Working with Excel files in Python

Chris Withers with help from John Machin
EuroPython 2009, Birmingham

Simplistix

The Tutorial Materials
These can be obtained by CD, USB drive or downloaded from here:

• http://www.simplistix.co.uk/presentations/europython2009excel.zip

The Website
The best place to start when working with Excel files in Python is the website:

• http://www.python-excel.org

© Simplistix Ltd 2009
License

THE WORK (AS DEFINED BELOW) IS PROVIDED UNDER THE TERMS OF THIS CREATIVE COMMONS PUBLIC LICENCE (“CCPL” OR “LICENCE”). THE WORK IS PROTECTED BY COPYRIGHT AND/OR OTHER APPLICABLE LAW. ANY USE OF THE WORK OTHER THAN AS AUTHORIZED UNDER THIS LICENCE OR COPYRIGHT LAW IS PROHIBITED. BY EXERCISING ANY RIGHTS TO THE WORK PROVIDED HERE, YOU ACCEPT AND AGREE TO BE BOUND BY THE TERMS OF THIS LICENCE. THE LICENSOR GRANTS YOU THE RIGHTS CONTAINED HERE IN CONSIDERATION OF YOUR ACCEPTANCE OF SUCH TERMS AND CONDITIONS.

This Creative Commons England and Wales Public Licence enables You (all capitalised terms defined below) to view, edit, modify, translate and distribute Works worldwide for Non-Commercial purposes under the terms of this Licence, provided that You credit the Original Author.

'The Licensor' [one or more legally recognised persons or entities offering the Work under the terms and conditions of this Licence] and

'You' agree as follows:

1. Definitions
   a) "Attribution" means acknowledging all the parties who have contributed to and have rights in the Work or Collective Work under this Licence.
   b) "Collective Work" means the Work in its entirety in unmodified form along with a number of other separate and independent works, assembled into a collective whole.
   c) "Derivative Work" means any work created by the editing, modification, adaptation or translation of the Work in any media (however a work that constitutes a Collective Work will not be considered a Derivative Work for the purpose of this Licence). For the avoidance of doubt, where the Work is a musical composition or sound recording, the synchronization of the Work in timed-relation with a moving image ("synching") will be considered a Derivative Work for the purpose of this Licence.
   d) "Licence" means this Creative Commons England and Wales Public Licence agreement.
   e) "Non-Commercial" means "not primarily intended for or directed towards commercial advantage or private monetary compensation". The exchange of the Work for other copyrighted works by means of digital file-sharing or otherwise shall not be considered to be intended for or directed towards commercial advantage or private monetary compensation, provided there is no payment of any monetary compensation in connection with the exchange of copyrighted works.
   f) "Original Author" means the individual (or entity) who created the Work.
   g) "Work" means the work protected by copyright which is offered under the terms of this Licence.
   h) For the purpose of this Licence, when not inconsistent with the context, words in the singular number include the plural number.

2. Licence Terms

2.1 The Licensor hereby grants to You a worldwide, royalty-free, non-exclusive, Licence for Non-Commercial use and for the duration of copyright in the Work.

You may:

- copy the Work;
- incorporate the Work into one or more Collective Works;
- copy the Work as incorporated in any Collective Work; and
- publish, distribute, archive, perform or otherwise disseminate the Work or the Work as incorporated in any Collective Work, to the public in any material form in any media whether now known or hereafter created.

HOWEVER,

You must not:

- impose any terms on the use to be made of the Work, the Work as incorporated in a Collective Work that alter or restrict the terms of this Licence or any rights granted under it or has the effect or intent of restricting the ability to exercise those rights;
- impose any digital rights management technology on the Work, the Work as incorporated in a Collective Work that alters or restricts the terms of this Licence or any rights granted under it or has the effect or intent of restricting the ability to exercise those rights;
- make any Derivative Works;
- sublicense the Work;
- subject the Work to any derogatory treatment as defined in the Copyright, Designs and Patents Act 1988.

FINALLY,

You must:

- make reference to this Licence (by Uniform Resource Identifier (URI), spoken word or as appropriate to the media used) on all copies of the Work and Collective Works published, distributed, performed or otherwise disseminated or made available to the public by You;
- recognise the Licensor’s / Original Author’s right of attribution in any Work and Collective Work that You publish, distribute, perform or otherwise disseminate to the public and ensure that You credit the Licensor / Original Author as appropriate to the media used; and
- to the extent reasonably practicable, keep intact all notices that refer to this Licence, in particular the URI, if any, that the Licensor specifies to be associated with the Work, unless such URI does not refer to the copyright notice or licensing information for the Work.

Additional Provisions for third parties making use of the Work

2.2. Further licence from the Licensor

Each time You publish, distribute, perform or otherwise disseminate

- the Work; or
- the Work as incorporated in a Collective Work

the Licensor agrees to offer to the relevant third party making use of the Work (in any of the alternatives set out above) a licence to use the Work on the same terms and conditions as granted to You hereunder.

2.3. This Licence does not affect any rights that the User may have under any applicable law, including fair use, fair dealing or any other legally recognised limitation or exception to copyright infringement.
2.4. All rights not expressly granted by the Licensor are hereby reserved, including but not limited to, the exclusive right to collect, whether individually or via a licensing body, such as a collecting society, royalties for any use of the Work for any reason which results in commercial advantage or private monetary compensation.

3. Warranties and Disclaimer

Except as required by law, the Work is licensed by the Licensor on an "as is" and "as available" basis and without any warranty of any kind, either express or implied.

4. Limit of Liability

Subject to any liability which may not be excluded or limited by law the Licensor shall not be liable and hereby expressly excludes all liability for loss or damage howsoever and whenever caused to You.

5. Termination

The rights granted to You under this Licence shall terminate automatically upon any breach by You of the terms of this Licence. Individuals or entities who have received Collective Works from You under this Licence, however, will not have their Licences terminated provided such individuals or entities remain in full compliance with those Licences.

6. General

6.1. The validity or enforceability of the remaining terms of this agreement is not affected by the holding of any provision of it to be invalid or unenforceable.

6.2. This Licence constitutes the entire Licence Agreement between the parties with respect to the Work licensed here. There are no understandings, agreements or representations with respect to the Work not specified here. The Licensor shall not be bound by any additional provisions that may appear in any communication in any form.

6.3. A person who is not a party to this Licence shall have no rights under the Contracts (Rights of Third Parties) Act 1999 to enforce any of its terms.

6.4. This Licence shall be governed by the law of England and Wales and the parties irrevocably submit to the exclusive jurisdiction of the Courts of England and Wales.

7. On the role of Creative Commons

7.1. Neither the Licensor nor the User may use the Creative Commons logo except to indicate that the Work is licensed under a Creative Commons Licence. Any permitted use has to be in compliance with the Creative Commons trade mark usage guidelines at the time of use of the Creative Commons trade mark. These guidelines may be found on the Creative Commons website or be otherwise available upon request from time to time.

7.2. Creative Commons Corporation does not profit financially from its role in providing this Licence and will not investigate the claims of any Licensor or user of the Licence.

7.3. One of the conditions that Creative Commons Corporation requires of the Licensor and You is an acknowledgement of its limited role and agreement by all who use the Licence that the Corporation is not responsible to anyone for the statements and actions of You or the Licensor or anyone else attempting to use or using this Licence.

7.4. Creative Commons Corporation is not a party to this Licence, and makes no warranty whatsoever in connection to the Work or in connection to the Licence, and in all events is not liable for any loss or damage resulting from the Licensor’s or Your reliance on this Licence or on its enforceability.

7.5. USE OF THIS LICENCE MEANS THAT YOU AND THE LICENSOR EACH ACCEPTS THESE CONDITIONS IN SECTION 7.1, 7.2, 7.3, 7.4 AND EACH ACKNOWLEDGES CREATIVE COMMONS CORPORATION’S VERY LIMITED ROLE AS A FACILITATOR OF THE LICENCE FROM THE LICENSOR TO YOU.

© Simplistix Ltd 2009
Introduction

This tutorial covers the following libraries:

**xlrd**
- [http://pypi.python.org/pypi/xlrd](http://pypi.python.org/pypi/xlrd)
- reading data and formatting from .xls files
- this tutorial covers version 0.7.1
- API documentation can be found at:
  - [https://secure.simplistix.co.uk/svn/xlrd/trunk/xlrd/doc/xlrd.html](https://secure.simplistix.co.uk/svn/xlrd/trunk/xlrd/doc/xlrd.html)

**xlwt**
- [http://pypi.python.org/pypi/xlwt](http://pypi.python.org/pypi/xlwt)
- writing data and formatting to .xls files
- this tutorial covers version 0.7.2
- incomplete API documentation can be found at:
  - [https://secure.simplistix.co.uk/svn/xlwt/trunk/xlwt/doc/xlwt.html](https://secure.simplistix.co.uk/svn/xlwt/trunk/xlwt/doc/xlwt.html)
- fairly complete examples can be found at
  - [https://secure.simplistix.co.uk/svn/xlwt/trunk/xlwt/examples/](https://secure.simplistix.co.uk/svn/xlwt/trunk/xlwt/examples/)

**xlutils**
- [http://pypi.python.org/pypi/xlutils](http://pypi.python.org/pypi/xlutils)
- a collection of utilities using both xlrd and xlwt:
  - copying data from a source to a target spreadsheet
  - filtering data from a source to a target spreadsheet
- this tutorial covers version 1.3.0 and above.
- documentation and examples can be found at:
  - [https://secure.simplistix.co.uk/svn/xlutils/trunk/xlutils/docs/](https://secure.simplistix.co.uk/svn/xlutils/trunk/xlutils/docs/)

There are still reasons why automating an Excel instance via COM is necessary:
- manipulation of graphs
- rich text cells
- reading formulae in cells
- working with macros and names
- the more esoteric things found in .xls files

© Simplistix Ltd 2009 [CC BY-NC-ND](http://creativecommons.org/licenses/by-nc-nd/3.0/)
Installation

There are several methods of installation available. While the following examples are for xlrd, the exact same steps can be used for any of the three libraries.

Install from Source

On Linux:

```
$ tar xzf xlrd.tgz
$ cd xlrd-0.7.1
$ python setup.py install
```

**NB:** Make sure you use the python you intend to use for your project.

On Windows, having used WinZip or similar to unpack xlrd-0.7.1.zip:

```
C:\> cd xlrd-0.7.1
C:\xlrd-0.7.1> \Python26\python setup.py install
```

**NB:** Make sure you use the python you intend to use for your project.

Install using Windows Installer

On Windows, you can download and run the xlrd-0.7.1.win32.exe installer.

Beware that this will only install to Python installations that are in the Windows registry.

Install using EasyInstall

This cross-platform method requires that you already have EasyInstall installed. For more information on this, please see:

- [http://peak.telecommunity.com/DevCenter/EasyInstall](http://peak.telecommunity.com/DevCenter/EasyInstall)

```
easy_install xlrd
```
Installation using Buildout

Buildout provides a cross-platform method of meeting the python package dependencies of a project without interfering with the system Python.

Having created a directory called mybuildout, download the following file into it:

• http://svn.zope.org/*checkout*/zc.buildout/trunk/bootstrap/bootstrap.py

Now, create a file in mybuildout called buildout.cfg containing the following:

```
[buildout]
parts = py
versions = versions

[versions]
xlrd=0.7.1
xlwt=0.7.2
xlutils=1.3.2

[py]
recipe = zc.recipe.egg
eggs =
  xlrd
  xlwt
  xlutils
interpreter = py

buildout.cfg
```

NB: The versions section is optional

Finally, run the following:

```
$ python bootstrap.py
$ bin/buildout
```

These lines:

• initialise the buildout environment
• run the buildout. This should be done each time dependencies change.

Now you can do the following:

```
$ bin/py your_xlrd_xlwt_xltuils_script.py
```

Buildout lives at http://pypi.python.org/pypi/zc.buildout
Reading Excel Files

All the examples shown below can be found in the `xlrd` directory of the course material.

Opening Workbooks

Workbooks can be loaded either from a file, an `mmap` object or from a string:

```python
from mmap import mmap, ACCESS_READ
from xlrd import open_workbook

print open_workbook('simple.xls')

with open('simple.xls', 'rb') as f:
    print open_workbook(  
        file_contents=mmap(f.fileno(), 0, access=ACCESS_READ)
    )

aString = open('simple.xls', 'rb').read()
print open_workbook(file_contents=aString)
```

Navigating a Workbook

Here is a simple example of workbook navigation:

```python
from xlrd import open_workbook

wb = open_workbook('simple.xls')

for s in wb.sheets():
    print 'Sheet:', s.name
    for row in range(s.nrows):
        values = []
        for col in range(s.ncols):
            values.append(s.cell(row, col).value)
        print ','.join(values)
        print
```

The next few sections will cover the navigation of workbooks in more detail.
Introspecting a Book

The xlrd.Book object returned by open_workbook contains all information to do with the workbook and can be used to retrieve individual sheets within the workbook. The nsheets attribute is an integer containing the number of sheets in the workbook. This attribute, in combination with the sheet_by_index method, is the most common way of retrieving individual sheets.

The sheet_names method returns a list of unicodes containing the names of all sheets in the workbook. Individual sheets can be retrieved using these names by way of the sheet_by_name function.

The results of the sheets method can be iterated over to retrieve each of the sheets in the workbook.

The following example demonstrates these methods and attributes:

```python
from xlrd import open_workbook

book = open_workbook('simple.xls')

print book.nsheets

for sheet_index in range(book.nsheets):
    print book.sheet_by_index(sheet_index)

print book.sheet_names()

for sheet_name in book.sheet_names():
    print book.sheet_by_name(sheet_name)

for sheet in book.sheets():
    print sheet
```

xlrd.Book objects have other attributes relating to the content of the workbook that are only rarely useful:

- codepage
- countries
- user_name

If you think you may need to use these attributes, please see the xlrd documentation.
**Introspecting a Sheet**

The `xlrd.sheet.Sheet` objects returned by any of the methods described above contain all the information to do with a worksheet and its contents.

The `name` attribute is a unicode representing the name of the worksheet.

The `nrows` and `ncols` attributes contain the number of rows and the number of columns, respectively, in the worksheet.

The following example shows how these can be used to iterate over and display the contents of one worksheet:

```python
from xlrd import open_workbook, cellname

book = open_workbook('odd.xls')
sheet = book.sheet_by_index(0)

print sheet.name
print sheet.nrows
print sheet.ncols

for row_index in range(sheet.nrows):
    for col_index in range(sheet.ncols):
        print cellname(row_index, col_index), '-',
        print sheet.cell(row_index, col_index).value

introspect_sheet.py
```

`xlrd.sheet.Sheet` objects have other attributes relating to the content of the worksheet that are only rarely useful:

- `col_label_ranges`
- `row_label_ranges`
- `visibility`

If you think you may need to use these attributes, please see the `xlrd` documentation.
**Getting a particular Cell**

As already seen in previous examples, the `cell` method of a `Sheet` object can be used to return the contents of a particular cell.

The `cell` method returns an `xlrd.sheet.Cell` object. These objects have very few attributes, of which `value` contains the actual value of the cell and `ctype` contains the type of the cell.

In addition, `Sheet` objects have two methods for returning these two types of data. The `cell_value` method returns the value for a particular cell, while the `cell_type` method returns the type of a particular cell. These methods can be quicker to execute than retrieving the `Cell` object.

Cell types are covered in more detail later. The following example shows the methods, attributes and classes in action:

```python
from xlrd import open_workbook, XL_CELL_TEXT

book = open_workbook('odd.xls')
sheet = book.sheet_by_index(1)

cell = sheet.cell(0, 0)
print cell
print cell.value
print cell.ctype == XL_CELL_TEXT

for i in range(sheet.ncols):
    print sheet.cell_type(1, i), sheet.cell_value(1, i)

cell_access.py
```
Iterating over the contents of a Sheet

We've already seen how to iterate over the contents of a worksheet and retrieve the resulting individual cells. However, there are methods to retrieve groups of cells more easily. There are a symmetrical set of methods that retrieve groups of cell information either by row or by column.

The `row` and `col` methods return all the `Cell` objects for a whole row or column, respectively.

The `row_slice` and `col_slice` methods return a list of `Cell` objects in a row or column, respectively, bounded by and start index and an optional end index.

The `row_types` and `col_types` methods return a list of integers representing the cell types in a row or column, respectively, bounded by and start index and an optional end index.

The `row_values` and `col_values` methods return a list of objects representing the cell values in a row or column, respectively, bounded by a start index and an optional end index.

The following examples demonstrates all of the sheet iteration methods:

```python
from xlrd import open_workbook

book = open_workbook('odd.xls')
sheet0 = book.sheet_by_index(0)
sheet1 = book.sheet_by_index(1)

print sheet0.row(0)
print sheet0.col(0)
print
print sheet0.row_slice(0,1)
print sheet0.row_slice(0,1,2)
print sheet0.row_values(0,1)
print sheet0.row_values(0,1,2)
print sheet0.row_types(0,1)
print sheet0.row_types(0,1,2)
print
print sheet1.col_slice(0,1)
print sheet0.col_slice(0,1,2)
print sheet1.col_values(0,1)
print sheet0.col_values(0,1,2)
print sheet1.col_types(0,1)
print sheet0.col_types(0,1,2)
```

`sheet_iteration.py`

© Simplistix Ltd 2009 [CC BY-NC-ND]
Utility Functions

When navigating around a workbook, it's often useful to be able to convert between row and column indexes and the Excel cell references that users may be used to seeing. The following functions are provided to help with this:

The `cellname` function turns a row and column index into a relative Excel cell reference.

The `cellnameabs` function turns a row and column index into an absolute Excel cell reference.

The `colname` function turns a column index into an Excel column name.

These three functions are demonstrated in the following example:

```python
from xlrd import cellname, cellnameabs, colname

print cellname(0,0), cellname(10,10), cellname(100,100)
print cellnameabs(3,1), cellnameabs(41,59), cellnameabs(265,358)
print colname(0), colname(10), colname(100)

utility.py
```

Unicode

All text attributes and values produced by `xlrd` will be either unicode objects or, in rare cases, ascii strings.

Each piece of text in an Excel file written by Microsoft Excel is encoded into one of the following:

- Latin1, if it fits
- UTF_16_LE, if it doesn't fit into Latin1
- In older files, by an encoding specified by an MS codepage. These are mapped to Python encodings by `xlrd` and still result in unicode objects.

In rare cases, other software has been known to write no codepage or the wrong codepage into Excel files. In this case, the correct encoding may need to be specified to `open_workbook`:

```python
from xlrd import open_workbook
book = open_workbook('dodgy.xls', encoding='cp1252')
```

Types of Cell

We have already seen the cell type expressed as an integer. This integer corresponds to a set of constants in `xlrd` that identify the type of the cell. The full set of possible cell types is listed in the following sections.
Text
These are represented by the `xlrd.XL_CELL_TEXT` constant.
Cells of this type will have values that are `unicode` objects.

Number
These are represented by the `xlrd.XL_CELL_NUMBER` constant.
Cells of this type will have values that are `float` objects.

Date
These are represented by the `xlrd.XL_CELL_DATE` constant.

**NB:** Dates don’t really exist in Excel files, they are merely Numbers with a particular number formatting.

`xlrd` will return `xlrd.XL_CELL_DATE` as the cell type if the number format string looks like a date.

The `xldate_as_tuple` method is provided for turning the `float` in a Date cell into a tuple suitable for instantiating various date/time objects. This example shows how to use it:

```python
from datetime import date, datetime, time
from xlrd import open_workbook, xldate_as_tuple

book = open_workbook('types.xls')
sheet = book.sheet_by_index(0)

date_value =
xldate_as_tuple(sheet.cell(3,2).value,book.datemode)
print datetime(*date_value), date(*date_value[:3])
datetime_value =
xldate_as_tuple(sheet.cell(3,3).value,book.datemode)
print datetime(*datetime_value)
time_value =
xldate_as_tuple(sheet.cell(3,4).value,book.datemode)
print time(*time_value[3:])
print datetime(*time_value)
dates.py
```

Caveats:

- Excel files have two possible date modes, one for files originally created on Windows and one for files originally created on an Apple machine. This is expressed as the `datemode` attribute of `xlrd.Book` objects and **must** be passed to `xldate_as_tuple`.
- The Excel file format has various problems with dates before 3 Jan 1904 that can cause date ambiguities that can result in `xldate_as_tuple` raising an `XLDateError`.
- The Excel formula function `DATE()` can return unexpected dates in certain circumstances.

© Simplistix Ltd 2009 [CC BY-NC-ND](http://creativecommons.org/licenses/by-nc-nd/3.0/)
Boolean
These are represented by the xlrd.XL_CELL_BOOLEAN constant.
Cells of this type will have values that are bool objects.

Error
These are represented by the xlrd.XL_CELL_ERROR constant.
Cells of this type will have values that are integers representing specific error codes.
The error_text_from_code function can be used to turn error codes into error messages:

```python
from xlrd import open_workbook, error_text_from_code

book = open_workbook('types.xls')
sheet = book.sheet_by_index(0)

print error_text_from_code[sheet.cell(5, 2).value]
pri print error_text_from_code[sheet.cell(5, 3).value]
```

errors.py

For a simpler way of sensibly displaying all cell types, see xlutils.display.
Empty / Blank

Excel files only store cells that either have information in them or have formatting applied to them. However, `xlrd` presents sheets as rectangular grids of cells.

Cells where no information is present in the Excel file are represented by the `xlrd.XL_CELL_EMPTY` constant. In addition, there is only one “empty cell”, whose value is an empty string, used by `xlrd`, so empty cells may be checked using a Python identity check.

Cells where only formatting information is present in the Excel file are represented by the `xlrd.XL_CELL_BLANK` constant and their value will always be an empty string.

```python
from xlrd import open_workbook, empty_cell

print empty_cell.value

book = open_workbook('types.xls')
sheet = book.sheet_by_index(0)
empty = sheet.cell(6,2)
blank = sheet.cell(7,2)
print empty is blank, empty is empty_cell, blank is empty_cell

book = open_workbook('types.xls', formatting_info=True)
sheet = book.sheet_by_index(0)
empty = sheet.cell(6,2)
blank = sheet.cell(7,2)
print empty.ctype, repr(empty.value)
print blank.ctype, repr(blank.value)

emptyblank.py
```
The following example brings all of the above cell types together and shows examples of their use:

```python
from xlrd import open_workbook

def cell_contents(sheet, row_x):
    result = []
    for col_x in range(2, sheet.ncols):
        cell = sheet.cell(row_x, col_x)
        result.append((cell.ctype, cell, cell.value))
    return result

sheet = open_workbook('types.xls').sheet_by_index(0)
print 'XL_CELL_TEXT', cell_contents(sheet, 1)
print 'XL_CELL_NUMBER', cell_contents(sheet, 2)
print 'XL_CELL_DATE', cell_contents(sheet, 3)
print 'XL_CELL_BOOLEAN', cell_contents(sheet, 4)
print 'XL_CELL_ERROR', cell_contents(sheet, 5)
print 'XL_CELL_BLANK', cell_contents(sheet, 6)
print 'XL_CELL_EMPTY', cell_contents(sheet, 7)
```

```python
sheet = open_workbook('types.xls', formatting_info=True).sheet_by_index(0)
print 'XL_CELL_TEXT', cell_contents(sheet, 1)
print 'XL_CELL_NUMBER', cell_contents(sheet, 2)
print 'XL_CELL_DATE', cell_contents(sheet, 3)
print 'XL_CELL_BOOLEAN', cell_contents(sheet, 4)
print 'XL_CELL_ERROR', cell_contents(sheet, 5)
print 'XL_CELL_BLANK', cell_contents(sheet, 6)
print 'XL_CELL_EMPTY', cell_contents(sheet, 7)
```

`cell_types.py`

### Names

These are an infrequently used but powerful way of abstracting commonly used information found within Excel files.

They have many uses, and `xlrd` can extract information from many of them. A notable exception are names that refer to sheet and VBA macros, which are extracted but should be ignored.

Names are created in Excel by navigating to **Insert > Name > Define**. If you plan to use `xlrd` to extract information from Names, familiarity with the definition and use of names in your chosen spreadsheet application is a good idea.
**Types**

A Name can refer to:

- A constant
  - CurrentInterestRate = 0.015
  - NameOfPHB = “Attila T. Hun”

- An absolute (i.e. not relative) cell reference
  - CurrentInterestRate = Sheet1!$B$4

- Absolute reference to a 1D, 2D, or 3D block of cells
  - MonthlySalesByRegion = Sheet2:Sheet5!$A$2:$M$100

- A list of absolute references
  - Print_Titles = [row_header_ref, col_header_ref])

Constants can be extracted.

The coordinates of an absolute reference can be extracted so that you can then extract the corresponding data from the relevant sheet(s).

A relative reference is useful only if you have external knowledge of what cells can be used as the origin. Many formulas found in Excel files include function calls and multiple references and are not useful, and can be too hard to evaluate.

A full calculation engine is not included in xlrd.

**Scope**

The scope of a Name can be global, or it may be specific to a particular sheet. A Name’s identifier may be re-used in different scopes. When there are multiple Names with the same identifier, the most appropriate one is used based on scope. A good example of this is the built-in name Print_Area; each worksheet may have one of these.

Examples:

- name=rate, scope=Sheet1, formula=0.015
- name=rate, scope=Sheet2, formula=0.023
- name=rate, scope=global, formula=0.040

A cell formula (1+rate)^20 is equivalent to 1.015^20 if it appears in Sheet1 but equivalent to 1.023^20 if it appears in Sheet2, and 1.040^20 if it appears in any other sheet.

**Usage**

Common reasons for using names include:

- Assigning textual names to values that may occur in many places within a workbook
  - eg: RATE = 0.015

- Assigning textual names to complex formulae that may be easily mis-copied
  - eg: SALES_RESULTS = $A$10:$M$999

Here’s an example real-world use case: reporting to head office. A company’s head office makes up a template workbook. Each department gets a copy to fill in. The various ranges
of data to be provided all have defined names. When the files come back, a script is used to validate that the department hasn’t trashed the workbook and the names are used to extract the data for further processing. Using names decouples any artistic repositioning of the ranges, by either head office template-designing user or by departmental users who are filling in the template, from the script which only has to know what the names of the ranges are.

In the examples directory of the xlrd distribution you will find namesdemo.xls which has examples of most of the non-macro varieties of defined names. There is also xlrdnamesAPIdemo.py which shows how to use the name lookup dictionaries, and how to extract constants and references and the data that references point to.

### Formatting

We've already seen that open_workbook has a parameter to load formatting information from Excel files. When this is done, all the formatting information is available, but the details of how it is presented are beyond the scope of this tutorial.

If you wish to copy existing formatted data to a new Excel file, see xlutils.copy and xlutils.filter.

If you do wish to inspect formatting information, you’ll need to consult the following attributes of the following classes:

**xlrd.Book**

- colour_map
- font_list
- format_list
- format_map
- palette_record
- style_name_map
- xf_list

**xlrd.sheet.Sheet**

- cell_xf_index
- rowinfo_map
- colinfo_map
- computed_column_width
- default_additional_space_above
- default_additional_space_below
- default_row_height
- default_row_height_mismatch
- default_row_hidden
- defcolwidth
- gcw
- merged_cells
- standard_width

**xlrd.sheet.Cell**

- xf_index

### Other Classes

In addition, the following classes are solely used to represent formatting information:

- xlrd.sheet.Rowinfo
- xlrd.sheet.Colinfo
- xlrd.formatting.Font
- xlrd.formatting.Format
- xlrd.formatting.XF
- xlrd.formatting.XFAlignment
- xlrd.formatting.XFBackground
- xlrd.formatting.XFBorder
Working with large Excel files

If you're working with particularly large Excel files then there are two features of xlrd that you should be aware of:

- The `on_demand` parameter can be passed as `True` to `open_workbook` resulting in worksheets only being loaded into memory when they are requested.
- `xlrd.Book` objects have an `unload_sheet` method that will unload worksheet, specified by either sheet index or sheet name, from memory.

The following example shows how a large workbook could be iterated over when only sheets matching a certain pattern need to be inspected, and where only one of those sheets ends up in memory at any one time:

```python
from xlrd import open_workbook

book = open_workbook('simple.xls', on_demand=True)

for name in book.sheet_names():
    if name.endswith('2'):
        sheet = book.sheet_by_name(name)
        print sheet.cell_value(0, 0)
        book.unload_sheet(name)
```

*large_files.py*
Introspecting Excel files with runxlrd.py

The xlrd source distribution includes a `runxlrd.py` script that is extremely useful for introspecting Excel files without writing a single line of Python.

You are encouraged to run a variety of the commands it provides over the Excel files provided in the course materials.

The following gives an overview of what's available from `runxlrd`, and can be obtained using `python runxlrd.py --help`:

```
runxlrd.py [options] command [input-file-patterns]
```

Commands:

- **2rows** Print the contents of first and last row in each sheet
- **3rows** Print the contents of first, second and last row in each sheet
- **bench** Same as "show", but doesn't print -- for profiling
- **biff_count[1]** Print a count of each type of BIFF record in the file
- **biff_dump[1]** Print a dump (char and hex) of the BIFF records in the file
- **fonts** hdr + print a dump of all font objects
- **hdr** Mini-overview of file (no per-sheet information)
- **hotshot** Do a hotshot profile run e.g. ... -f1 hotshot bench bigfile*.xls
- **labels** Dump of sheet.col_label_ranges and ...row... for each sheet
- **name_dump** Dump of each object in book.name_obj_list
- **names** Print brief information for each NAME record
- **ov** Overview of file
- **profile** Like "hotshot", but uses cProfile
- **show** Print the contents of all rows in each sheet
- **version[0]** Print versions of xlrd and Python and exit
- **xfc** Print "XF counts" and cell-type counts -- see code for details

[0] means no file arg
[1] means only one file arg i.e. no glob.glob pattern

Options:

- `-h, --help` show this help message and exit
- `-l LOGFILENAME, --logfilename=LOGFILENAME` contains error messages
- `-v VERBOSITY, --verbosity=VERBOSITY` level of information and diagnostics provided
- `-p PICKLEABLE, --pickleable=PICKLEABLE` 1: ensure Book object is pickleable (default); 0: don't bother
- `-m MMAP, --mmap=MMAP` 1: use mmap; 0: don't use mmap; -1: accept heuristic
- `-e ENCODING, --encoding=ENCODING` encoding override
- `-f FORMATTING, --formatting=FORMATTING` 0 (default): no fmt info 1: fmt info (all cells)
- `-g GC, --gc=GC` 0: auto gc enabled; 1: auto gc disabled, manual collect after each file; 2: no gc
- `-s ONESHEET, --onesheet=ONESHEET` restrict output to this sheet (name or index)
- `-u, --unnumbered` omit line numbers or offsets in biff_dump
Writing Excel Files

All the examples shown below can be found in the xlwt directory of the course material.

Creating elements within a Workbook

Workbooks are created with xlwt by instantiating an xlwt.Workbook object, manipulating it and then calling its save method.

The save method may be passed either a string containing the path to write to or a file-like object, opened for writing in binary mode, to which the binary Excel file data will be written.

The following objects can be created within a workbook:

Worksheets

Worksheets are created with the add_sheet method of the Workbook class.

To retrieve an existing sheet from a Workbook, use its get_sheet method. This method is particularly useful when the Workbook has been instantiated by xlutils.copy.

Rows

Rows are created using the row method of the Worksheet class and contain all of the cells for a given row.

The row method is also used to retrieve existing rows from a Worksheet.

If a large number of rows have been written to a Worksheet and memory usage is becoming a problem, the flush_row_data method may be called on the Worksheet. Once called, any rows flushed cannot be accessed or modified.

It is recommended that flush_row_data is called for every 1000 or so rows of a normal size that are written to an xlwt.Workbook. If the rows are huge, that number should be reduced.

Columns

Columns are created using the col method of the Worksheet class and contain display formatting information for a given column.

The col method is also used to retrieve existing columns from a Worksheet.

Cells

Cells can be written using either the write method of either the Worksheet or Row class.

A more detailed discussion of different ways of writing cells and the different types of cell that may be written is covered later.
A Simple Example

The following example shows how all of the above methods can be used to build and save a simple workbook:

```python
from tempfile import TemporaryFile
from xlwt import Workbook

book = Workbook()
sheet1 = book.add_sheet('Sheet 1')
book.add_sheet('Sheet 2')

sheet1.write(0, 0, 'A1')
sheet1.write(0, 1, 'B1')
row1 = sheet1.row(1)
row1.write(0, 'A2')
row1.write(1, 'B2')
sheet1.col(0).width = 10000

sheet2 = book.get_sheet(1)
sheet2.row(0).write(0, 'Sheet 2 A1')
sheet2.row(0).write(1, 'Sheet 2 B1')
sheet2.flush_row_data()
sheet2.write(1, 0, 'Sheet 2 A3')
sheet2.col(0).width = 5000
sheet2.col(0).hidden = True

book.save('simple.xls')
book.save(TemporaryFile())

simple.py
```

Unicode

The best policy is to pass unicode objects to all xlwt-related method calls.

If you absolutely have to use encoded strings then make sure that the encoding used is consistent across all calls to any xlwt-related methods.

If encoded strings are used and the encoding is not 'ascii', then any Workbook objects must be created with the appropriate encoding specified:

```python
from xlwt import Workbook

book = Workbook(encoding='utf-8')
```
Writing to Cells

A number of different ways of writing a cell are provided by xlwt along with different strategies for handling multiple writes to the same cell.

Different ways of writing cells

There are generally three ways to write to a particular cell:

- **Worksheet.write(row_index,column_index,value)**
  - This is just syntactic sugar for sheet.row(row_index).write(column_index,value)
  - It can be useful when you only want to write one cell to a row

- **Row.write(column_index,value)**
  - This will write the correct type of cell based on the value passed
  - Because it figures out what type of cell to write, this method may be slower for writing large workbooks

- **Specialist write methods on the Row class**
  - Each type of cell has a specialist setter method as covered in the “Types of Cell” section below.
  - These require you to pass the correct type of Python object but can be faster.

In general, use Worksheet.write for convenience and the specialist write methods if you require speed for a large volume of data.

Overwriting Cells

The Excel file format does nothing to prevent multiple records for a particular cell occurring but, if this happens, the results will vary depending on what application is used to open the file. Excel will display a “File error: data may have been lost” while OpenOffice.org will show the last record for the cell that occurs in the file.

To help prevent this, xlwt provides two modes of operation:

- Writing to the same cell more than once will result in an exception
  This is the default mode.

- Writing to the same cell more than once will replace the record for that cell, and only one record will be written when the Workbook is saved.
The following example demonstrates these two options:

```python
from xlwt import Workbook

book = Workbook()
sheet1 = book.add_sheet('Sheet 1',cell_overwrite_ok=True)
sheet1.write(0,0,'original')
sheet = book.get_sheet(0)
sheet.write(0,0,'new')

sheet2 = book.add_sheet('Sheet 2')
sheet2.write(0,0,'original')
sheet2.write(0,0,'new')

overwriting.py
```

The most common case for needing to overwrite cells is when an existing Excel file has been loaded into a Workbook instance using `xlutils.copy`.

### Types of Cell

All types of cell supported by the Excel file format can be written:

#### Text

When passed a `unicode` or string, the `write` methods will write a Text cell. The `set_cell_text` method of the `Row` class can also be used to write Text cells. When passed a string, these methods will first decode the string using the Workbook’s encoding.

#### Number

When passed a `float`, `int`, `long`, or `decimal.Decimal`, the `write` methods will write a Number cell. The `set_cell_number` method of the `Row` class can also be used to write Number cells.

#### Date

When passed a `datetime.datetime`, `datetime.date` or `datetime.time`, the `write` methods will write a Date cell. The `set_cell_date` method of the `Row` class can also be used to write Date cells. Note: As mentioned earlier, a date is not really a separate type in Excel; if you don’t apply a date format, it will be treated as a number.

#### Boolean

When passed a `bool`, the `write` methods will write a Boolean cell. The `set_cell_boolean` method of the `Row` class can also be used to write Text cells.
**Error**

You shouldn't ever want to write Error cells!

However, if you absolutely must, the `set_cell_error` method of the Row class can be used to do so. For convenience, it can be called with either hexadecimal error codes, expressed as integers, or the error text that Excel would display.

**Blank**

It is not normally necessary to write blank cells. The one exception to this is if you wish to apply formatting to a cell that contains nothing.

To do this, either call the `write` methods with an empty string or None, or use the `set_cell_blank` method of the Row class.

If you need to do this for more than one cell in a row, using the `set_cell_mulblanks` method will result in a smaller Excel file when the Workbook is saved.
The following example brings all of the above cell types together and shows examples use both the generic `write` method and the specialist methods:

```python
from datetime import date, time, datetime
from decimal import Decimal
from xlwt import Workbook, Style

wb = Workbook()
ws = wb.add_sheet('Type examples')
ws.row(0).write(0, u'£')
ws.row(0).write(1, 'Text')
ws.row(1).write(0, 3.1415)
ws.row(1).write(1, 15)
ws.row(1).write(2, 265L)
ws.row(1).write(3, Decimal('3.65'))
ws.row(2).set_cell_number(0, 3.1415)
ws.row(2).set_cell_number(1, 15)
ws.row(2).set_cell_number(2, 265L)
ws.row(2).set_cell_number(3, Decimal('3.65'))
ws.row(3).write(0, date(2009, 3, 18))
ws.row(3).write(1, datetime(2009, 3, 18, 17, 0, 1))
ws.row(3).write(2, time(17, 1))
ws.row(4).set_cell_date(0, date(2009, 3, 18))
ws.row(4).set_cell_date(1, datetime(2009, 3, 18, 17, 0, 1))
ws.row(4).set_cell_date(2, time(17, 1))
ws.row(5).write(0, False)
ws.row(5).write(1, True)
ws.row(6).set_cell_boolean(0, False)
ws.row(6).set_cell_boolean(1, True)
ws.row(7).set_cell_error(0, 0x17)
ws.row(7).set_cell_error(1, '#NULL!')
ws.row(8).write(0, '', Style.easyxf('pattern: pattern solid, fore_colour green;'))
ws.row(8).write(1, None, Style.easyxf('pattern: pattern solid, fore_colour blue;'))
ws.row(9).set_cell_blank(0, Style.easyxf('pattern: pattern solid, fore_colour yellow;'))
ws.row(10).set_cell_mulblanks(5, 10, Style.easyxf('pattern: pattern solid, fore_colour red;'))

wb.save('types.xls')
cell_types.py
```
Styles

Most elements of an Excel file can be formatted. For many elements including cells, rows and columns, this is done by assigning a style, known as an XF record, to that element.

This is done by passing an xlwt.XFStyle instance to the optional last argument to the various write methods and specialist set_cell_ methods. xlwt.Row and xlwt.Column instances have set_style methods to which an xlwt.XFStyle instance can be passed.

XFStyle

In xlwt, the XF record is represented by the XFStyle class and its related attribute classes. The following example shows how to create a red Date cell with Arial text and a black border:

```python
from datetime import date
from xlwt import Workbook, XFStyle, Borders, Pattern, Font

fnt = Font()
fnt.name = 'Arial'

borders = Borders()
borders.left = Borders.THICK
borders.right = Borders.THICK
borders.top = Borders.THICK
borders.bottom = Borders.THICK

pattern = Pattern()
pattern.pattern = Pattern.SOLID_PATTERN
pattern.pattern_fore_colour = 0x0A

style = XFStyle()
style.num_format_str='YYYY-MM-DD'
style.font = fnt
style.borders = borders
style.pattern = pattern

book = Workbook()
sheet = book.add_sheet('A Date')
sheet.write(1,1,date(2009,3,18),style)

book.save('date.xls')

xfstyle_format.py
```

This can be quite cumbersome!
easyxf

Thankfully, xlwt provides the easyxf helper to create XFStyle instances from human readable text and an optional string containing a number format.

Here is the above example, this time created with easyxf:

```python
from datetime import date
from xlwt import Workbook, easyxf

book = Workbook()
sheet = book.add_sheet('A Date')

sheet.write(1,1,date(2009,3,18),easyxf(
    'font: name Arial;
    borders: left thick, right thick, top thick, bottom thick;
    pattern: pattern solid, fore_colour red,'
    num_format_str='YYYY-MM-DD'
))

book.save('date.xls')

easyxf_format.py
```

The human readable text breaks roughly as follows, in pseudo-regular expression syntax:

```plaintext
(<element>:(<attribute> <value>,)+;)+
```

This means:

- The text contains a semi-colon delimited list of element definitions.
- Each element contains a comma-delimited list of attribute and value pairs.

The following sections describe each of the types of element by providing a table of their attributes and possible values for those attributes. For explanations of how to express boolean values and colours, please see the “Types of attribute” section.
# Font

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>bold</strong></td>
<td>A boolean value. The default is False.</td>
</tr>
<tr>
<td><strong>charset</strong></td>
<td>The character set to use for this font, which can be one of the following:</td>
</tr>
<tr>
<td></td>
<td>ansi_latin, sys_default, symbol, apple_roman, ansi_jap_shift_jis, ansi_kor_hangul,</td>
</tr>
<tr>
<td></td>
<td>ansi_kor_johab, ansi_chinese_gbk, ansi_chinese_big5, ansi_greek, ansi_turkish,</td>
</tr>
<tr>
<td></td>
<td>ansi_vietnamese, ansi_hebrew, ansi_arabic, ansi_baltic, ansi_cyrillic, ansi_thai,</td>
</tr>
<tr>
<td></td>
<td>ansi_latin_ii, oem_latin_1</td>
</tr>
<tr>
<td></td>
<td>The default is sys_default.</td>
</tr>
<tr>
<td><strong>colour</strong></td>
<td>A colour specifying the colour for the text. The default is the automatic</td>
</tr>
<tr>
<td></td>
<td>colour.</td>
</tr>
<tr>
<td><strong>escapement</strong></td>
<td>This can be one of none, superscript or subscript.</td>
</tr>
<tr>
<td><strong>family</strong></td>
<td>This should be a string containing the name of the font family to use.</td>
</tr>
<tr>
<td></td>
<td>You probably want to use name instead of this attribute and leave this to</td>
</tr>
<tr>
<td></td>
<td>its default value.</td>
</tr>
<tr>
<td></td>
<td>The default is None.</td>
</tr>
<tr>
<td><strong>height</strong></td>
<td>The height of the font as expressed by multiplying the point size by 20.</td>
</tr>
<tr>
<td></td>
<td>The default is 200, which equates to 10pt.</td>
</tr>
<tr>
<td><strong>italic</strong></td>
<td>A boolean value. The default is False.</td>
</tr>
<tr>
<td><strong>name</strong></td>
<td>This should be a string containing the name of the font family to use.</td>
</tr>
<tr>
<td></td>
<td>The default is Arial.</td>
</tr>
<tr>
<td><strong>outline</strong></td>
<td>A boolean value. The default is False.</td>
</tr>
<tr>
<td><strong>shadow</strong></td>
<td>A boolean value. The default is False.</td>
</tr>
<tr>
<td><strong>struck_out</strong></td>
<td>A boolean value. The default is False.</td>
</tr>
<tr>
<td><strong>underline</strong></td>
<td>A boolean value or one of none, single, single_acc, double or double_acc.</td>
</tr>
<tr>
<td></td>
<td>The default is none.</td>
</tr>
<tr>
<td><strong>color_index</strong></td>
<td>A synonym for colour</td>
</tr>
<tr>
<td><strong>colour_index</strong></td>
<td>A synonym for colour</td>
</tr>
<tr>
<td><strong>color</strong></td>
<td>A synonym for colour</td>
</tr>
<tr>
<td><strong>alignment</strong></td>
<td></td>
</tr>
<tr>
<td>--------------</td>
<td></td>
</tr>
<tr>
<td><strong>direction</strong></td>
<td>One of general, lr, or rl. The default is general.</td>
</tr>
<tr>
<td><strong>horizontal</strong></td>
<td>One of the following: general, left, center</td>
</tr>
<tr>
<td><strong>indent</strong></td>
<td>A indentation amount between 0 and 15. The default is 0.</td>
</tr>
<tr>
<td><strong>rotation</strong></td>
<td>An integer rotation in degrees between -90 and +90 or one of stacked or none. The default is none.</td>
</tr>
<tr>
<td><strong>shrink_to_fit</strong></td>
<td>A boolean value. The default is False.</td>
</tr>
<tr>
<td><strong>vertical</strong></td>
<td>One of the following: top, center</td>
</tr>
<tr>
<td><strong>wrap</strong></td>
<td>A boolean value. The default is False.</td>
</tr>
<tr>
<td><strong>dire</strong></td>
<td>This is a synonym for direction.</td>
</tr>
<tr>
<td><strong>horiz</strong></td>
<td>This is a synonym for horizontal.</td>
</tr>
<tr>
<td><strong>horz</strong></td>
<td>This is a synonym for horizontal.</td>
</tr>
<tr>
<td><strong>inde</strong></td>
<td>This is a synonym for indent.</td>
</tr>
<tr>
<td><strong>rota</strong></td>
<td>This is a synonym for rotation.</td>
</tr>
<tr>
<td><strong>shri</strong></td>
<td>This is a synonym for shrink_to_fit.</td>
</tr>
<tr>
<td><strong>shrink</strong></td>
<td>This is a synonym for shrink_to_fit.</td>
</tr>
<tr>
<td><strong>vert</strong></td>
<td>This is a synonym for vertical.</td>
</tr>
<tr>
<td>Property</td>
<td>Description</td>
</tr>
<tr>
<td>---------------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>left</td>
<td>A type of border line*</td>
</tr>
<tr>
<td>right</td>
<td>A type of border line*</td>
</tr>
<tr>
<td>top</td>
<td>A type of border line*</td>
</tr>
<tr>
<td>bottom</td>
<td>A type of border line*</td>
</tr>
<tr>
<td>diag</td>
<td>A type of border line*</td>
</tr>
<tr>
<td>left_colour</td>
<td><em>A colour. The default is the automatic colour.</em></td>
</tr>
<tr>
<td>right_colour</td>
<td><em>A colour. The default is the automatic colour.</em></td>
</tr>
<tr>
<td>top_colour</td>
<td><em>A colour. The default is the automatic colour.</em></td>
</tr>
<tr>
<td>bottom_colour</td>
<td><em>A colour. The default is the automatic colour.</em></td>
</tr>
<tr>
<td>diag_colour</td>
<td><em>A colour. The default is the automatic colour.</em></td>
</tr>
<tr>
<td>need_diag_1</td>
<td><em>A boolean value. The default is False.</em></td>
</tr>
<tr>
<td>need_diag_2</td>
<td><em>A boolean value. The default is False.</em></td>
</tr>
</tbody>
</table>

*This can be either an integer width between 0 and 13 or one of the following: no_line, thin, medium, dashed, dotted, thick, double, hair, medium_dashed, thin_dash_dotted, medium_dash_dotted, thin_dash_dot_dotted, medium_dash_dot_dotted, slanted_medium_dash_dotted
**pattern**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>back_colour</td>
<td>A colour. The default is the automatic colour.</td>
</tr>
<tr>
<td>fore_colour</td>
<td>A colour. The default is the automatic colour.</td>
</tr>
<tr>
<td>pattern</td>
<td>One of the following: no_fill, none, solid, solid_fill, solid_pattern,</td>
</tr>
<tr>
<td></td>
<td>finedots, alt_bars, sparse_dots, thick_horz_bands, thick_vert_bands,</td>
</tr>
<tr>
<td></td>
<td>thick_backward_diag, thick_forward_diag, big_spots, bricks, thin_horz_bands,</td>
</tr>
<tr>
<td></td>
<td>thin_vert_bands, thin_backward_diag, thin_forward_diag, squares, diamonds</td>
</tr>
<tr>
<td></td>
<td>The default is none.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>fore_color</td>
<td>A synonym for fore_colour</td>
</tr>
<tr>
<td>back_color</td>
<td>A synonym for back_colour</td>
</tr>
<tr>
<td>pattern_fore_colour</td>
<td>A synonym for fore_colour</td>
</tr>
<tr>
<td>pattern_fore_color</td>
<td>A synonym for fore_colour</td>
</tr>
<tr>
<td>pattern_back_colour</td>
<td>A synonym for back_colour</td>
</tr>
<tr>
<td>pattern_back_color</td>
<td>A synonym for back_colour</td>
</tr>
</tbody>
</table>

**protection**

The protection features of the Excel file format are only partially implemented in `xlwt`. Avoid them unless you plan on finishing their implementation.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>cell_locked</td>
<td>A boolean value. The default is True.</td>
</tr>
<tr>
<td>formula_hidden</td>
<td>A boolean value. The default is False.</td>
</tr>
</tbody>
</table>

**align**

A synonym for `alignment`

**border**

A synonym for `borders`

**Types of attribute**

`Boolean` values are either True or False, but easyxf allows great flexibility in how you choose to express those two values:

- **True** can be expressed by `1`, `yes`, `true`, or `on`
- **False** can be expressed by `0`, `no`, `false`, or `off`
Colours in Excel files are a confusing mess. The safest bet to do is just pick from the following list of colour names that easyxf understands.

The names used are those reported by the Excel 2003 GUI when you are inspecting the default colour palette.

Warning: There are many differences between this implicit mapping from colour-names to RGB values and the mapping used in standards such as HTML and CSS.

<table>
<thead>
<tr>
<th>Colour</th>
<th>Colour</th>
<th>Colour</th>
<th>Colour</th>
</tr>
</thead>
<tbody>
<tr>
<td>aqua</td>
<td>dark_red_ega</td>
<td>light_blue</td>
<td>plum</td>
</tr>
<tr>
<td>black</td>
<td>dark_teal</td>
<td>light_green</td>
<td>purple_ega</td>
</tr>
<tr>
<td>blue</td>
<td>dark_yellow</td>
<td>light_orange</td>
<td>red</td>
</tr>
<tr>
<td>blue_gray</td>
<td>gold</td>
<td>light_turquoise</td>
<td>rose</td>
</tr>
<tr>
<td>bright_green</td>
<td>gray_ega</td>
<td>light_yellow</td>
<td>sea_green</td>
</tr>
<tr>
<td>brown</td>
<td>gray25</td>
<td>lime</td>
<td>silver_ega</td>
</tr>
<tr>
<td>coral</td>
<td>gray40</td>
<td>magenta_ega</td>
<td>sky_blue</td>
</tr>
<tr>
<td>cyan_ega</td>
<td>gray50</td>
<td>ocean_blue</td>
<td>tan</td>
</tr>
<tr>
<td>dark_blue</td>
<td>gray80</td>
<td>olive_ega</td>
<td>teal</td>
</tr>
<tr>
<td>dark_blue_ega</td>
<td>green</td>
<td>olive_green</td>
<td>teal_ega</td>
</tr>
<tr>
<td>dark_green</td>
<td>ice_blue</td>
<td>orange</td>
<td>turquoise</td>
</tr>
<tr>
<td>dark_green_ega</td>
<td>indigo</td>
<td>pale_blue</td>
<td>violet</td>
</tr>
<tr>
<td>dark_purple</td>
<td>ivory</td>
<td>periwinkle</td>
<td>white</td>
</tr>
<tr>
<td>dark_red</td>
<td>lavender</td>
<td>pink</td>
<td>yellow</td>
</tr>
</tbody>
</table>

NB: grey can be used instead of gray wherever it occurs above.

Formatting Rows and Columns

It is possible to specify default formatting for rows and columns within a worksheet. This is done using the set_style method of the Row and Column instances, respectively.

The precedence of styles is as follows:

- the style applied to a cell
- the style applied to a row
- the style applied to a column

It is also possible to hide whole rows and columns by using the hidden attribute of Row and Column instances.

The width of a Column can be controlled by setting its width attribute to an integer where 1 is 1/256 of the width of the zero character, using the first font that occurs in the Excel file.

Do not be fooled by the height attribute of the Row class, it does nothing. Specify a style on the row and set its font height attribute instead.
The following example shows these methods and properties in use along with the style precedence:

```python
from xlwt import Workbook, easyxf
from xlwt.Utils import rowcol_to_cell

row = easyxf('pattern: pattern solid, fore_colour blue')
col = easyxf('pattern: pattern solid, fore_colour green')
cell = easyxf('pattern: pattern solid, fore_colour red')

book = Workbook()

sheet = book.add_sheet('Precedence')
for i in range(0,10,2):
    sheet.row(i).set_style(row)
for i in range(0,10,2):
    sheet.col(i).set_style(col)
for i in range(10):
    sheet.write(i,i,None,cell)

sheet = book.add_sheet('Hiding')
for rowx in range(10):
    for colx in range(10):
        sheet.write(rowx,colx,rowcol_to_cell(rowx,colx))
for i in range(0,10,2):
    sheet.row(i).hidden = True
    sheet.col(i).hidden = True

sheet = book.add_sheet('Row height and Column width')
for i in range(10):
    sheet.write(0,i,0)
for i in range(10):
    sheet.row(i).set_style(easyxf('font:height '+str(200*i)))
    sheet.col(i).width = 256*i

book.save('format_rowscols.xls')
format_rowscols.py
```

**Formatting Sheets and Workbooks**
There are many possible settings that can be made on Sheets and Workbooks.
Most of them you will never need or want to touch.
If you think you do, see the “Other Properties” section below.
**Style compression**

While it's fine to create as many XFStyle and their associated Font instances as you like, each one written to Workbook will result in an XF record and a Font record. Excel has fixed limits of around 400 Fonts and 4000 XF records so care needs to be taken when generating large Excel files.

To help with this, `xlwt.Workbook` has an optional `style_compression` parameter with the following meaning:

- **0** – no compression. This is the default.
- **1** – compress Fonts only. Not very useful.
- **2** – compress Fonts and XF records.

The following example demonstrates these three options:

```python
from xlwt import Workbook, easyxf

style1 = easyxf('font: name Times New Roman')
style2 = easyxf('font: name Times New Roman')
style3 = easyxf('font: name Times New Roman')

def write_cells(book):
    sheet = book.add_sheet('Content')
    sheet.write(0,0,'A1',style1)
    sheet.write(0,1,'B1',style2)
    sheet.write(0,2,'C1',style3)

book = Workbook()
write_cells(book)
book.save('3xf3fonts.xls')

book = Workbook(style_compression=1)
write_cells(book)
book.save('3xf1font.xls')

book = Workbook(style_compression=2)
write_cells(book)
book.save('1xf1font.xls')

stylecompression.py
```

Be aware that doing this compression involves deeply nested comparison of the XFStyle objects, so may slow down writing of large files where many styles are used.

The recommended best practice is to create all the styles you will need in advance and leave `style_compression` at its default value.
**Formulae**

Formulae can be written by `xlwt` by passing an `xlwt.Formula` instance to either of the write methods or by using the `set_cell_formula` method of Row instances, bugs allowing.

The following are supported:

- all the built-in Excel formula functions
- references to other sheets in the same workbook
- access to all the add-in functions in the Analysis Toolpak (ATP)
- comma or semicolon as the argument separator in function calls
- case-insensitive matching of formula names

The following are not supported:

- references to external workbooks
- array aka Ctrl-Shift-Enter aka CSE formulas
- references to defined Names
- using formulas for data validation or conditional formatting
- evaluation of formulae

The following example shows some of these things in action:

```python
from xlwt import Workbook, Formula

book = Workbook()

sheet1 = book.add_sheet('Sheet 1')
sheet1.write(0, 0, 10)
sheet1.write(0, 1, 20)
sheet1.write(1, 0, Formula('A1/B1'))

sheet2 = book.add_sheet('Sheet 2')
row = sheet2.row(0)
row.write(0, Formula('SUM(1,2,3)'))
row.write(1, Formula('SUM(1;2;3)'))
row.write(2, Formula('$A$1+$B$1*SUM(Sheet 1!$A$1:$B$2)'))

book.save('formula.xls')
```

**Names**

Names cannot currently be written by `xlwt`. 
Utility methods
The Utils module of xlwt contains several useful utility functions:

**col_by_name**
This will convert a string containing a column identifier into an integer column index.

**cell_to_rowcol**
This will convert a string containing an excel cell reference into a four-element tuple containing:

=row, col, row_abs, col_abs=

- **row** – integer row index of the referenced cell
- **col** – integer column index of the referenced cell
- **row_abs** – boolean indicating whether the row index is absolute (True) or relative (False)
- **col_abs** – boolean indicating whether the column index is absolute (True) or relative (False)

**cell_to_rowcol2**
This will convert a string containing an excel cell reference into a two-element tuple containing:

=row, col=

- **row** – integer row index of the referenced cell
- **col** – integer column index of the referenced cell

**rowcol_to_cell**
This will convert an integer row and column index into a string excel cell reference, with either index optionally being absolute.

**cellrange_to_rowcol_pair**
This will convert a string containing an excel range into a four-element tuple containing:

=row1, col1, row2, col2=

- **row1** – integer row index of the start of the range
- **col1** – integer column index of the start of the range
- **row2** – integer row index of the end of the range
- **col2** – integer column index of the end of the range

**rowcol_pair_to_cellrange**
This will convert a pair of integer row and column indexes into a string containing an excel cell range. Any of the indexes specified can optionally be made to be absolute.

**valid_sheet_name**
This function takes a single string argument and returns a boolean value indication whether the sheet name will work without problems (True) or will cause complaints from Excel (False).
The following example shows all of these functions in use:

```python
from xlwt import Utils

print 'AA ->',Utils.col_by_name('AA')
print 'A ->',Utils.col_by_name('A')

print 'A1 ->',Utils.cell_to_rowcol('A1')
print '$A$1 ->',Utils.cell_to_rowcol('$A$1')

print 'A1 ->',Utils.cell_to_rowcol2('A1')

print (0,0),'->',Utils.rowcol_to_cell(0,0)
print (0,0,False,True),'->',
print Utils.rowcol_to_cell(row=0,col=0,row_abs=True,col_abs=True)

print '1:3 ->',Utils.cellrange_to_rowcol_pair('1:3')
print 'B:G ->',Utils.cellrange_to_rowcol_pair('B:G')
print 'A2:B7 ->',Utils.cellrange_to_rowcol_pair('A2:B7')
print 'A1 ->',Utils.cellrange_to_rowcol_pair('A1')

print (0,0,100,100),'->',
print Utils.rowcol_pair_to_cellrange(0,0,100,100)
print (0,0,100,100,True,False,False,False),'->',
print Utils.rowcol_pair_to_cellrange(row1=0,col1=0,row2=100,col2=100,
row1_abs=True,col1_abs=False,
row2_abs=False,col2_abs=True)

for name in ('',"'quoted'","O'hare","X'*32","[]:\x00""):
    print 'Is %r a valid sheet name?' % name,
    if Utils.valid_sheet_name(name):
        print "Yes"
    else:
        print "No"
```

utilities.py
Other properties

There are many other properties that you can set on xlwt-related objects. They are all listed below, for each of the types of object. The names are mostly intuitive but you are warned to experiment thoroughly before attempting to use any of these in an important situation as some properties exist that aren’t saved to the resulting Excel files and some others are only partially implemented.

**xlwt.Workbook**

- owner
- country_code
- wnd_protect
- obj_protect
- protect
- backup_on_save
- hpos
- vpos
- width
- height
- active_sheet
- tab_width
- wnd_visible
- wnd_mini
- hscroll_visible
- vscroll_visible
- tabs_visible
- dates_1904
- use_cell_values

**xlwt.Row**

- set_style
- height
- has_default_height
- height_mismatch
- level
- collapse
- hidden
- space_above
- space_below

**xlwt.Column**

- set_style
- width
- width_in_pixels
- hidden
- level
- collapse
xlwt.Worksheet

name
visibility
row_default_height_mismatch
row_default_hidden
row_default_space_above
row_default_space_below
show_formulas
show_grid
show_headers
show_zero_values
auto_colour_grid
cols_right_to_left
show_outline
remove_splits
selected
sheet_visible
page_preview
first_visible_row
first_visible_col
grid_colour
dialog_sheet
auto_style_outline
outline_below
outline_right
fit_num_pages
show_row_outline
show_col_outline
alt_expr_eval
alt_formula_entries
row_default_height
col_default_height
calc_mode
calc_count
RC_ref_mode
iterations_on
delta

save_recalc
print_headers
print_grid
header_str
footer_str
print_centered_vert
print_centered_horz
left_margin
right_margin
top_margin
bottom_margin
paper_size_code
print_scaling
start_page_number
fit_width_to_pages
fit_height_to_pages
print_in_rows
portrait
print_colour
print_draft
print_notes
print_notes_at_end
print_omit_errors
print_hres
header_margin
footer_margin
copies_num
wnd_protect
obj_protect
protect
scen_protect
password

© Simplistix Ltd 2009 [CC BY-NC-ND]
Some examples of Other Properties
The following sections contain examples of how to use some of the properties listed above.

**Hyperlinks**

Hyperlinks are a type of formula as shown in the following example:

```python
from xlwt import Workbook, easyxf, Formula

style = easyxf('font: underline single')

book = Workbook()
sheet = book.add_sheet('Hyperlinks')

sheet.write(0, 0, Formula('HYPERLINK("http://www.python.org";"Python")'), style)

link = 'HYPERLINK("mailto:python-excel@googlegroups.com";"help")'
sheet.write(1, 0, Formula(link), style)

book.save("hyperlinks.xls")

copyfile("python.bmp", "images.xls")
```

**Images**

Images can be inserted using the `insert_bitmap` method of the `Sheet` class:

```python
from xlwt import Workbook
w = Workbook()
ws = w.add_sheet('Image')
ws.insert_bitmap('python.bmp', 0, 0)
w.save('images.xls')
```

NB: Images are not displayed by OpenOffice.org
Merged cells
Merged groups of cells can be inserted using the `write_merge` method of the `Sheet` class:

```python
from xlwt import Workbook, easyxf
style = easyxf(
    'pattern: pattern solid, fore_colour red;
    align: vertical center, horizontal center;
)
w = Workbook()
ws = w.add_sheet('Merged')
ws.write_merge(1, 5, 1, 5, 'Merged', style)
w.save('merged.xls')
```

Borders
Writing a single cell with borders is simple enough, however applying a border to a group of cells is painful as shown in this example:

```python
from xlwt import Workbook, easyxf
tl = easyxf('border: left thick, top thick')
t = easyxf('border: top thick')
tr = easyxf('border: right thick, top thick')
r = easyxf('border: right thick')
br = easyxf('border: right thick, bottom thick')
b = easyxf('border: bottom thick')
bl = easyxf('border: left thick, bottom thick')
l = easyxf('border: left thick')

w = Workbook()
ws = w.add_sheet('Border')
ws.write(1, 1, style=tl)
ws.write(1, 2, style=t)
ws.write(1, 3, style=tr)
ws.write(2, 3, style=r)
ws.write(3, 3, style=br)
ws.write(3, 2, style=b)
ws.write(3, 1, style=bl)
ws.write(2, 1, style=l)

w.save('borders.xls')
```

NB: Extra care needs to be taken if you’re updating an existing Excel file!
Split and Freeze panes

It is fairly straightforward to create frozen panes using xlwt.

The location of the split is specified using the integer `vert_split_pos` and `horz_split_pos` properties of the `Sheet` class.

The first visible cells are specified using the integer `vert_split_first_visible` and `horz_split_first_visible` properties of the `Sheet` class.

The following example shows them all in action:

```python
from xlwt import Workbook
from xlwt.Utils import rowcol_to_cell

w = Workbook()
sheet = w.add_sheet('Freeze')
sheet.panes_frozen = True
sheet.remove_splits = True
sheet.vert_split_pos = 2
sheet.horz_split_pos = 10
sheet.vert_split_first_visible = 5
sheet.horz_split_first_visible = 40

for col in range(20):
    for row in range(80):
        sheet.write(row, col, rowcol_to_cell(row, col))

w.save('panes.xls')

panes.py
```

Split panes are a less frequently used feature and their support is less complete in xlwt.

The procedure for creating split panes is exactly the same as for frozen panes except that the `panes_frozen` attribute of the Worksheet should be set to `False` instead of `True`.

However, if you really need split panes, you're advised to see professional help before proceeding!
Outlines
These are a little known and little used feature of the Excel file format that can be very useful when dealing with categorised data.
Their use is best shown by example:

```python
from xlwt import Workbook
data = [
['','','2008','','2009'],
['','','Jan','Feb','Jan','Feb'],
['Company X'],
['','Division A'],
['','',100,200,300,400],
['','Division B'],
['','',100,99,98,50],
['Company Y'],
['','Division A'],
['','',100,100,100,100],
['','Division B'],
['','',100,101,102,103],
]
w = Workbook()
ws = w.add_sheet('Outlines')
for i,row in enumerate(data):
    for j,cell in enumerate(row):
        ws.write(i,j,cell)
ws.row(2).level = 1
ws.row(3).level = 2
ws.row(4).level = 3
ws.row(5).level = 2
ws.row(6).level = 3
ws.row(7).level = 1
ws.row(8).level = 2
ws.row(9).level = 3
ws.row(10).level = 2
ws.row(11).level = 3
ws.col(2).level = 1
ws.col(3).level = 2
ws.col(4).level = 1
ws.col(5).level = 2
w.save('outlines.xls')
```

**Zoom magnification and Page Break Preview**

The zoom percentage used when viewing a sheet in normal mode can be controlled by setting the `normal_magn` attribute of a Sheet instance.

The zoom percentage used when viewing a sheet in page break preview mode can be controlled by setting the `preview_magn` attribute of a Sheet instance.

A Sheet can also be made to show a page break preview by setting the `page_preview` attribute of the Sheet instance to True.

Here's an example to show all three in action:

```python
from xlwt import Workbook

w = Workbook()

ws = w.add_sheet('Normal')
ws.write(0,0,'Some text')
ws.normal_magn = 75

ws = w.add_sheet('Page Break Preview')
ws.write(0,0,'Some text')
ws.preview_magn = 150
ws.page_preview = True

w.save('zoom.xls')

zoom.py
```
Filtering Excel Files

Any examples shown below can be found in the xlutils directory of the course material.

Other utilities in xlutils

The xlutils package contains several utilities in addition to those for filtering. The following are often useful:

**xlutils.styles**

This module contains one class which, when instantiated with an xlrd.Workbook, will let you discover the style name and information from a given cell in that workbook as shown in the following example:

```python
from xlrd import open_workbook
from xlutils.styles import Styles

book = open_workbook('source.xls',formatting_info=True)
styles = Styles(book)
sheet = book.sheet_by_index(0)

print styles[sheet.cell(1,1)].name
print styles[sheet.cell(1,2)].name

A1_style = styles[sheet.cell(0,0)]
A1_font = book.font_list[A1_style.xf.font_index]
print book.colour_map[A1_font.colour_index]

styles.py
```

NB: For obvious reasons, open_workbook must be called with formatting_info=True in order to use xlutils.styles.

Full documentation and examples can be found in the styles.txt file in the docs folder of xlutils's source distribution.
**xlutils.display**

This module contains utility functions for easy and safe display of information returned by xlrd.

`quoted_sheet_name` is called with the name attribute of an `xlrd.sheet.Sheet` instance and will return an encoded string containing a quoted version of the sheet's name.

`cell_display` is called with an `xlrd.sheet.Cell` instance and returns an encoded string containing a sensible representation of the cells contents, even for Date and Error cells. If a date cell is to be displayed, `cell_display` must be called with the `datemode` attribute of the `xlrd.Book` from which the cell came.

The following examples show both functions in action:

```python
from xlrd import open_workbook
from xlutils.display import quoted_sheet_name
from xlutils.display import cell_display

wb = open_workbook('source.xls')

print quoted_sheet_name(wb.sheet_names()[0])
print repr(quoted_sheet_name(u'Price (\xa3)','utf-8'))
print quoted_sheet_name(u'My Sheet')
print quoted_sheet_name(u"John's Sheet")

sheet = wb.sheet_by_index(0)
print cell_display(sheet.cell(1,1))
print cell_display(sheet.cell(1,3),wb.datemode)
```

Full documentation and examples can be found in the display.txt file in the docs folder of xlutils' source distribution.
**xlutils.copy**

This module contains one function that will take an **xlrd.Book** and returns an **xlwt.Workbook** populated with the data and formatting found in the **xlrd.Book**.

This is extremely useful for updating an existing spreadsheet as the following example shows:

```python
from xlrd import open_workbook
from xlwt import easyxf
from xlutils.copy import copy

rb = open_workbook('source.xls',formatting_info=True)
rs = rb.sheet_by_index(0)
wb = copy(rb)
ws = wb.get_sheet(0)

plain = easyxf('')
for i,cell in enumerate(rs.col(2)):
    if not i:
        continue
    ws.write(i,2,cell.value,plain)

for i,cell in enumerate(rs.col(4)):
    if not i:
        continue
    ws.write(i,4,cell.value-1000)

wb.save('output.xls')
```

copy.py

It is important to note that some things won’t be copied:

- Formulae
- Names
- anything ignored by xlrd

In addition to the modules described above, there are also **xlutils.margins** and **xlutils.save**, but these are only useful in certain situations. Refer to their documentation in the **xlutils** source distribution.
Structure of xlutils.filter

This framework is designed to filter and split Excel files using a series of modular readers, filters and writers as shown in the diagram below:

![Diagram showing the flow of information between components]

The flow of information between the components is by method calls on the next component in the chain. The possible method calls are listed in the table below, where

- **rdbook** is an *xlrd.Book* instance,
- **rdsheet** is an *xlrd.sheet.Sheet* instance,
- **rdrowx**, **rdcolx**, **wtrowx** and **wtcolx** and integer indexes specifying the cell to read from and write to,
- **wtbook_name** is a string specifying the name of the Excel file to write to
- and **wtsheet_name** is a unicode specifying the name of the sheet to write to:

<table>
<thead>
<tr>
<th>Method Call</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>start()</td>
<td>This method is called before processing of a batch of input. It can be called at any time. One common use is to reset all the filters in a chain in the event of an error during the processing of an rdbook.</td>
</tr>
<tr>
<td>workbook(rdbook,wtbook_name)</td>
<td>This method is called every time processing of a new workbook starts</td>
</tr>
<tr>
<td>sheet(rdsheet,wtsheet_name)</td>
<td>This method is called every time processing of a new sheet in the current workbook starts</td>
</tr>
<tr>
<td>set_rdsheet(rdsheet)</td>
<td>This method is called to indicate a change for the source of cells mid-way through writing a sheet.</td>
</tr>
<tr>
<td>row(rdrowx,wtrowx)</td>
<td>The row method is called every time processing of a new row in the current sheet starts.</td>
</tr>
<tr>
<td>cell(rdrowx,rdcolx,wtrowx,wtcolx)</td>
<td>This is called for every cell in the sheet being processed. This is the most common method in which filtering and queuing of onward calls to the next component takes place.</td>
</tr>
<tr>
<td>finish</td>
<td>This method is called once processing of all workbooks has been completed.</td>
</tr>
</tbody>
</table>

© Simplistix Ltd 2009 [CC BY-NC-ND]
Readers

A reader's job is to obtain one or more xlrd.Book objects and iterate over those objects issuing appropriate calls to the next component in the chain. The order of calling is expected to be as follows:

- **start**
  - workbook, once for each xlrd.Book object obtained
    - sheet, once for each sheet found in the current book
    - set_rdsheet, whenever the sheet from which cells to be read needs to be changed. This method may not be called between calls to row and cell, and between multiple calls to cell. It may only be called once all cell calls for a row have been made.
  - row, once for each row in the current sheet
    - cell, once for each cell in the row
- **finish**, once all xlrd.Book objects have been processed

Also, for method calls made by a reader, the following should be true:

- wtbook_name should be the filename of the file the xlrd.Book object originated from.
- wtsheet_name should be rdbook.name
- wtrowx should be equal to rdrowx
- rdcolx should be equal to wtcolx

Because of these restrictions, an xlutils.filter.BaseReader class is provided that will normally only need to have one of two methods overridden to get any required functionality:

- get_filepaths – if implemented, this must return an iterable sequence of paths to excel files that can be opened with python's builtin file.
- get_workbooks – if implemented, this must return an sequence of 2-tuples. Each tuple must contain an xlrd.Book object followed by a string containing the filename of the file from which the xlrd.Book object was loaded.
Filters

Implementing these components is where the bulk of the work will be done by users of the `xlutils.filter` framework. A Filter's responsibilities are to accept method calls from the preceding component in the chain, do any processing necessary and then emit appropriate method calls to the next component in the chain.

There is very little constraint on what order Filters receive and emit method calls other than that the order of method calls emitted must remain consistent with the structure given above. This enables components to be freely interchanged more easily.

Because Filters may only need to implement few of the full set of method calls, an `xlutils.filter.BaseFilter` is provided that does nothing but pass the method calls on to the next component in the chain. The implementation of this filter is useful to see when embarking on Filter implementation:

```python
class BaseFilter:
    def start(self):
        self.next.start()

    def workbook(self, rdbook, wtbook_name):
        self.next.workbook(rdbook, wtbook_name)

    def sheet(self, rdsheet, wtsheet_name):
        self.rdsheet = rdsheet
        self.next.sheet(rdsheet, wtsheet_name)

    def set_rdsheet(self, rdsheet):
        self.rdsheet = rdsheet
        self.next.set_rdsheet(rdsheet)

    def row(self, rdrowx, wtrowx):
        self.next.row(rdrowx, wtrowx)

    def cell(self, rdrowx, rdcolx, wtrowx, wtcolx):
        self.next.cell(rdrowx, rdcolx, wtrowx, wtcolx)

    def finish(self):
        self.next.finish()
```
Writers

These components do the grunt work of actually copying the appropriate information from the rdbook and serialising it into an Excel file. This is a complicated process and not for the faint of hard to re-implement.

For this reason, an xlutils.filter.BaseWriter component is provided that does all of the hard work and has one method that needs to be implemented. That method is get_stream and it is called with the filename of the Excel file to be written. Implementations of this method are expected to return a new file-like object that has a write and, by default, a close method each time they are called.

Subclasses may also override the boolean close_after_write attribute, which is True by default, to indicate that the file-like objects returned from get_stream should not have their close method called once serialisation of the Excel file data is complete.

It is important to note that some things won't be copied from the rdbook by BaseWriter:

- Formulae
- Names
- anything ignored by xlrd

Process

The process function is responsible for taking a series of components as its arguments. The first of these should be a Reader. The last of these should be a Writer. The rest should be the necessary Filters in the order of processing required.

The process method will wire these components together by way of their next attributes and then kick the process off by calling the Reader and passing the first Filter in the chain as its argument.
A worked example

Suppose we want to filter an existing Excel file to omit rows that have an X in the first column.

The following example shows possible components to do this and shows how they would be instantiated and called to achieve this:

```python
import os
from xlutils.filter import 
    BaseReader, BaseFilter, BaseWriter, process

class Reader(BaseReader):
    def get_filepaths(self):
        return [os.path.abspath('source.xls')]

class Writer(BaseWriter):
    def get_stream(self, filename):
        return file(filename, 'wb')

class Filter(BaseFilter):
    pending_row = None
    wtrowxi = 0
    def workbook(self, rdbook, wtbook_name):
        self.next.workbook(rdbook, 'filtered-' + wtbook_name)
    def row(self, rdrowx, wtrowx):
        self.pending_row = (rdrowx, wtrowx)
    def cell(self, rdrowx, rdcolx, wtrowx, wtcolx):
        if rdcolx == 0:
            value = self.rdsheet.cell(rdrowx, rdcolx).value
            if value.strip().lower() == 'x':
                self.ignore_row = True
                self.wtrowxi -= 1
            else:
                self.ignore_row = False
                rdrowx, wtrowx = self.pending_row
                self.next.row(rdrowx, wtrowx + self.wtrowxi)
        elif not self.ignore_row:
            self.next.cell(
                rdrowx, rdcolx, wtrowx + self.wtrowxi, wtcolx-1
            )

process(Reader(), Filter(), Writer())

filter.py
```

In reality, we would not need to implement the Reader and Writer components, as there are already suitable components included.
Existing components

The xlutils.filter framework comes with a wide range of existing components, each of which is briefly described below. For full descriptions and worked examples of all these components, please see filter.txt in the docs folder of the xlutils source distribution.

GlobReader

If you’re processing files that are on disk, then this is probably the reader for you. It returns all files matching the path specification it’s instantiated with.

XLRDReader

This reader can be used at the start of a chain when you already have an xlrd.Book object and you’ll looking to process it with xlutils.filter.

TestReader

This reader is specifically designed for testing filter implementations with known sets of cells.

DirectoryWriter

If you want files you’re processing to end up on disk, then this is probably the writer for you. It stores files in the directory it is instantiated with.

StreamWriter

If you want to write exactly one workbook to a stream, such as a tempfile.TemporaryFile or sys.stdout, then this is the writer for you.

XLWTWriter

If you want to change cells after the filtering process is complete then this writer can be used to obtain the xlwt.Workbook objects that BaseWriter generates.

ColumnTrimmer

This filter will strip columns containing no useful data from the end of sheets. The definition of “no useful data” can be controlled during instantiation of this filter.

ErrorFilter

This filter caches all method calls in a file on disk and will only pass them on the next component in the chain when its finish method has been called and no error messages have been logged to the python logging framework.

If Boolean or error Cells are encountered, an error message will be logged to the python logging framework will will also usually mean that no methods will be emitted from this component to the next component in the chain.

Finally, cell method calls corresponding to Empty cells in rdsheet will not be passed on to the next component in the chain.

Calling this component’s start method will reset it.

Echo

This filter will print calls to the methods configured when the filter is instantiated along with the arguments passed.
MemoryLogger

This filter will dump stats to the path it was configured with using the heapy package if it is available. If it is not available, no operations are performed. For more information on heapy, please see http://guppy-pe.sourceforge.net/#Heapy
Possible Tasks for Workshop

The following is a list of tasks that can be attempted by any attendee who hasn't brought their own tasks to attempt.

**Installation with IronPython**
The libraries have been used successfully with IronPython, but this has not been thoroughly tested or documented.

**Installation with Jython**
The libraries should all work with Jython, but no one has so far attempted to do so.

**Inserting a row into a sheet**
Starting with an existing Excel file, attempt to create a new Excel file with a row inserted at a given position.

**Splitting a Book into its Sheets**
Starting with an existing Excel file, create a directory containing one file for each worksheet in the original file.

**Reporting errors in a directory full on Excel files**
Scan a directory of Excel files and report the location of any error cells.
A progression of this task is to allow the passing of options to indicate what types of error to report.

**Removing Rows containing errors**
Starting with an existing Excel file, create a filtering process that generates a new Excel file that excludes any rows containing error cells.
A progression of this task is to generate a new Excel file that contains empty cells where there were errors in the original file.

**Filtering Excel files to and from a web server**
This task is to create components for xlutils.filter that can read from a website and write back to that website.
The task should result in an HTTPReader and an HTTPWriter.

**Producing a report from a database**
This task is to take a typical database query and dump it into an Excel file such that the heading row is set up nicely with decent alignment in a frozen pane.
As a precursor to this task, you may need to set up a typical database!