Value: _MethodFunc('find_class', copy=False)</td>
</tr>
<tr>
<td>make_links_absolute</td>
<td>Value: _MethodFunc('make_links_absolute', copy=True)</td>
</tr>
<tr>
<td>resolve_base_href</td>
<td>Value: _MethodFunc('resolve_base_href', copy=True)</td>
</tr>
<tr>
<td>iterlinks</td>
<td>Value: _MethodFunc('iterlinks', copy=False)</td>
</tr>
<tr>
<td>rewrite_links</td>
<td>Value: _MethodFunc('rewrite_links', copy=True)</td>
</tr>
</tbody>
</table>
Module lxml.html.ElementSoup

Legacy interface to the BeautifulSoup HTML parser.

Functions

<table>
<thead>
<tr>
<th>convert_tree(beautiful_soup_tree, makeelement=None)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Convert a BeautifulSoup tree to a list of Element trees.</td>
</tr>
<tr>
<td>Returns a list instead of a single root Element to support HTML-like soup with more than one root element.</td>
</tr>
<tr>
<td>You can pass a different Element factory through the makeelement keyword.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>parse(file, beautifulsoup=None, makeelement=None)</th>
</tr>
</thead>
</table>
Module lxml.html.builder

A set of HTML generator tags for building HTML documents.

Usage:

```python
>>> from lxml.html.builder import *
>>> html = HTML(
...    HEAD( TITLE("Hello World") ),
...    BODY( CLASS("main"),
...          H1("Hello World !")
...    )
...)

>>> import lxml.etree
>>> print lxml.etree.tostring(html, pretty_print=True)
<html>
    <head>
        <title>Hello World</title>
    </head>
    <body class="main">
        <h1>Hello World !</h1>
    </body>
</html>
```

Functions

CLASS(v)

FOR(v)

Variables

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>Value: ElementMaker(makeelement=html_parser.makeelement)</td>
</tr>
<tr>
<td>A</td>
<td>Value: E.a</td>
</tr>
<tr>
<td>ABBR</td>
<td>Value: E.abbr</td>
</tr>
<tr>
<td>ACRONYM</td>
<td>Value: E.acronym</td>
</tr>
<tr>
<td>ADDRESS</td>
<td>Value: E.address</td>
</tr>
<tr>
<td>APPLET</td>
<td>Value: E.applet</td>
</tr>
<tr>
<td>AREA</td>
<td>Value: E.area</td>
</tr>
<tr>
<td>B</td>
<td>Value: E.b</td>
</tr>
<tr>
<td>BASE</td>
<td>Value: E.base</td>
</tr>
<tr>
<td>BASEFONT</td>
<td>Value: E.basefont</td>
</tr>
</tbody>
</table>

continued on next page
<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BDO</td>
<td>Value: E.bdo</td>
</tr>
<tr>
<td>BIG</td>
<td>Value: E.big</td>
</tr>
<tr>
<td>BLOCKQUOTE</td>
<td>Value: E.blockquote</td>
</tr>
<tr>
<td>BODY</td>
<td>Value: E.body</td>
</tr>
<tr>
<td>BR</td>
<td>Value: E.br</td>
</tr>
<tr>
<td>BUTTON</td>
<td>Value: E.button</td>
</tr>
<tr>
<td>CAPTION</td>
<td>Value: E.caption</td>
</tr>
<tr>
<td>CENTER</td>
<td>Value: E.center</td>
</tr>
<tr>
<td>CITE</td>
<td>Value: E.cite</td>
</tr>
<tr>
<td>CODE</td>
<td>Value: E.code</td>
</tr>
<tr>
<td>COL</td>
<td>Value: E.col</td>
</tr>
<tr>
<td>COLGROUP</td>
<td>Value: E.colgroup</td>
</tr>
<tr>
<td>DD</td>
<td>Value: E.dd</td>
</tr>
<tr>
<td>DEL</td>
<td>Value: getattr(E, 'del')</td>
</tr>
<tr>
<td>DFN</td>
<td>Value: E.dfn</td>
</tr>
<tr>
<td>DIR</td>
<td>Value: E.dir</td>
</tr>
<tr>
<td>DIV</td>
<td>Value: E.div</td>
</tr>
<tr>
<td>DL</td>
<td>Value: E_dl</td>
</tr>
<tr>
<td>DT</td>
<td>Value: E.dt</td>
</tr>
<tr>
<td>EM</td>
<td>Value: E.em</td>
</tr>
<tr>
<td>FIELDSET</td>
<td>Value: E.fieldset</td>
</tr>
<tr>
<td>FONT</td>
<td>Value: E.font</td>
</tr>
<tr>
<td>FORM</td>
<td>Value: E.form</td>
</tr>
<tr>
<td>FRAME</td>
<td>Value: E.frame</td>
</tr>
<tr>
<td>FRAMESET</td>
<td>Value: E.frameset</td>
</tr>
<tr>
<td>H1</td>
<td>Value: E.h1</td>
</tr>
<tr>
<td>H2</td>
<td>Value: E.h2</td>
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<tr>
<td>H3</td>
<td>Value: E.h3</td>
</tr>
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<td>H4</td>
<td>Value: E.h4</td>
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<tr>
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<td>Value: E.h5</td>
</tr>
<tr>
<td>H6</td>
<td>Value: E.h6</td>
</tr>
<tr>
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<td>Value: E.head</td>
</tr>
<tr>
<td>HR</td>
<td>Value: E.hr</td>
</tr>
<tr>
<td>HTML</td>
<td>Value: E.html</td>
</tr>
<tr>
<td>I</td>
<td>Value: E.i</td>
</tr>
<tr>
<td>IFRAME</td>
<td>Value: E.iframe</td>
</tr>
<tr>
<td>IMG</td>
<td>Value: E.img</td>
</tr>
<tr>
<td>INPUT</td>
<td>Value: E.input</td>
</tr>
<tr>
<td>INS</td>
<td>Value: E.ins</td>
</tr>
<tr>
<td>ISINDEX</td>
<td>Value: E.isindex</td>
</tr>
<tr>
<td>KBD</td>
<td>Value: E.kbd</td>
</tr>
<tr>
<td>LABEL</td>
<td>Value: E.label</td>
</tr>
<tr>
<td>LEGEND</td>
<td>Value: E.legend</td>
</tr>
<tr>
<td>LI</td>
<td>Value: E.li</td>
</tr>
<tr>
<td>LINK</td>
<td>Value: E.link</td>
</tr>
<tr>
<td>MAP</td>
<td>Value: E.map</td>
</tr>
</tbody>
</table>

---

*continued on next page*
<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MENU</td>
<td>Value: E.menu</td>
</tr>
<tr>
<td>META</td>
<td>Value: E.meta</td>
</tr>
<tr>
<td>NOFRAMES</td>
<td>Value: E.noframes</td>
</tr>
<tr>
<td>NOSCRPT</td>
<td>Value: E.noscript</td>
</tr>
<tr>
<td>OBJECT</td>
<td>Value: E.object</td>
</tr>
<tr>
<td>OL</td>
<td>Value: E.ol</td>
</tr>
<tr>
<td>OPTGROUP</td>
<td>Value: E.optgroup</td>
</tr>
<tr>
<td>OPTION</td>
<td>Value: E.option</td>
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<td>P</td>
<td>Value: E.p</td>
</tr>
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<td>PARAM</td>
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<td>PRE</td>
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<tr>
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<td>Value: E.q</td>
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<td>S</td>
<td>Value: E.s</td>
</tr>
<tr>
<td>SAMP</td>
<td>Value: E.samp</td>
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<tr>
<td>SCRIPT</td>
<td>Value: E.script</td>
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<tr>
<td>SELECT</td>
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</tr>
<tr>
<td>SMALL</td>
<td>Value: E.small</td>
</tr>
<tr>
<td>SPAN</td>
<td>Value: E.span</td>
</tr>
<tr>
<td>STRIKE</td>
<td>Value: E.strike</td>
</tr>
<tr>
<td>STRONG</td>
<td>Value: E.strong</td>
</tr>
<tr>
<td>STYLE</td>
<td>Value: E.style</td>
</tr>
<tr>
<td>SUB</td>
<td>Value: E.sub</td>
</tr>
<tr>
<td>SUP</td>
<td>Value: E.sup</td>
</tr>
<tr>
<td>TABLE</td>
<td>Value: E.table</td>
</tr>
<tr>
<td>TBODY</td>
<td>Value: E.tbody</td>
</tr>
<tr>
<td>TD</td>
<td>Value: E.td</td>
</tr>
<tr>
<td>TEXTAREA</td>
<td>Value: E.textarea</td>
</tr>
<tr>
<td>TFOOT</td>
<td>Value: E.tfoot</td>
</tr>
<tr>
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<td>Value: E.th</td>
</tr>
<tr>
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<td>Value: E.thead</td>
</tr>
<tr>
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</tr>
<tr>
<td>TR</td>
<td>Value: E.tr</td>
</tr>
<tr>
<td>TT</td>
<td>Value: E.tt</td>
</tr>
<tr>
<td>U</td>
<td>Value: E.u</td>
</tr>
<tr>
<td>UL</td>
<td>Value: E.ul</td>
</tr>
<tr>
<td>VAR</td>
<td>Value: E.var</td>
</tr>
<tr>
<td><strong>package</strong></td>
<td>Value: 'lxml.html'</td>
</tr>
</tbody>
</table>
Module lxml.html.clean

A cleanup tool for HTML.
Removes unwanted tags and content. See the Cleaner class for details.

Functions

```python
autolink(el, link_regexes=_link_regexes,
avoid_elements=_avoid_elements, avoid_hosts=_avoid_hosts,
avoid_classes=_avoid_classes)
```

Turn any URLs into links.
It will search for links identified by the given regular expressions (by default mailto and http(s) links).
It won't link text in an element in avoid_elements, or an element with a class in avoid_classes. It won't link to anything with a host that matches one of the regular expressions in avoid_hosts (default localhost and 127.0.0.1).
If you pass in an element, the element’s tail will not be substituted, only the contents of the element.

```python
autolink_html(html, *args, **kw)
```

```python
word_break(el, max_width=40,
avoid_elements=_avoid_word_break_elements,
avoid_classes=_avoid_word_break_classes,
brake_character=unichr(0x200b))
```

Breaks any long words found in the body of the text (not attributes).
Doesn’t effect any of the tags in avoid_elements, by default <textarea> and <pre>
Breaks words by inserting &#8203;, which is a unicode character for Zero Width Space character. This generally takes up no space in rendering, but does copy as a space, and in monospace contexts usually takes up space.

```python
word_break_html(html, *args, **kw)
```
Class Cleaner

```python
class Cleaner:
    def __init__(self, scripts=False, javascript=False, comments=False, style=False, links=False, meta=False, page_structure=False, processing_instructions=False, embedded=False, frames=False, forms=False, annoying_tags=False, remove_tags=False, kill_tags=False, allow_tags=False, remove_unknown_tags=False, safe_attrs_only=False, safe_attrs=False):
        # Initialize attributes
        self.scripts = scripts
        self.javascript = javascript
        self.comments = comments
        self.style = style
        self.links = links
        self.meta = meta
        self.page_structure = page_structure
        self.processing_instructions = processing_instructions
        self.embedded = embedded
        self.frames = frames
        self.forms = forms
        self.annoying_tags = annoying_tags
        self.remove_tags = remove_tags
        self.kill_tags = kill_tags
        self.allow_tags = allow_tags
        self.remove_unknown_tags = remove_unknown_tags
        self.safe_attrs_only = safe_attrs_only
        self.safe_attrs = safe_attrs
```

Variables

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>clean</td>
<td>Value: Cleaner()</td>
</tr>
<tr>
<td>clean_html</td>
<td>Value: clean.clean_html</td>
</tr>
</tbody>
</table>

Instances cleans the document of each of the possible offending elements. The cleaning is controlled by attributes; you can override attributes in a subclass, or set them in the constructor.

- **scripts**: Removes any `<script>` tags.
- **javascript**: Removes any Javascript, like an `onclick` attribute. Also removes stylesheets as they could contain Javascript.
- **comments**: Removes any comments.
- **style**: Removes any style tags or attributes.
- **links**: Removes any `<link>` tags
- **meta**: Removes any `<meta>` tags
- **page_structure**: Structural parts of a page: `<head>`, `<html>`, `<title>`.
- **processing_instructions**: Removes any processing instructions.
- **embedded**: Removes any embedded objects (flash, iframes)
- **frames**: Removes any frame-related tags
- **forms**: Removes any form tags
- **annoying_tags**: Tags that aren’t wrong, but are annoying. `<blink>` and `<marquee>`
- **remove_tags**: A list of tags to remove. Only the tags will be removed, their content will get pulled up into the parent tag.
- **kill_tags**: A list of tags to kill. Killing also removes the tag’s content, i.e. the whole subtree, not just the tag itself.
- **allow_tags**: A list of tags to include (default include all).
- **remove_unknown_tags**: Remove any tags that aren’t standard parts of HTML.
- **safe_attrs_only**: If true, only include ‘safe’ attributes (specifically the list from the feed-parser HTML sanitisation web site).
- **safe_attrs**: A set of attribute names to override the default list of attributes considered
'safe' (when safe_attrs_only=True).

**add_nofollow**: If true, then any `<a>` tags will have `rel="nofollow"` added to them.

**host_whitelist**: A list or set of hosts that you can use for embedded content (for content like `<object>`, `<link rel="stylesheet">`, etc). You can also implement/override the method `allow_embedded_url(el, url)` or `allow_element(el)` to implement more complex rules for what can be embedded. Anything that passes this test will be shown, regardless of the value of (for instance) `embedded`.

Note that this parameter might not work as intended if you do not make the links absolute before doing the cleaning.

Note that you may also need to set `whitelist_tags`.

**whitelist_tags**: A set of tags that can be included with `host_whitelist`. The default is `iframe` and `embed`; you may wish to include other tags like `script`, or you may want to implement `allow_embedded_url` for more control. Set to `None` to include all tags.

This modifies the document *in place*.

**Methods**

```
__init__(self, **kw)
```

x.__init__(...) initializes x; see help(type(x)) for signature

Overrides: object.__init__ (inherited documentation)

```
__call__(self, doc)
```

Cleans the document.

```
allow_follow(self, anchor)
```

Override to suppress rel="nofollow" on some anchors.

```
allow_element(self, el)
```

```
allow_embedded_url(self, el, url)
```

**kill_conditional_comments**(self, doc)

IE conditional comments basically embed HTML that the parser doesn’t normally see. We can’t allow anything like that, so we’ll kill any comments that could be conditional.

**clean_html**(self, html)

*Inherited from object*

__delattr__(), __format__(), __getattribute__(), __hash__(), __new__(), __reduce__(), __reduce_ex__(), __repr__(), __setattr__(), __sizeof__(), __str__(), __subclasshook__()

**Properties**

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>class</em></td>
<td><strong>Inherited from object</strong></td>
</tr>
</tbody>
</table>

**Class Variables**

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
<tr>
<td>javascript</td>
<td>Value: True</td>
</tr>
<tr>
<td>comments</td>
<td>Value: True</td>
</tr>
<tr>
<td>style</td>
<td>Value: False</td>
</tr>
<tr>
<td>links</td>
<td>Value: True</td>
</tr>
<tr>
<td>meta</td>
<td>Value: True</td>
</tr>
<tr>
<td>page_structure</td>
<td>Value: True</td>
</tr>
<tr>
<td>processing_instructions</td>
<td>Value: True</td>
</tr>
<tr>
<td>embedded</td>
<td>Value: True</td>
</tr>
<tr>
<td>frames</td>
<td>Value: True</td>
</tr>
<tr>
<td>forms</td>
<td>Value: True</td>
</tr>
<tr>
<td>annoying_tags</td>
<td>Value: True</td>
</tr>
<tr>
<td>remove_tags</td>
<td>Value: None</td>
</tr>
<tr>
<td>allow_tags</td>
<td>Value: None</td>
</tr>
<tr>
<td>kill_tags</td>
<td>Value: None</td>
</tr>
<tr>
<td>remove_unknown_tags</td>
<td>Value: True</td>
</tr>
<tr>
<td>safe_attrs_only</td>
<td>Value: True</td>
</tr>
<tr>
<td>safe_attrs</td>
<td>Value: frozenset(['abbr', 'accept', 'accept-charset', 'accesskey...])</td>
</tr>
<tr>
<td>addnofollow</td>
<td>Value: False</td>
</tr>
<tr>
<td>host_whitelist</td>
<td>Value: ()</td>
</tr>
<tr>
<td>whitelist_tags</td>
<td>Value: set(['iframe', 'embed'])</td>
</tr>
</tbody>
</table>
### Module lxml.html.defs

#### Variables

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<th>Description</th>
</tr>
</thead>
<tbody>
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<tr>
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</tr>
<tr>
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</tr>
<tr>
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</tr>
<tr>
<td>top_level_tags</td>
<td><code>frozenset(['body', 'frameset', 'head', 'html'])</code></td>
</tr>
<tr>
<td>head_tags</td>
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</tr>
<tr>
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</tr>
<tr>
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</tr>
<tr>
<td>table_tags</td>
<td><code>frozenset(['caption', 'col', 'colgroup', 'table', 'tbody...']</code></td>
</tr>
<tr>
<td>block_tags</td>
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</tr>
<tr>
<td>form_tags</td>
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</tr>
<tr>
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</tr>
<tr>
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</tr>
</tbody>
</table>

*continued on next page*
<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
<tr>
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<td><strong>Value:</strong> frozenset(['frame', 'frameset', 'noframes'])</td>
</tr>
<tr>
<td>html5_tags</td>
<td><strong>Value:</strong> frozenset(['article', 'aside', 'audio', 'canvas', 'comman...']</td>
</tr>
<tr>
<td>nonstandard_tags</td>
<td><strong>Value:</strong> frozenset(['blink', 'marquee'])</td>
</tr>
<tr>
<td>tags</td>
<td><strong>Value:</strong> frozenset(['a', 'abbr', 'acronym', 'address', 'applet', '...']</td>
</tr>
<tr>
<td><strong>package</strong></td>
<td><strong>Value:</strong> None</td>
</tr>
</tbody>
</table>
Module `lxml.html.diff`

Functions

```python
html_annotate(doclist, markup=<function default_markup at 0x2b5da428f6e0>)
```

doclist should be ordered from oldest to newest, like:

```python
generate_html(annotate([(version1, 'version 1'),
                        (version2, 'version 2')]))
```

The documents must be fragments (str/UTF8 or unicode), not complete documents.

The markup argument is a function to markup the spans of words. This function
is called like markup('Hello', 'version 2'), and returns HTML. The first
argument is text and never includes any markup. The default uses a span with a

```python
>>> print(default_markup('Some Text', 'by Joe'))
```

htmldiff(old_html, new_html)

Do a diff of the old and new document. The documents are HTML fragments
(str/UTF8 or unicode), they are not complete documents (i.e., no `<html>` tag).

Returns HTML with `<ins>` and `<del>` tags added around the appropriate text.

Markup is generally ignored, with the markup from new_html preserved, and
possibly some markup from old_html (though it is considered acceptable to lose
some of the old markup). Only the words in the HTML are diffed. The exception
is `<img>` tags, which are treated like words, and the href attribute of `<a>` tags,
which are noted inside the tag itself when there are changes.
Module lxml.html.formfill

Functions

```python
fill_form(el, values, form_id=None, form_index=None)
```

```python
fill_form_html(html, values, form_id=None, form_index=None)
```

```python
insert_errors(el, errors, form_id=None, form_index=None,
              error_class='error', error_creator=default_error_creator)
```

```python
insert_errors_html(html, values, **kw)
```

Class FormNotFound

- object
  - exceptions.BaseException
    - exceptions.Exception
      - exceptions.StandardError
        - exceptions.LookupError
          - lxml.html.formfill.FormNotFound

Raised when no form can be found

Methods

**Inherited from exceptions.LookupError**

- __init__(), __new__()  
**Inherited from exceptions.BaseException**

- __delattr__(), __getattr__(), __getitem__(), __getslice__(), __reduce__(), __repr__(),
  __setattr__(), __setstate__(), __str__(), __unicode__()

**Inherited from object**

- __format__(), __hash__(), __reduce_ex__(), __sizeof__(), __subclasshook__()

Properties
Class DefaultErrorCreator

object → lxml.html.formfill.DefaultErrorCreator

Methods

__init__ (self, **kw)
x.__init__(...) initializes x; see help(type(x)) for signature Overrides:
object.__init__ exitit(inherited documentation)

call (self, el, is_block, message)

Inherited from object

__delattr__ (), __format__ (), __getattr__ (), __hash__ (), __new__ (), __reduce__ (),
__reduce_ex__ (), __repr__ (), __setattr__ (), __sizeof__ (), __str__ (), __subclasshook__ ()

Properties

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>class</strong></td>
<td>Inherited from object</td>
</tr>
</tbody>
</table>

Class Variables

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>insert_before</td>
<td>True</td>
<td></td>
</tr>
<tr>
<td>block_inside</td>
<td>True</td>
<td></td>
</tr>
<tr>
<td>error_container_tag</td>
<td>'div'</td>
<td></td>
</tr>
<tr>
<td>error_message_class</td>
<td>'error-message'</td>
<td></td>
</tr>
<tr>
<td>error_block_class</td>
<td>'error-block'</td>
<td></td>
</tr>
<tr>
<td>default_message</td>
<td>'Invalid'</td>
<td></td>
</tr>
</tbody>
</table>
Module lxml.html.html5parser

An interface to html5lib that mimics the lxml.html interface.

Functions

**document_fromstring**(*html, guess_charset=True, parser=None*)

Parse a whole document into a string.

**fragments_fromstring**(*html, no_leading_text=False, guess_charset=False, parser=None*)

Parses several HTML elements, returning a list of elements.

The first item in the list may be a string. If no_leading_text is true, then it will be an error if there is leading text, and it will always be a list of only elements.

If *guess_charset* is True and the text was not unicode but a bytestring, the *chardet* library will perform charset guessing on the string.

**fragment_fromstring**(*html, create_parent=False, guess_charset=False, parser=None*)

Parses a single HTML element; it is an error if there is more than one element, or if anything but whitespace precedes or follows the element.

If create_parent is true (or is a tag name) then a parent node will be created to encapsulate the HTML in a single element. In this case, leading or trailing text is allowed.

**fromstring**(*html, guess_charset=True, parser=None*)

Parse the html, returning a single element/document.

This tries to minimally parse the chunk of text, without knowing if it is a fragment or a document.

*base_url* will set the document’s *base_url* attribute (and the tree’s *docinfo.URL*)
parse(filename_url_or_file, guess_charset=True, parser=None)

Parse a filename, URL, or file-like object into an HTML document tree. Note: this returns a tree, not an element. Use parse(...).getroot() to get the document root.

Variables

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>xhtml_parser</td>
<td>Value: XHTMLParser()</td>
</tr>
<tr>
<td>html_parser</td>
<td>Value: HTMLParser()</td>
</tr>
<tr>
<td><strong>package</strong></td>
<td>Value: 'lxml.html'</td>
</tr>
</tbody>
</table>

Class HTMLParser

object

html5lib.html5parser.HTMLParser

lxml.html.html5parser.HTMLParser

An html5lib HTML parser with lxml as tree.

Methods

__init__(self, strict=False, **kwargs)

strict - raise an exception when a parse error is encountered

tree - a treebuilder class controlling the type of tree that will be returned. Built in treebuilders can be accessed through html5lib.treebuilders.getTreeBuilder(treeType)

tokenizer - a class that provides a stream of tokens to the treebuilder. This may be replaced for e.g. a sanitizer which converts some tags to text. Overrides: object.__init__(inherited documentation)

Inherited from html5lib.html5parser.HTMLParser

adjustForeignAttributes(), adjustMathMLAttributes(), adjustSVGAttributes(), isHTM-LIntegrationPoint(), isMathMLTextIntegrationPoint(), mainLoop(), normalizeToken(), normalizedTokens(), parse(), parseError(), parseFragment(), parseRCDATARawtext(), reparseTokenNormal(), reset(), resetInsertionMode()
Class XHTMLParser

Module lxml.html.html5parser

__delattr__(), __format__(), __getattribute__(), __hash__(), __new__(), __reduce__(),
__reduce_ex__(), __repr__(), __setattr__(), __sizeof__(), __str__(), __subclasshook__()

Properties

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inherited from object</td>
<td></td>
</tr>
<tr>
<td><strong>class</strong></td>
<td></td>
</tr>
</tbody>
</table>

Class XHTMLParser

html5lib.XHTMLParser

 lxml.html.html5parser.XHTMLParser

An html5lib XHTML Parser with lxml as tree.

Methods

_init__(self, strict=False, **kwargs)
Module `lxml.html.soupparser`

External interface to the BeautifulSoup HTML parser.

Functions

```python
fromstring(data, beautifulsoup=None, makeelement=None, **bsargs)
```

Parse a string of HTML data into an Element tree using the BeautifulSoup parser.

Returns the root `<html>` Element of the tree.

You can pass a different BeautifulSoup parser through the `beautifulsoup` keyword, and a different Element factory function through the `makeelement` keyword. By default, the standard BeautifulSoup class and the default factory of `lxml.html` are used.

```python
parse(file, beautifulsoup=None, makeelement=None, **bsargs)
```

Parse a file into an ElementTree using the BeautifulSoup parser.

You can pass a different BeautifulSoup parser through the `beautifulsoup` keyword, and a different Element factory function through the `makeelement` keyword. By default, the standard BeautifulSoup class and the default factory of `lxml.html` are used.

```python
convert_tree(beautiful_soup_tree, makeelement=None)
```

Convert a BeautifulSoup tree to a list of Element trees.

Returns a list instead of a single root Element to support HTML-like soup with more than one root element.

You can pass a different Element factory through the `makeelement` keyword.
Module lxml.html.usedoctest

Doctest module for HTML comparison.

Usage:

    >>> import lxml.html.usedoctest
    >>> # now do your HTML doctests ...

See lxml.doctestcompare.
Package lxml.includes

Variables

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>package</strong></td>
<td>Value: None</td>
</tr>
</tbody>
</table>
**Package lxml.isoschematron**

The `lxml.isoschematron` package implements ISO Schematron support on top of the pure-xslt `skeleton` implementation.

**Functions**

```python
stylesheet_params(**kwargs)
```

Convert keyword args to a dictionary of stylesheet parameters. XSL stylesheet parameters must be XPath expressions, i.e.:

- string expressions, like "5"
- simple (number) expressions, like "5"
- valid XPath expressions, like "/a/b/text()"

This function converts native Python keyword arguments to stylesheet parameters following these rules: If an arg is a string wrap it with `XSLT.strparam()`. If an arg is an XPath object use its path string. If arg is None raise TypeError. Else convert arg to string.

**Variables**

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>extract_xsd</td>
<td><code>_etree.XSLT(_etree.parse(os.path.join(_resources_dir, 'xs...'))</code></td>
<td></td>
</tr>
<tr>
<td>extract_rng</td>
<td><code>_etree.XSLT(_etree.parse(os.path.join(_resources_dir, 'xs...'))</code></td>
<td></td>
</tr>
<tr>
<td>iso_dsd1_include</td>
<td><code>_etree.XSLT(_etree.parse(os.path.join(_resources_dir, 'xs...'))</code></td>
<td></td>
</tr>
<tr>
<td>iso_abstract_expand</td>
<td><code>_etree.XSLT(_etree.parse(os.path.join(_resources_dir, 'xs...'))</code></td>
<td></td>
</tr>
<tr>
<td>iso_svrl_for_xslt1</td>
<td><code>_etree.XSLT(_etree.parse(os.path.join(_resources_dir, 'xs...'))</code></td>
<td></td>
</tr>
<tr>
<td>svrl_validation_errors</td>
<td><code>//svrl:failed-assert</code></td>
<td></td>
</tr>
<tr>
<td>schematron_schema_valid</td>
<td><code>_etree.RelaxNG(_etree.parse(os.path.join(_resources_dir, '...'))</code></td>
<td></td>
</tr>
</tbody>
</table>

*continued on next page*
Class Schematron

object  lxml.etree._Validator  lxml.isoschematron.Schematron

An ISO Schematron validator.

Pass a root Element or an ElementTree to turn it into a validator. Alternatively, pass a filename
as keyword argument 'file' to parse from the file system. Built on the Schematron language
'reference' skeleton pure-xslt implementation, the validator is created as an XSLT 1.0 stylesheet
using these steps:

0) (Extract from XML Schema or RelaxNG schema)
1) Process inclusions
2) Process abstract patterns
3) Compile the schematron schema to XSLT

The include and expand keyword arguments can be used to switch off steps 1) and 2).
To set parameters for steps 1), 2) and 3) hand parameter dictionaries to the keyword argu-
ments include_params, expand_params or compile_params. For convenience, the
compile-step parameter phase is also exposed as a keyword argument phase. This takes
precedence if the parameter is also given in the parameter dictionary. If store_schematron
is set to True, the (included-and-expanded) schematron document tree is stored and available
through the schematron property. If store_xslt is set to True, the validation XSLT doc-
ument tree will be stored and can be retrieved through the validator_xslt property. With
store_report set to True (default: False), the resulting validation report document gets
stored and can be accessed as the validation_report property.

Schematron is a less well known, but very powerful schema language. The main idea is to use
the capabilities of XPath to put restrictions on the structure and the content of XML documents.
Here is a simple example:

```python
>>> from lxml import isoschematron
>>> schematron = isoschematron.Schematron(etree.XML(''
... <schema xmlns="http://purl.oclc.org/dsdl/schematron" >
... <pattern id="id_only_attribute">
... <title>id is the only permitted attribute name</title>
... <rule context="*">
... <report test="@*[not(name()="id")]">Attribute
... <name path="@*[not(name()="id")]"/> is forbidden</name/>
... </report>
... </rule>
... </schema>''
)
```

443
...   </pattern>
...   </schema>
...   '')

>>> xml = etree.XML('''
... <AAA name="aaa">
...   <BBB id="bbb"/>
...   <CCC color="ccc"/>
... </AAA>
... '''

>>> schematron.validate(xml)
0

>>> xml = etree.XML('''
... <AAA id="aaa">
...   <BBB id="bbb"/>
...   <CCC/>
... </AAA>
... '''

>>> schematron.validate(xml)
1

Methods

__init__(self, etree=None, file=None, include=True, expand=True, include_params={}, expand_params={}, compile_params={}, store_schematron=False, store_xslt=False, store_report=False, phase=None)

x.__init__(...) initializes x; see help(type(x)) for signature  Overrides: object.__init__(inherited documentation)

__call__(self, etree)

Validate doc using Schematron.

Returns true if document is valid, false if not.

Inherited from lxml.etree._Validator

__new__(), assertValid(), assert_(), validate()

Inherited from object

__delattr__(), __format__(), __getattribute__(), __hash__(), __reduce__(), __reduce_ex__(),
Class Schematron

---

__repr__(), __setattr__(), __sizeof__(), __str__(), __subclasshook__()

Properties

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>schematron</td>
<td>ISO-schematron schema document (None if object has been initialized with store_schematron=False).</td>
</tr>
<tr>
<td>validator_xslt</td>
<td>ISO-schematron skeleton implementation XSLT validator document (None if object has been initialized with store_xslt=False).</td>
</tr>
<tr>
<td>validation_report</td>
<td>ISO-schematron validation result report (None if result-storing has been turned off).</td>
</tr>
</tbody>
</table>

Inherited from lxml.etree._Validator

error_log

Inherited from object

__class__
Module lxml.objectify

The lxml.objectify module implements a Python object API for XML. It is based on lxml.etree. **Version:** 3.4.4

**Functions**

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DataElement</strong>(_value, attrib=None, nsmap=None, _pytype=None, _xsi=None, **_attributes)</td>
<td>Create a new element from a Python value and XML attributes taken from keyword arguments or a dictionary passed as second argument. Automatically adds a '_pytype' attribute for the Python type of the value, if the type can be identified. If '_pytype' or '_xsi' are among the keyword arguments, they will be used instead. If the _value argument is an ObjectifiedDataElement instance, its py:pytype, xsi:type and other attributes and nsmap are reused unless they are redefined in attrib and/or keyword arguments.</td>
</tr>
<tr>
<td><strong>Element</strong>(_tag, attrib=None, nsmap=None, _pytype=None,**_attributes)</td>
<td>Objectify specific version of the lxml.etree Element() factory that always creates a structural (tree) element. NOTE: requires parser based element class lookup activated in lxml.etree!</td>
</tr>
<tr>
<td><strong>SubElement</strong>(_parent, _tag, attrib=None, nsmap=None,**_extra)</td>
<td>Subelement factory. This function creates an element instance, and appends it to an existing element.</td>
</tr>
</tbody>
</table>
XML(xml, parser=None, base_url=None)

Objectify specific version of the lxml.etree XML() literal factory that uses the objectify parser.

You can pass a different parser as second argument.

The `base_url` keyword argument allows to set the original base URL of the document to support relative Paths when looking up external entities (DTD, XInclude, ...).

annotate(element_or_tree, ignore_old=True, ignore_xsi=False, empty_pytype=None, empty_type=None, annotate_xsi=0, annotate_pytype=1)

Recursively annotates the elements of an XML tree with ’xsi:type’ and/or ’py:pytype’ attributes.

If the ’ignore_old’ keyword argument is True (the default), current ’py:pytype’ attributes will be ignored for the type annotation. Set to False if you want reuse existing ’py:pytype’ information (iff appropriate for the element text value).

If the ’ignore_xsi’ keyword argument is False (the default), existing ’xsi:type’ attributes will be used for the type annotation, if they fit the element text values.

Note that the mapping from Python types to XSI types is usually ambiguous. Currently, only the first XSI type name in the corresponding PyType definition will be used for annotation. Thus, you should consider naming the widest type first if you define additional types.

The default ’py:pytype’ annotation of empty elements can be set with the `empty_pytype` keyword argument. Pass ’str’, for example, to make string values the default.

The default ’xsi:type’ annotation of empty elements can be set with the `empty_type` keyword argument. The default is not to annotate empty elements. Pass ’string’, for example, to make string values the default.

The keyword arguments ’annotate_xsi’ (default: 0) and ’annotate_pytype’ (default: 1) control which kind(s) of annotation to use.
def deannotate(element_or_tree, pytype=True, xsi=True, xsi_nil=False, cleanup_namespaces=False):

Recursively de-annotate the elements of an XML tree by removing 'py:pytype' and/or 'xsi:type' attributes and/or 'xsi:nil' attributes.

If the 'pytype' keyword argument is True (the default), 'py:pytype' attributes will be removed. If the 'xsi' keyword argument is True (the default), 'xsi:type' attributes will be removed. If the 'xsi_nil' keyword argument is True (default: False), 'xsi:nil' attributes will be removed.

Note that this does not touch the namespace declarations by default. If you want to remove unused namespace declarations from the tree, pass the option cleanup_namespaces=True.

def dump(...):

dump(_Element element not None)

Return a recursively generated string representation of an element.

def enable_recursive_str(on=True):

Enable a recursively generated tree representation for str(element), based on objectify.dump(element).

def fromstring(xml, parser=None, base_url=None):

Objectify specific version of the lxml.etree fromstring() function that uses the objectify parser.

You can pass a different parser as second argument.

The base_url keyword argument allows to set the original base URL of the document to support relative Paths when looking up external entities (DTD, XInclude, ...).
### getRegisteredTypes()

Returns a list of the currently registered PyType objects.

To add a new type, retrieve this list and call unregister() for all entries. Then add the new type at a suitable position (possibly replacing an existing one) and call register() for all entries.

This is necessary if the new type interferes with the type check functions of existing ones (normally only int/float/bool) and must the tried before other types. To add a type that is not yet parsable by the current type check functions, you can simply register() it, which will append it to the end of the type list.

### makeparser(remove_blank_text=True, **kw)

Create a new XML parser for objectify trees.

You can pass all keyword arguments that are supported by etree.XMLParser(). Note that this parser defaults to removing blank text. You can disable this by passing the remove_blank_text boolean keyword option yourself.

### parse(f, parser=None, base_url=None)

Parse a file or file-like object with the objectify parser.

You can pass a different parser as second argument.

The base_url keyword allows setting a URL for the document when parsing from a file-like object. This is needed when looking up external entities (DTD, XInclude, ...) with relative paths.
### pyannotate(element_or_tree, ignore_old=False, ignore_xsi=False, empty_pytype=None)

Recursively annotates the elements of an XML tree with 'pytype' attributes. If the 'ignore_old' keyword argument is True (the default), current 'pytype' attributes will be ignored and replaced. Otherwise, they will be checked and only replaced if they no longer fit the current text value. Setting the keyword argument `ignore_xsi` to True makes the function additionally ignore existing `xsi:type` annotations. The default is to use them as a type hint.

The default annotation of empty elements can be set with the `empty_pytype` keyword argument. The default is not to annotate empty elements. Pass 'str', for example, to make string values the default.

### pytypename(obj)

Find the name of the corresponding PyType for a Python object.

### set_default_parser(new_parser=None)

Replace the default parser used by objectify’s Element() and fromstring() functions. The new parser must be an etree.XMLParser. Call without arguments to reset to the original parser.

### set_pytype_attribute_tag(attribute_tag=None)

Change name and namespace of the XML attribute that holds Python type information. Do not use this unless you know what you are doing. Reset by calling without argument. Default:

```
"{http://codespeak.net/lxml/objectify/pytype}pytype"
```
xsiannotate(element_or_tree, ignore_old=False, ignore_pytype=False, empty_type=None)

Recursively annotates the elements of an XML tree with 'xsi:type' attributes.

If the 'ignore_old' keyword argument is True (the default), current 'xsi:type' attributes will be ignored and replaced. Otherwise, they will be checked and only replaced if they no longer fit the current text value.

Note that the mapping from Python types to XSI types is usually ambiguous. Currently, only the first XSI type name in the corresponding PyType definition will be used for annotation. Thus, you should consider naming the widest type first if you define additional types.

Setting the keyword argument ignore_pytype to True makes the function additionally ignore existing pytype annotations. The default is to use them as a type hint.

The default annotation of empty elements can be set with the empty_type keyword argument. The default is not to annotate empty elements. Pass 'string', for example, to make string values the default.

Variables

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>Value:</td>
</tr>
<tr>
<td></td>
<td>&lt;lxml.objectify.ElementMaker object at 0x2b5da2f54b90&gt;</td>
</tr>
<tr>
<td>PYTYPE_ATTRIBUTE</td>
<td>Value:</td>
</tr>
<tr>
<td></td>
<td>'{<a href="http://codespeak.net/lxml/objectify/pytype%7Dpytype">http://codespeak.net/lxml/objectify/pytype}pytype</a>'</td>
</tr>
</tbody>
</table>
Class **BoolElement**

object

lxml.etree._Element

lxml.etree.ElementBase

lxml.objectify.ObjectifiedElement

lxml.objectify.ObjectifiedDataElement

lxml.objectify.NumberElement

lxml.objectify.IntElement

lxml.objectify.BoolElement

Boolean type base on string values: 'true' or 'false'.

Note that this inherits from IntElement to mimic the behaviour of Python’s bool type.

Methods

\[\_\_eq\_\_(x, y)\]

\[x==y\] Overrides: lxml.objectify.NumberElement.__eq__

\[\_\_ge\_\_(x, y)\]

\[x>=y\] Overrides: lxml.objectify.NumberElement.__ge__

\[\_\_gt\_\_(x, y)\]

\[x>y\] Overrides: lxml.objectify.NumberElement.__gt__

\[\_\_hash\_\_(x)\]

\[hash(x)\] Overrides: object.__hash__
__le__(x, y)

x <= y Overrides: lxml.objectify.NumberElement.__le__

__lt__(x, y)

x < y Overrides: lxml.objectify.NumberElement.__lt__

__ne__(x, y)

x != y Overrides: lxml.objectify.NumberElement.__ne__

__new__(T, S, ...)

Return Value
a new object with type S, a subtype of T
Overrides: object.__new__

__nonzero__(x)

x != 0 Overrides: lxml.etree._Element.__nonzero__

__repr__(x)

repr(x) Overrides: object.__repr__

__str__(x)

str(x) Overrides: object.__str__

Inherited from lxml.objectify.NumberElement(Section B)

__abs__(), __add__(), __and__(), __complex__(), __div__(), __float__(), __hex__(),
__int__(), __invert__(), __long__(), __lshift__(), __mod__(), __mul__(), __neg__(),
__oct__(), __or__(), __pos__(), __pow__(), __radd__(), __rand__(), __rdiv__(),
__rlshift__(), __rmod__(), __rmul__(), __ror__(), __rpow__(), __rrshift__(), __rshift__(),
__rsub__(), __rtruediv__(), __rxor__(), __sub__(), __truediv__(), __xor__()

Inherited from lxml.objectify.ObjectifiedElement(Section B)

__delattr__(), __delitem__(), __getattr__(), __getattribute__(), __getitem__(), __iter__(),
Class ElementMaker

Inherited from lxml.etree.ElementBase (Section B)

__init__()

Inherited from lxml.etree._Element

__contains__(), __copy__(), __deepcopy__(), __reversed__(), addnext(), addprevious(), append(), clear(), extend(), find(), findall(), findtext(), get(), getiterator(), getnext(), getparent(), getprevious(), getroottree(), index(), insert(), items(), iter(), iterancestors(), iterchildren(), iterdescendants(), iterfind(), itersiblings(), itertext(), keys(), makeelement(), remove(), replace(), set(), values(), xpath()

Inherited from object

__format__(), __reduce_ex__(), __sizeof__(), __subclasshook__()

Properties

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>pyval</td>
<td></td>
</tr>
<tr>
<td>Inherited from lxml.objectify.ObjectifiedElement (Section B)</td>
<td></td>
</tr>
<tr>
<td>Inherited from lxml.etree._Element</td>
<td>attrib, base, nsmap, prefix, sourceline, tag, tail</td>
</tr>
<tr>
<td>Inherited from object</td>
<td><strong>class</strong></td>
</tr>
</tbody>
</table>

Class ElementMaker

object ← lxml.objectify.ElementMaker

ElementMaker(self, namespace=None, nsmap=None, annotate=True, makeelement=None)

An ElementMaker that can be used for constructing trees.

Example:

```python
group = ElementMaker(annotate=False)
group.attributes = {'class': 'par'}
html = M.html(M.body(M.p('hello', attributes, M.br, 'objectify', style='font-weight: bold')))
from lxml.etree import tostring
print(tostring(html, method='html').decode('ascii'))
```

<html><body><p style="font-weight: bold" class="par">hello<br>objectify</p></body></html>
To create tags that are not valid Python identifiers, call the factory directly and pass the tag name as first argument:

```python
>>> root = M('tricky-tag', 'some text')
>>> print(root.tag)
tricky-tag
>>> print(root.text)
some text
```

Note that this module has a predefined ElementMaker instance called `E`.

Methods

```python
__call__(x, ...)
```

```python
x(...)
```

```python
__getattr__(...)
```

```python
__getattribute__(...)
```

```python
x.__getattribute__('name') <==> x.name  Overrides: object.__getattribute__
```

```python
__init__(self, namespace=None, nsmap=None, annotate=True, makeelement=None)
```

```python
x.__init__(...) initializes x; see help(type(x)) for signature  Overrides: object.__init__
```

```python
__new__(T, S, ...)
```

**Return Value**
a new object with type S, a subtype of T

Overrides: object.__new__

**Inherited from object**

```python
__delattr__(), __format__(), __hash__(), __reduce__(), __reduce_ex__(), __repr__(),
__setattr__(), __sizeof__(), __str__(), __subclasshook__()
```

Properties
Class FloatElement

object

lxml.etree._Element

lxml.etree.ElementBase

lxml.objectify.ObjectifiedElement

lxml.objectify.ObjectifiedDataElement

| Class FloatElement

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inherited from object</td>
<td></td>
</tr>
<tr>
<td><strong>class</strong></td>
<td></td>
</tr>
</tbody>
</table>

Methods

__new__(T, S, ...)

Return Value

a new object with type S, a subtype of T

Overrides: object.__new__

Inherited from lxml.objectify.NumberElement(Section B)

__abs__(), __add__(), __and__(), __complex__(), __div__(), __eq__(), __float__(),
__ge__(), __gt__(), __hash__(), __hex__(), __int__(), __invert__(), __le__(), __long__(),
__lshift__(), __lt__(), __mod__(), __mul__(), __ne__(), __neg__(), __nonzero__(),
__oct__(), __or__(), __pos__(), __pow__(), __radd__(), __rand__(), __rdiv__(),
__repr__(), __rlshift__(), __rmod__(), __rmul__(), __ror__(), __rpow__(), __rrshift__(),
__rshift__(), __rsub__(), __rtruediv__(), __rxor__(), __str__(), __sub__(), __truediv__(), __xor__()

Inherited from lxml.objectify.ObjectifiedElement(Section B)

__delattr__(), __delitem__(), __getattr__(), __getattribute__(), __getitem__(), __iter__(),
__len__(), __reduce__(), __setattr__(), __setitem__(), addattr(), countchildren(), descendantpaths(), getchildren()

Inherited from lxml.etree.ElementBase(Section B)

__init__()
Class IntElement

Inherited from lxml.etree._Element

__contains__(), __copy__(), __deepcopy__(), __reversed__(), addnext(), addprevious(), append(), clear(), extend(), find(), findall(), findtext(), get(), getiterator(), getnext(), getparent(), getprevious(), getroottree(), index(), insert(), items(), iter(), iterancestors(), iterchildren(), iterdescendants(), iterfind(), itersiblings(), itertext(), keys(), makeelement(), remove(), replace(), set(), values(), xpath()

Inherited from object

__format__(), __reduce_ex__(), __sizeof__(), __subclasshook__()

Properties

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>pyval</td>
<td>Inherited from lxml.objectify.NumberElement (Section B)</td>
</tr>
<tr>
<td>text</td>
<td>Inherited from lxml.objectify.ObjectifiedElement (Section B)</td>
</tr>
<tr>
<td>attrib, base, nsmap, prefix, sourceline, tag, tail</td>
<td>Inherited from lxml.etree._Element</td>
</tr>
<tr>
<td><em>class</em>_</td>
<td>Inherited from object</td>
</tr>
</tbody>
</table>

Class IntElement

doctree

lxml.etree._Element

lxml.etree.ElementBase

lxml.objectify.ObjectifiedElement

lxml.objectify.ObjectifiedDataElement

lxml.objectify.NumberElement

lxml.objectify.IntElement

Known Subclasses: lxml.objectify.BoolElement
**Class** IntElement  
**Module** lxml.objectify

**Methods**

```python
__new__(T, S, ...)
```

**Return Value**

a new object with type S, a subtype of T

Overrides: object.__new__

**Inherited from lxml.objectify.NumberElement (Section B)**

- __abs__(), __add__(), __and__(), __complex__(), __div__(), __eq__(), __float__(),
  __ge__(), __gt__(), __hash__(), __hex__(), __int__(), __invert__(), __le__(), __long__(),
  __lshift__(), __lt__(), __mod__(), __mul__(), __ne__(), __neg__(), __nonzero__(),
  __oct__(), __or__(), __pos__(), __pow__(), __radd__(), __rand__(), __rdiv__(),
  __repr__(), __rlshift__(), __rmod__(), __rmul__(), __ror__(), __rpow__(), __rrshift__(),
  __rshift__(), __rsub__(), __rtruediv__(), __rxor__(), __str__(), __sub__(), __true-
  div__(), __xor__()

**Inherited from lxml.objectify.ObjectifiedElement (Section B)**

- __delattr__(), __delitem__(), __getattribute__(), __getattr__(), __getitem__(),
  __iter__(),
  __len__(), __reduce__(), __reduce_ex__(), __setattr__(), __setitem__(), addattr(),
  countchildren(), descendantpaths(), getchildren()

**Inherited from lxml.etree.ElementBase (Section B)**

- __init__()

**Inherited from lxml.etree._Element**

- __contains__(), __copy__(), __deepcopy__(), __reversed__(), addnext(), addpre-
  vious(), append(), clear(), extend(), find(), findall(), findtext(), get(),
  getiterator(), getnext(), getparent(), getprevious(), getroottree(), index(),
  insert(), items(), iter(), iterancestors(), itercanchildren(), iterdescendants(),
  iterfind(), itersiblings(), itertext(), keys(), makeelement(), remove(),
  replace(), set(), values(), xpath()

**Inherited from object**

- __format__(), __reduce_ex__(), __sizeof__(), __subclasshook__()

**Properties**

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<tr>
<td>pyval</td>
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<td><strong>Inherited from lxml.objectify.ObjectifiedElement (Section B)</strong></td>
<td></td>
</tr>
<tr>
<td>text</td>
<td></td>
</tr>
<tr>
<td><strong>Inherited from lxml.etree._Element</strong></td>
<td></td>
</tr>
<tr>
<td>attrib, base, nsmap, prefix, sourceline, tag, tail</td>
<td></td>
</tr>
<tr>
<td><strong>Inherited from object</strong></td>
<td></td>
</tr>
</tbody>
</table>

*continued on next page*
Class `LongElement`

```python
doctype
long_element
```

Methods

```python
__new__(T, S, ...)
```

Return Value

A new object with type S, a subtype of T

Overides: object.__new__

Inherited from `lxml.objectify.NumberElement` (Section B)

```python
__abs__(), __add__(), __and__(), __complex__(), __div__(), __eq__(), __float__(),
__ge__(), __gt__(), __hash__(), __hex__(), __int__(), __invert__(), __le__(), __long__(),
__lshift__(), __lt__(), __mod__(), __mul__(), __ne__(), __neg__(), __nonzero__(),
__oct__(), __or__(), __pos__(), __pow__(), __radd__(), __rand__(), __round__(), __rdiv__(),
__repr__(), __rlshift__(), __rmod__(), __rmul__(), __ror__(), __rpow__(), __rrshift__(),
__rshift__(), __rsub__(), __rtruediv__(), __xor__(), __str__(), __subclassof__(),
true_div__(), __xor__()
```

Inherited from `lxml.objectify.ObjectifiedElement` (Section B)

```python
__delattr__(), __delitem__(), __getattribute__(), __getitem__(), __iter__(),
__len__(), __reduce__(), __reduce_ex__(), __setattribute__(), __setitem__(),
addattr(), countchildren(), descendantpaths(), getchildren()
```

Inherited from `lxml.etree.ElementBase` (Section B)

```python
__init__()
```

Inherited from `lxml.etree._Element`

```python
459
```
Class NoneElement

Inherited from object

___contains___(), ___copy___(), ___deepcopy___(), ___reversed___(), addnext(), addprevious(), append(), clear(), extend(), find(), findall(), findtext(), get(), getiterator(), getnext(), getparent(), getprevious(), getroottree(), index(), insert(), items(), iter(), iterancestors(), iterchildren(), iterdescendants(), iterfind(), itersiblings(), itertext(), keys(), makeelement(), remove(), replace(), set(), values(), xpath()

Inherited from object

___format___(), ___reduce_ex___(), ___sizeof___(), ___subclasshook___()

Properties

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inherited from lxml.objectify.NumberElement (Section B) pyval</td>
<td></td>
</tr>
<tr>
<td>Inherited from lxml.objectify.ObjectifiedElement (Section B) text</td>
<td></td>
</tr>
<tr>
<td>Inherited from lxml.etree._Element attrib, base, nsmap, prefix, sourceline, tag, tail</td>
<td></td>
</tr>
<tr>
<td>Inherited from object <em>class</em>_</td>
<td></td>
</tr>
</tbody>
</table>

Class NoneElement

object

lxml.etree._Element

lxml.etree.ElementBase

lxml.objectify.ObjectifiedElement

lxml.objectify.ObjectifiedDataElement

lxml.objectify.NoneElement

Methods

___eq__(x, y)

x==y
Class NoneElement

Module lxml.objectify

_\texttt{ge\_}(x, y)

x\geq y

_\texttt{gt\_}(x, y)

x>y

_\texttt{hash\_}(x)

hash(x) Overrides: object.__hash__

_\texttt{le\_}(x, y)

x\leq y

_\texttt{lt\_}(x, y)

x<y

_\texttt{ne\_}(x, y)

x\neq y

_\texttt{new\_}(T, S, ...)

\textbf{Return Value}

a new object with type S, a subtype of T

Overrides: object.__new__

_\texttt{nonzero\_}(x)

x != 0 Overrides: lxml.etree._Element.__nonzero__

_\texttt{repr\_}(x)

repr(x) Overrides: object.__repr__
**Class NoneElement**

**Module lxml.objectify**

```python
__str__(x)
```

```python
str(x)  Overrides: object.__str__
```

*Inherited from lxml.objectify.ObjectifiedElement (Section B)*

```python
__delattr__(), __delitem__(), __getattr__(), __getattribute__(), __getitem__(), __iter__(), __len__(), __reduce__(), __reduce_ex__(), __setattr__(), __setitem__(), addattr(), countchildren(), descendantpaths(), getchildren()
```

*Inherited from lxml.etree.ElementBase (Section B)*

```python
__init__()
```

*Inherited from lxml.etree._Element*

```python
__contains__(), __copy__(), __deepcopy__(), __reversed__(), addnext(), addprevious(), append(), clear(), extend(), find(), findall(), findtext(), get(), getiterator(), getnext(), getparent(), getprevious(), getroottree(), index(), insert(), items(), iter(), iterancestors(), itercitems(), itercvalues(), itercchildren(), itercdescendants(), itercfind(), itersiblings(), itertext(), keys(), makeelement(), remove(), replace(), set(), values(), xpath()
```

*Inherited from object*

```python
__format__(), __reduce_ex__(), __sizeof__(), __subclasshook__()
```

**Properties**

<table>
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<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
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<tr>
<td>pyval</td>
<td><em>Inherited from lxml.objectify.ObjectifiedElement (Section B)</em></td>
</tr>
<tr>
<td>text</td>
<td></td>
</tr>
<tr>
<td>attrib, base, nsmap, prefix, sourceline, tag, tail</td>
<td><em>Inherited from lxml.etree._Element</em></td>
</tr>
<tr>
<td><strong>class</strong></td>
<td><em>Inherited from object</em></td>
</tr>
</tbody>
</table>
Class NumberElement

object
xml.etree._Element
xml.etree.ElementBase
xml.objectify.ObjectifiedElement
xml.objectify.ObjectifiedDataElement
xml.objectify.NumberElement


Methods

__abs__(x)
abs(x)

__add__(x, y)
x+y

__and__(x, y)
x&y

__complex__(...)

__div__(x, y)
x/y

__eq__(x, y)
x==y
<table>
<thead>
<tr>
<th>Method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>__float__</code></td>
<td><code>float(x)</code></td>
</tr>
<tr>
<td><code>__ge__</code></td>
<td><code>x&gt;=y</code></td>
</tr>
<tr>
<td><code>__gt__</code></td>
<td><code>x&gt;y</code></td>
</tr>
<tr>
<td><code>__hash__</code></td>
<td><code>hash(x)</code></td>
</tr>
<tr>
<td><code>__hex__</code></td>
<td><code>hex(x)</code></td>
</tr>
<tr>
<td><code>__int__</code></td>
<td><code>int(x)</code></td>
</tr>
<tr>
<td><code>__invert__</code></td>
<td><code>~x</code></td>
</tr>
<tr>
<td><code>__le__</code></td>
<td><code>x&lt;=y</code></td>
</tr>
<tr>
<td><code>__long__</code></td>
<td><code>long(x)</code></td>
</tr>
</tbody>
</table>
__lshift__(x, y)

x << y

__lt__(x, y)

x < y

__mod__(x, y)

x % y

__mul__(x, y)

x * y

__ne__(x, y)

x != y

__neg__(x)

-x

__new__(T, S, ...)

Return Value

a new object with type S, a subtype of T

Overrides: object.__new__

__nonzero__(x)

x != 0  Overrides: lxml.etree._Element.__nonzero__

__oct__(x)

oct(x)
```python
__or__(x, y)
xly

__pos__(x)
+x

__pow__(x, y, z=...)  
pow(x, y[, z])

__radd__(x, y)
y+x

__rand__(x, y)
y&x

__rdiv__(x, y)
y/x

__repr__(x)
repr(x) Overrides: object.__repr__

__rlshift__(x, y)
y«x

__rmod__(x, y)
y%x
```
<table>
<thead>
<tr>
<th>Method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>__rmul__</code></td>
<td>$(y \cdot x)$</td>
</tr>
<tr>
<td><code>__ror__</code></td>
<td>$(y \mid x)$</td>
</tr>
<tr>
<td><code>__rpow__</code></td>
<td>$(y, x, z=\ldots)$</td>
</tr>
<tr>
<td></td>
<td>$\text{pow}(x, y[, z])$</td>
</tr>
<tr>
<td><code>__rrshift__</code></td>
<td>$(y \gg x)$</td>
</tr>
<tr>
<td><code>__rshift__</code></td>
<td>$(x \gg y)$</td>
</tr>
<tr>
<td><code>__rsub__</code></td>
<td>$(y-x)$</td>
</tr>
<tr>
<td><code>__rtruediv__</code></td>
<td>$(y/x)$</td>
</tr>
<tr>
<td><code>__rxor__</code></td>
<td>$(y^{\wedge}x)$</td>
</tr>
<tr>
<td><code>__str__</code></td>
<td>$\text{str}(x)$ Overrides: object.<strong>str</strong></td>
</tr>
</tbody>
</table>
Class NumberElement

Module lxml.objectify

```
__sub__(x, y)
```

```
x-y
```

```
__truediv__(x, y)
```

```
x/y
```

```
__xor__(x, y)
```

```
x^y
```

Inherited from lxml.objectify.ObjectifiedElement(Section B)

- __delattr__()
- __delitem__()
- __getattr__()
- __getattribute__()
- __getitem__()
- __iter__()
- __len__()
- __reduce__()
- __reduce_ex__()
- __setattr__()
- __setitem__()
- addattr()
- countchildren()
- descendantpaths()
- getchildren()

Inherited from lxml.etree.ElementBase(Section B)

- __init__()

Inherited from lxml.etree._Element

- __contains__()
- __copy__()
- __deepcopy__()
- __reversed__()
- addnext()
- addprevious()
- append()
- clear()
- extend()
- find()
- findall()
- findtext()
- get()
- getiterator()
- getnext()
- getparent()
- getprevious()
- getroottree()
- index()
- insert()
- items()
- iter()
- iterancestors()
- itercalculate()
- iterdataliers()
- itersiblings()
- itertext()
- keys()
- makeelement()
- remove()
- replace()
- set()
- values()
- xpath()

Inherited from object

- __format__()
- __reduce_ex__()
- __sizeof__()
- __subclasshook__()

Properties

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>pyval</td>
<td>Inherited from lxml.objectify.ObjectifiedElement (Section B)</td>
</tr>
<tr>
<td>text</td>
<td>Inherited from lxml.etree._Element</td>
</tr>
<tr>
<td>attrib, base, nsmap, prefix, sourceline, tag, tail</td>
<td>Inherited from object</td>
</tr>
<tr>
<td><em>class</em>_</td>
<td></td>
</tr>
</tbody>
</table>
Class ObjectPath

```
object
    lxml.objectify.ObjectPath
```

ObjectPath(path) Immutable object that represents a compiled object path.

Example for a path: ‘root.child[1].{other}child[25]’

Methods

```
__call__(...)  
Follow the attribute path in the object structure and return the target attribute value.  
If it is not found, either returns a default value (if one was passed as second argument) or raises AttributeError.

__init__(path)  
x.__init__(...) initializes x; see help(type(x)) for signature  
Overrides: object.__init__

__new__(T, S, ...)  
Return Value  
a new object with type S, a subtype of T  
Overrides: object.__new__

__str__(x)  
str(x)  
Overrides: object.__str__

addattr(self, root, value)  
Append a value to the target element in a subtree.  
If any of the children on the path does not exist, it is created.

hasattr(self, root)
**Class ObjectifiedDataElement**

```
setattr(self, root, value)
```

Set the value of the target element in a subtree.

If any of the children on the path does not exist, it is created.

**Inherited from object**

```
__delattr__(), __format__(), __getattribute__(), __hash__(), __reduce__(), __reduce_ex__(),
__repr__(), __setattr__(), __sizeof__(), __subclasshook__()
```

**Properties**

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>find</td>
<td></td>
</tr>
</tbody>
</table>

*Inherited from object*

```
__class__
```

**Class ObjectifiedDataElement**

```
object
lxmlelement._Element
lxmlelement.ElementBase
lxmlobjectify.ObjectifiedElement
lxmlobjectify.ObjectifiedDataElement
```

**Known Subclasses:** lxml.objectify.NumberElement, lxml.objectify.NoneElement, lxml.objectify.StringElement

This is the base class for all data type Elements. Subclasses should override the `pyval` property and possibly the `__str__` method.

**Methods**

```
__new__(T, S, ...)
```

**Return Value**

- a new object with type S, a subtype of T

*Overrides: object.__new__*
Class ObjectifiedDataElement

Module lxml.objectify

Inherited from lxml.objectify.ObjectifiedElement (Section B)

Inherited from lxml.etree.ElementBase (Section B)

Inherited from lxml.etree._Element

Inherited from object

Properties

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>pyval</td>
<td></td>
</tr>
</tbody>
</table>

Inherited from lxml.objectify.ObjectifiedElement (Section B)

text

Inherited from lxml.etree._Element

attrib, base, nsmap, prefix, sourceline, tag, tail

Inherited from object

__class__
Class ObjectifiedElement

```
object

lxml.etree._Element

lxml.etree.ElementBase

lxml.objectify.ObjectifiedElement
```

**Known Subclasses:** lxml.objectify.ObjectifiedDataElement

Main XML Element class.

Element children are accessed as object attributes. Multiple children with the same name are available through a list index. Example:

```python
>>> root = XML("<root><c1><c2>0</c2><c2>1</c2></c1></root>")
>>> second_c2 = root.c1.c2[1]
>>> print(second_c2.text)
1
```

Note that you cannot (and must not) instantiate this class or its subclasses.

**Methods**

```
__delattr__(...)
```

```
x.__delattr__('name') <==> del x.name  Overrides: object.__delattr__
```

```
__delitem__(x, y)
```

```
del x[y]  Overrides: lxml.etree._Element.__delitem__
```

```
__getattr__(...)
```

```
Return the (first) child with the given tag name. If no namespace is provided, the child will be looked up in the same one as self.
```

```
__getattribute__(...)
```

```
x.__getattribute__('name') <==> x.name  Overrides: object.__getattribute__
```
Class **ObjectifiedElement**

**Module** lxml.objectify

---

### `__getitem__(...)`

Return a sibling, counting from the first child of the parent. The method behaves like both a dict and a sequence.

- If argument is an integer, returns the sibling at that position.
- If argument is a string, does the same as getattr(). This can be used to provide namespaces for element lookup, or to look up children with special names (text etc.).
- If argument is a slice object, returns the matching slice.

Overrides: lxml.etree._Element.__getitem__

### `__iter__(...)`

Iterate over self and all siblings with the same tag. Overrides:
lxml.etree._Element.__iter__

### `__len__(...)`

Count self and siblings with the same tag. Overrides:
lxml.etree._Element.__len__

### `__new__(T, S, ...)`

**Return Value**

A new object with type `S`, a subtype of `T`

Overrides: object.__new__

### `__reduce__(...)`

Helper for pickle. Overrides: object.__reduce__ extit(inherited documentation)

### `__setattr__(...)`

Set the value of the (first) child with the given tag name. If no namespace is provided, the child will be looked up in the same one as self. Overrides:

object.__setattr__

---

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__setitem__(...)  

Set the value of a sibling, counting from the first child of the parent. Implements key assignment, item assignment and slice assignment.

- If argument is an integer, sets the sibling at that position.
- If argument is a string, does the same as setattr(). This is used to provide namespaces for element lookup.
- If argument is a sequence (list, tuple, etc.), assign the contained items to the siblings.

Overrides: lxml.etree._Element.__setitem__

__str__(x)  

str(x)  Overrides: object.__str__

addattr(self, tag, value)  

Add a child value to the element.

As opposed to append(), it sets a data value, not an element.

countchildren(self)  

Return the number of children of this element, regardless of their name.

descendantpaths(self, prefix=None)  

Returns a list of object path expressions for all descendants.

getchildren(self)  

Returns a sequence of all direct children. The elements are returned in document order.  Overrides: lxml.etree._Element.getchildren

*Inherited from lxml.etree.ElementBase(Section B)*

__init__()
Inherited from lxml.etree._Element

__contains__(), __copy__(), __deepcopy__(), __nonzero__(), __repr__(), __reversed__(),
addevent()), addprevious(), append(), clear(), extend(), find(), findall(), findtext(), get(),
getiterator(), getnext(), getparent(), getprevious(), getroot(), index(), insert(), items(),
iter(), iterancestors(), iterchildren(), iterdescendants(), iterfind(), itersiblings(), iter-
text(), keys(), makeelement(), remove(), replace(), set(), values(), xpath()

Inherited from object

__format__(), __hash__(), __reduce_ex__(), __sizeof__(), __subclasshook__()

Properties

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>text</td>
<td>Text before the first subelement. This is either a string or the value None, if there was no text.</td>
</tr>
</tbody>
</table>

Inherited from lxml.etree._Element

attrib, base, nsmap, prefix, sourceline, tag, tail

Inherited from object

__class__

Class ObjectifyElementClassLookup

ObjectifyElementClassLookup(self, tree_class=None, empty_data_class=None) Element class lookup method that uses the objectify classes.

Methods

__init__(self, tree_class=None, empty_data_class=None)

Lookup mechanism for objectify.

The default Element classes can be replaced by passing subclasses of ObjectifiedElement and ObjectifiedDataElement as keyword arguments. 'tree_class' defines inner tree classes (defaults to ObjectifiedElement), 'empty_data_class' defines the default class for empty data elements (defaults to StringElement). Overrides: object.__init__
Class PyType

Inherited from object

__delattr__(), __format__(), __getattribute__(), __hash__(), __reduce__(), __reduce_ex__(),
__repr__(), __setattr__(), __sizeof__(), __str__(), __subclasshook__()

Properties

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inherited from object</td>
<td></td>
</tr>
<tr>
<td><strong>class</strong></td>
<td></td>
</tr>
</tbody>
</table>

Example:

```
PyType('int', int, MyIntClass).register()
```

Note that the order in which types are registered matters. The first matching type will be used.

Methods

```python
__init__(self, name, type_check, type_class, stringify=None)
```

x.__init__(...) initializes x; see help(type(x)) for signature  Overrides:
object.__init__

```
__new__ *(T, S, ...)*

**Return Value**

A new object with type S, a subtype of T

Overrides: object.__new__

__repr__ *(x)*

repr(x)  Overrides: object.__repr__

**register**(self, before=None, after=None)

Register the type.

The additional keyword arguments 'before' and 'after' accept a sequence of type names that must appear before/after the new type in the type list. If any of them is not currently known, it is simply ignored. Raises ValueError if the dependencies cannot be fulfilled.

**unregister**(self)

*Inherited from object*

__delattr__(), __format__(), __getattribute__(), __hash__(), __reduce__(), __reduce_ex__(), __setattr__(), __sizeof__(), __str__(), __subclasshook__()

**Properties**

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>name</td>
<td></td>
</tr>
<tr>
<td>stringify</td>
<td></td>
</tr>
<tr>
<td>type_check</td>
<td></td>
</tr>
</tbody>
</table>
| xmlSchemaTypes | The list of XML Schema datatypes this Python type maps to.  
Note that this must be set before registering the type! |

*Inherited from object*
Class StringElement

object

lxml.etree._Element

lxml.etree.ElementBase

lxml.objectify.ObjectifiedElement

lxml.objectify.ObjectifiedDataElement

lxml.objectify.StringElement

String data class.

Note that this class does not support the sequence protocol of strings: len(), iter(), str_attr[0], str_attr[0:1], etc. are not supported. Instead, use the .text attribute to get a 'real' string.

Methods

__add__(x, y)

x+y

__complex__(...)

__eq__(x, y)

x==y

__float__(x)

float(x)

__ge__(x, y)

x>=y
__gt__(x, y)

x>y

__hash__(x)

hash(x) Overrides: object.__hash__

__int__(x)

int(x)

__le__(x, y)

x<=y

__long__(x)

long(x)

__lt__(x, y)

x<y

__mod__(x, y)

x%y

__mul__(x, y)

x*y

__ne__(x, y)

x!=y
Class StringElement

Module lxml.objectify

__new__(T, S, ...)

**Return Value**

a new object with type S, a subtype of T

Overrides: object.__new__

__nonzero__(x)

x != 0  Overrides: lxml.etree._Element.__nonzero__

__radd__(x, y)

y+x

__repr__(x)

repr(x)  Overrides: object.__repr__

__rmod__(x, y)

y%x

__rmul__(x, y)

y*x

strlen(...)  

Inherited from lxml.objectify.ObjectifiedDataElement(Section B)

__str__()

Inherited from lxml.objectify.ObjectifiedElement(Section B)

__delattr__(), __delitem__(), __getattr__(), __getattribute__(), __getitem__(), __iter__(),

__len__(), __reduce__(), __setattr__(), __setitem__(), addattr(), countchildren(), descendentpaths(), getchildren()

Inherited from lxml.etree.ElementBase(Section B)

__init__()

Inherited from lxml.etree._Element
Class StringElement

Module lxml.objectify

__contains__(), __copy__(), __deepcopy__(), __reversed__(), addnext(), addprevious(), append(), clear(), extend(), find(), findall(), findtext(), get(), getiterator(), getnext(), getparent(), getprevious(), getroottree(), index(), insert(), items(), iter(), iterancestors(), iterchildren(), iterdescendants(), iterfind(), itersiblings(), itertext(), keys(), makeelement(), remove(), replace(), set(), values(), xpath()

Inherited from object

__format__(), __reduce_ex__(), __sizeof__(), __subclasshook__()

Properties

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<th>Description</th>
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<tbody>
<tr>
<td>pyval</td>
<td>Inherited from lxml.objectify.ObjectifiedElement (Section B) text</td>
</tr>
<tr>
<td>text</td>
<td>Inherited from lxml.etree._Element</td>
</tr>
<tr>
<td>attrib, base, nsmap, prefix, sourceline, tag, tail</td>
<td>Inherited from object</td>
</tr>
<tr>
<td><strong>class</strong></td>
<td></td>
</tr>
</tbody>
</table>
Module lxml.pyclasslookup

Variables

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>package</strong></td>
<td>Value: 'lxml'</td>
</tr>
</tbody>
</table>
Module lxml.sax

SAX-based adapter to copy trees from/to the Python standard library.
Use the ElementTreeContentHandler class to build an ElementTree from SAX events.
Use the ElementTreeProducer class or the saxify() function to fire the SAX events of an ElementTree against a SAX ContentHandler.
See http://codespeak.net/lxml/sax.html

Functions

```python
saxify(element_or_tree, content_handler)
```

One-shot helper to generate SAX events from an XML tree and fire them against a SAX ContentHandler.

Variables

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>package</strong></td>
<td>Value: 'lxml'</td>
</tr>
</tbody>
</table>

Class SaxError

object

exceptions.BaseException

exceptions.Exception

lxml.etree.Error

lxml.etree.LxmlError

lxml.sax.SaxError

General SAX error.

Methods

*Inherited from lxml.etree.LxmlError (Section B)*

__init__()
**Inherited from exceptions.Exception**

```python
__new__(self)
```

**Inherited from exceptions.BaseException**

```python
__delattr__(self), __getattribute__(self), __getitem__(self), __getslice__(self), __reduce__(self), __repr__(self),
__setattr__(self), __setstate__(self), __str__(self), __unicode__(self)
```

**Inherited from object**

```python
__format__(self), __hash__(self), __reduce_ex__(self), __sizeof__(self), __subclasshook__(self)
```

**Properties**

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inherited from exceptions.BaseException</td>
<td>args, message</td>
</tr>
<tr>
<td>Inherited from object</td>
<td><strong>class</strong></td>
</tr>
</tbody>
</table>

**Class Variables**

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inherited from lxml.etree.LxmlError (Section B)</td>
<td><strong>qualname</strong></td>
</tr>
</tbody>
</table>

**Class ElementTreeContentHandler**

```python
xml.sax.handler.ContentHandler
xsd.sax.ElementTreeContentHandler
```

Build an lxml ElementTree from SAX events.

**Methods**

```python
__init__(self, makeelement=None)
```

Overrides: xml.sax.handler.ContentHandler.__init__
**setDocumentLocator**(self, locator)

Called by the parser to give the application a locator for locating the origin of document events.

SAX parsers are strongly encouraged (though not absolutely required) to supply a locator: if it does so, it must supply the locator to the application by invoking this method before invoking any of the other methods in the DocumentHandler interface.

The locator allows the application to determine the end position of any document-related event, even if the parser is not reporting an error. Typically, the application will use this information for reporting its own errors (such as character content that does not match an application’s business rules). The information returned by the locator is probably not sufficient for use with a search engine.

Note that the locator will return correct information only during the invocation of the events in this interface. The application should not attempt to use it at any other time. Overrides: xml.sax.handler.ContentHandler.setDocumentLocator

**startDocument**(self)

Receive notification of the beginning of a document.

The SAX parser will invoke this method only once, before any other methods in this interface or in DTDHandler (except for setDocumentLocator). Overrides: xml.sax.handler.ContentHandler.startDocument

**endDocument**(self)

Receive notification of the end of a document.

The SAX parser will invoke this method only once, and it will be the last method invoked during the parse. The parser shall not invoke this method until it has either abandoned parsing (because of an unrecoverable error) or reached the end of input. Overrides: xml.sax.handler.ContentHandler.endDocument
startPrefixMapping(self, prefix, uri)

Begin the scope of a prefix-URI Namespace mapping.

The information from this event is not necessary for normal Namespace processing: the SAX XML reader will automatically replace prefixes for element and attribute names when the http://xml.org/sax/features/namespaces feature is true (the default).

There are cases, however, when applications need to use prefixes in character data or in attribute values, where they cannot safely be expanded automatically; the start/endPrefixMapping event supplies the information to the application to expand prefixes in those contexts itself, if necessary.

Note that start/endPrefixMapping events are not guaranteed to be properly nested relative to each-other: all startPrefixMapping events will occur before the corresponding startElement event, and all endPrefixMapping events will occur after the corresponding endElement event, but their order is not guaranteed. Overrides: xml.sax.handler.ContentHandler.startPrefixMapping extit(inherited documentation)

endPrefixMapping(self, prefix)

End the scope of a prefix-URI mapping.

See startPrefixMapping for details. This event will always occur after the corresponding endElement event, but the order of endPrefixMapping events is not otherwise guaranteed. Overrides: xml.sax.handler.ContentHandler.endPrefixMapping extit(inherited documentation)

startElementNS(self, ns_name, qname, attributes=None)

Signals the start of an element in namespace mode.

The name parameter contains the name of the element type as a (uri, localname) tuple, the qname parameter the raw XML 1.0 name used in the source document, and the attrs parameter holds an instance of the Attributes class containing the attributes of the element.

The uri part of the name tuple is None for elements which have no namespace. Overrides: xml.sax.handler.ContentHandler.startElementNS extit(inherited documentation)
### processingInstruction(self, target, data)

Receive notification of a processing instruction.

The Parser will invoke this method once for each processing instruction found: note that processing instructions may occur before or after the main document element.

A SAX parser should never report an XML declaration (XML 1.0, section 2.8) or a text declaration (XML 1.0, section 4.3.1) using this method. Overrides: xml.sax.handler.ContentHandler.processingInstruction (inherited documentation)

### endElementNS(self, ns_name, qname)

Signals the end of an element in namespace mode.

The name parameter contains the name of the element type, just as with the startElementNS event. Overrides: xml.sax.handler.ContentHandler.endElementNS (inherited documentation)

### startElement(self, name, attributes=None)

Signals the start of an element in non-namespace mode.

The name parameter contains the raw XML 1.0 name of the element type as a string and the attrs parameter holds an instance of the Attributes class containing the attributes of the element. Overrides: xml.sax.handler.ContentHandler.startElement (inherited documentation)

### endElement(self, name)

Signals the end of an element in non-namespace mode.

The name parameter contains the name of the element type, just as with the startElement event. Overrides: xml.sax.handler.ContentHandler.endElement (inherited documentation)

### characters(self, data)

Receive notification of character data.

The Parser will call this method to report each chunk of character data. SAX parsers may return all contiguous character data in a single chunk, or they may split it into several chunks; however, all of the characters in any single event must come from the same external entity so that the Locator provides useful information. Overrides: xml.sax.handler.ContentHandler.characters (inherited documentation)
**Class ElementTreeProducer**

**Module lxml.sax**

```python
ignoreWhitespace(self, data)
```

Receive notification of character data.

The Parser will call this method to report each chunk of character data. SAX parsers may return all contiguous character data in a single chunk, or they may split it into several chunks; however, all of the characters in any single event must come from the same external entity so that the Locator provides useful information. Overrides: xml.sax.handler.ContentHandler.ignorableWhitespace

**Inherited from xml.sax.handler.ContentHandler**

```python
skippedEntity()
```

**Properties**

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>etree</td>
<td>Contains the generated ElementTree after parsing is finished.</td>
</tr>
</tbody>
</table>

**Class ElementTreeProducer**

**Module lxml.sax**

```python
object lxml.sax.ElementTreeProducer
```

Produces SAX events for an element and children.

**Methods**

```python
__init__(self, element_or_tree, content_handler)
```

x.__init__(...) initializes x; see help(type(x)) for signature  Overrides: object.__init__

```python
saxify(self)
```

**Inherited from object**

```python
__delattr__(), __format__(), __getattribute__(), __hash__(), __new__(), __reduce__(), __reduce_ex__(), __repr__(), __setattr__(), __sizeof__(), __str__(), __subclasshook__()
```

**Properties**

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<table>
<thead>
<tr>
<th>Name</th>
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<tr>
<td>Inherited from object</td>
<td><strong>class</strong></td>
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</tbody>
</table>
Module lxml.usedoctest

Doctest module for XML comparison.

Usage:

```python
>>> import lxml.usedoctest
>>> # now do your XML doctests ...
```

See lxml.doctestcompare