
xlwings - Make Excel Fly!

Release dev

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CHAPTER 1

Video course

Those who prefer a didactically structured video course over this documentation should have a look at our video course:

<https://training.xlwings.org/p/xlwings>

It's also a great way to support the ongoing development of xlwings :)

2.1 Prerequisites

- xlwings requires an **installation of Excel** and therefore only works on **Windows** and **macOS**. Note that macOS currently does not support UDFs.
- xlwings requires at least Python 3.6.

Here are the last versions of xlwings to support:

- Python 3.5: 0.19.5
- Python 2.7: 0.16.6

2.2 Installation

xlwings comes pre-installed with

- [Anaconda](#) (Windows and macOS)
- [WinPython](#) (Windows only) Make sure **not** to take the `dot` version as this only contains Python.

If you are new to Python or have trouble installing xlwings, one of these distributions is highly recommended. Otherwise, you can also install it manually with pip:

```
pip install xlwings
```

or conda:

```
conda install xlwings
```

Note that the official `conda` package might be a few releases behind. You can, however, use the `conda-forge` channel (replace `install` with `upgrade` if `xlwings` is already installed):

```
conda install -c conda-forge xlwings
```

Note: When you are on macOS and are installing `xlwings` with `conda` (or use the version that comes with Anaconda), you'll need to run `$ xlwings runpython install` once to enable the `RunPython` calls from VBA. This is done automatically if you install the addin via `$ xlwings addin install`.

2.3 Add-in

To install the add-in, run the following command:

```
xlwings addin install
```

To call Excel from Python, you don't need an add-in. Also, you can use a single file VBA module (*standalone workbook*) instead of the add-in. For more details, see [Add-in & Settings](#).

Note: The add-in needs to be the same version as the Python package. Make sure to re-install the add-in after upgrading the `xlwings` package.

2.4 Dependencies

- **Windows:** `pywin32`
- **Mac:** `psutil`, `appscript`

The dependencies are automatically installed via `conda` or `pip`.

2.5 How to activate xlwings PRO

`xlwings PRO` offers access to *additional functionality*. All PRO features are marked with `xlwings PRO` in the docs.

Note: To get access to the additional functionality of `xlwings PRO`, you need a license key and at least `xlwings v0.19.0`. Everything under the `xlwings.pro` subpackage is distributed under a commercial license. See *xlwings PRO* for more details.

To activate the license key, run the following command:

```
xlwings license update -k LICENSE_KEY
```

Make sure to replace `LICENSE_KEY` with your personal key. This will store the license key under your `xlwings.conf` file (see [User Config: Ribbon/Config File](#) for where this is on your system). Alternatively, you can also store the license key as an environment variable with the name `XLWINGS_LICENSE_KEY`.

xlwings PRO requires additionally the `cryptography` and `Jinja2` packages which come preinstalled with Anaconda and WinPython. Otherwise, install them via pip or conda.

With pip, you can also run `pip install "xlwings[pro]"` which will take care of the extra dependencies for xlwings PRO.

2.6 Optional Dependencies

- NumPy
- Pandas
- Matplotlib
- Pillow/PIL
- Flask (for REST API)
- cryptography (for xlwings.pro)
- Jinja2 (for xlwings.pro.reports)

These packages are not required but highly recommended as they play very nicely with xlwings. They are all pre-installed with Anaconda. With pip, you can install xlwings with all optional dependencies as follows:

```
pip install "xlwings[all]"
```

2.7 Update

To update to the latest xlwings version, run the following in a command prompt:

```
pip install --upgrade xlwings
```

or:

```
conda update -c conda-forge xlwings
```

Make sure to keep your version of the Excel add-in in sync with your Python package by running the following (make sure to close Excel first):

```
xlwings addin install
```

2.8 Uninstall

To uninstall xlwings completely, first uninstall the add-in, then uninstall the xlwings package using the same method (pip or conda) that you used for installing it:

```
xlwings addin remove
```

Then

```
pip uninstall xlwings
```

or:

```
conda remove xlwings
```

Finally, manually remove the *.xlwings* directory in your home folder if it exists.

CHAPTER 3

Quickstart

This guide assumes you have xlwings already installed. If that's not the case, head over to [Installation](#).

3.1 1. Interacting with Excel from a Jupyter notebook

If you're just interested in getting a pandas DataFrame in and out of your Jupyter notebook, you can use the `view` and `load` functions, see [Jupyter Notebooks: Interact with Excel](#).

3.2 2. Scripting: Automate/interact with Excel from Python

Establish a connection to a workbook:

```
>>> import xlwings as xw
>>> wb = xw.Book() # this will create a new workbook
>>> wb = xw.Book('FileName.xlsx') # connect to a file that is open or in the
↪current working directory
>>> wb = xw.Book(r'C:\path\to\file.xlsx') # on Windows: use raw strings to
↪escape backslashes
```

If you have the same file open in two instances of Excel, you need to fully qualify it and include the app instance. You will find your app instance key (the PID) via `xw.apps.keys()`:

```
>>> xw.apps[10559].books['FileName.xlsx']
```

Instantiate a sheet object:

```
>>> sht = wb.sheets['Sheet1']
```

Reading/writing values to/from ranges is as easy as:

```
>>> sht.range('A1').value = 'Foo 1'
>>> sht.range('A1').value
'Foo 1'
```

There are many **convenience features** available, e.g. Range expanding:

```
>>> sht.range('A1').value = [['Foo 1', 'Foo 2', 'Foo 3'], [10.0, 20.0, 30.0]]
>>> sht.range('A1').expand().value
[['Foo 1', 'Foo 2', 'Foo 3'], [10.0, 20.0, 30.0]]
```

Powerful converters handle most data types of interest, including Numpy arrays and Pandas DataFrames in both directions:

```
>>> import pandas as pd
>>> df = pd.DataFrame([[1,2], [3,4]], columns=['a', 'b'])
>>> sht.range('A1').value = df
>>> sht.range('A1').options(pd.DataFrame, expand='table').value
      a      b
0.0  1.0  2.0
1.0  3.0  4.0
```

Matplotlib figures can be shown as pictures in Excel:

```
>>> import matplotlib.pyplot as plt
>>> fig = plt.figure()
>>> plt.plot([1, 2, 3, 4, 5])
[<matplotlib.lines.Line2D at 0x1071706a0>]
>>> sht.pictures.add(fig, name='MyPlot', update=True)
<Picture 'MyPlot' in <Sheet [Workbook4]Sheet1>>
```

3.3 3. Macros: Call Python from Excel

You can call Python functions either by clicking the Run button (new in v0.16) in the add-in or from VBA using the RunPython function:

The Run button expects a function called `main` in a Python module with the same name as your workbook. The great thing about that approach is that you don't need your workbooks to be macro-enabled, you can save it as `xlsx`.

If you want to call any Python function no matter in what module it lives or what name it has, use RunPython:

```
Sub HelloWorld()
    RunPython "import hello; hello.world()"
End Sub
```

Note: Per default, RunPython expects `hello.py` in the same directory as the Excel file with the same name, **but you can change both of these things:** if your Python file is in a different folder, add that folder

to the PYTHONPATH in the config. If the file has a different name, change the RunPython command accordingly.

Refer to the calling Excel book by using `xw.Book.caller()`:

```
# hello.py
import numpy as np
import xlwings as xw

def world():
    wb = xw.Book.caller()
    wb.sheets[0].range('A1').value = 'Hello World!'
```

To make this run, you'll need to have the xlwings add-in installed or have the workbooks setup in the standalone mode. The easiest way to get everything set up is to use the xlwings command line client from either a command prompt on Windows or a terminal on Mac: `xlwings quickstart myproject`.

For details about the addin, see [Add-in & Settings](#).

3.4 4. UDFs: User Defined Functions (Windows only)

Writing a UDF in Python is as easy as:

```
import xlwings as xw

@xw.func
def hello(name):
    return 'Hello {0}'.format(name)
```

Converters can be used with UDFs, too. Again a Pandas DataFrame example:

```
import xlwings as xw
import pandas as pd

@xw.func
@xw.arg('x', pd.DataFrame)
def correl2(x):
    # x arrives as DataFrame
    return x.corr()
```

Import this function into Excel by clicking the import button of the xlwings add-in: For a step-by-step tutorial, see [User Defined Functions \(UDFs\)](#).

CHAPTER 4

Connect to a Book

When reading/writing data to the active sheet, you don't need a book object:

```
>>> import xlwings as xw
>>> xw.Range('A1').value = 'something'
```

4.1 Python to Excel

The easiest way to connect to a book is offered by `xw.Book`: it looks for the book in all app instances and returns an error, should the same book be open in multiple instances. To connect to a book in the active app instance, use `xw.books` and to refer to a specific app, use:

```
>>> app = xw.App() # or something like xw.apps[10559] for existing apps, get
↳ the available PIDs via xw.apps.keys()
>>> app.books['Book1']
```

	<code>xw.Book</code>	<code>xw.books</code>
New book	<code>xw.Book()</code>	<code>xw.books.add()</code>
Unsaved book	<code>xw.Book('Book1')</code>	<code>xw.books['Book1']</code>
Book by (full)name	<code>xw.Book(r'C:/path/to/file.xlsx')</code>	<code>xw.books.open(r'C:/path/to/file.xlsx')</code>

Note: When specifying file paths on Windows, you should either use raw strings by putting an `r` in front of the string or use double back-slashes like so: `C:\\path\\to\\file.xlsx`.

4.2 Excel to Python (RunPython)

To reference the calling book when using `RunPython` in VBA, use `xw.Book.caller()`, see [Call Python with “RunPython”](#). Check out the section about [Debugging](#) to see how you can call a script from both sides, Python and Excel, without the need to constantly change between `xw.Book.caller()` and one of the methods explained above.

4.3 User Defined Functions (UDFs)

Unlike `RunPython`, UDFs don't need a call to `xw.Book.caller()`, see [User Defined Functions \(UDFs\)](#). You'll usually use the `caller` argument which returns the xlwings range object from where you call the function.

CHAPTER 5

Syntax Overview

The xlwings object model is very similar to the one used by VBA.

All code samples below depend on the following import:

```
>>> import xlwings as xw
```

5.1 Active Objects

```
# Active app (i.e. Excel instance)
>>> app = xw.apps.active

# Active book
>>> wb = xw.books.active # in active app
>>> wb = app.books.active # in specific app

# Active sheet
>>> sht = xw.sheets.active # in active book
>>> sht = wb.sheets.active # in specific book

# Range on active sheet
>>> xw.Range('A1') # on active sheet of active book of active app
```

A Range can be instantiated with A1 notation, a tuple of Excel's 1-based indices, a named range or two Range objects:

```
xw.Range('A1')
xw.Range('A1:C3')
xw.Range((1,1))
```

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```
xw.Range((1,1), (3,3))
xw.Range('NamedRange')
xw.Range(xw.Range('A1'), xw.Range('B2'))
```

5.2 Full qualification

Round brackets follow Excel's behavior (i.e. 1-based indexing), while square brackets use Python's 0-based indexing/slicing. As an example, the following expressions all reference the same range:

```
xw.apps[763].books[0].sheets[0].range('A1')
xw.apps(10559).books(1).sheets(1).range('A1')
xw.apps[763].books['Book1'].sheets['Sheet1'].range('A1')
xw.apps(10559).books('Book1').sheets('Sheet1').range('A1')
```

Note that the apps keys are different for you as they are the process IDs (PID). You can get the list of your PIDs via `xw.apps.keys()`.

5.3 Range indexing/slicing

Range objects support indexing and slicing, a few examples:

```
>>> rng = xw.Book().sheets[0].range('A1:D5')
>>> rng[0, 0]
<Range [Workbook1] Sheet1!$A$1>
>>> rng[1]
<Range [Workbook1] Sheet1!$B$1>
>>> rng[:, 3:]
<Range [Workbook1] Sheet1!$D$1:$D$5>
>>> rng[1:3, 1:3]
<Range [Workbook1] Sheet1!$B$2:$C$3>
```

5.4 Range Shortcuts

Sheet objects offer a shortcut for range objects by using index/slice notation on the sheet object. This evaluates to either `sheet.range` or `sheet.cells` depending on whether you pass a string or indices/slices:

```
>>> sht = xw.Book().sheets['Sheet1']
>>> sht['A1']
<Range [Book1] Sheet1!$A$1>
>>> sht['A1:B5']
<Range [Book1] Sheet1!$A$1:$B$5>
>>> sht[0, 1]
<Range [Book1] Sheet1!$B$1>
>>> sht[:10, :10]
<Range [Book1] Sheet1!$A$1:$J$10>
```

5.5 Object Hierarchy

The following shows an example of the object hierarchy, i.e. how to get from an app to a range object and all the way back:

```
>>> rng = xw.apps[10559].books[0].sheets[0].range('A1')
>>> rng.sheet.book.app
<Excel App 10559>
```


This tutorial gives you a quick introduction to the most common use cases and default behaviour of xlwings when reading and writing values. For an in-depth documentation of how to control the behavior using the `options` method, have a look at *Converters and Options*.

All code samples below depend on the following import:

```
>>> import xlwings as xw
```

6.1 Single Cells

Single cells are by default returned either as `float`, `unicode`, `None` or `datetime` objects, depending on whether the cell contains a number, a string, is empty or represents a date:

```
>>> import datetime as dt
>>> sht = xw.Book().sheets[0]
>>> sht.range('A1').value = 1
>>> sht.range('A1').value
1.0
>>> sht.range('A2').value = 'Hello'
>>> sht.range('A2').value
'Hello'
>>> sht.range('A3').value is None
True
>>> sht.range('A4').value = dt.datetime(2000, 1, 1)
>>> sht.range('A4').value
datetime.datetime(2000, 1, 1, 0, 0)
```

6.2 Lists

- 1d lists: Ranges that represent rows or columns in Excel are returned as simple lists, which means that once they are in Python, you've lost the information about the orientation. If that is an issue, the next point shows you how to preserve this info:

```
>>> sht = xw.Book().sheets[0]
>>> sht.range('A1').value = [[1],[2],[3],[4],[5]] # Column orientation
↳ (nested list)
>>> sht.range('A1:A5').value
[1.0, 2.0, 3.0, 4.0, 5.0]
>>> sht.range('A1').value = [1, 2, 3, 4, 5]
>>> sht.range('A1:E1').value
[1.0, 2.0, 3.0, 4.0, 5.0]
```

To force a single cell to arrive as list, use:

```
>>> sht.range('A1').options(ndim=1).value
[1.0]
```

Note: To write a list in column orientation to Excel, use transpose: `sht.range('A1').options(transpose=True).value = [1,2,3,4]`

- 2d lists: If the row or column orientation has to be preserved, set `ndim` in the Range options. This will return the Ranges as nested lists (“2d lists”):

```
>>> sht.range('A1:A5').options(ndim=2).value
[[1.0], [2.0], [3.0], [4.0], [5.0]]
>>> sht.range('A1:E1').options(ndim=2).value
[[1.0, 2.0, 3.0, 4.0, 5.0]]
```

- 2 dimensional Ranges are automatically returned as nested lists. When assigning (nested) lists to a Range in Excel, it's enough to just specify the top left cell as target address. This sample also makes use of index notation to read the values back into Python:

```
>>> sht.range('A10').value = [['Foo 1', 'Foo 2', 'Foo 3'], [10, 20, 30]]
>>> sht.range((10,1),(11,3)).value
[['Foo 1', 'Foo 2', 'Foo 3'], [10.0, 20.0, 30.0]]
```

Note: Try to minimize the number of interactions with Excel. It is always more efficient to do `sht.range('A1').value = [[1,2],[3,4]]` than `sht.range('A1').value = [1, 2]` and `sht.range('A2').value = [3, 4]`.

6.3 Range expanding

You can get the dimensions of Excel Ranges dynamically through either the method `expand` or through the `expand` keyword in the `options` method. While `expand` gives back an expanded Range object, `options` are only evaluated when accessing the values of a Range. The difference is best explained with an example:

```
>>> sht = xw.Book().sheets[0]
>>> sht.range('A1').value = [[1,2], [3,4]]
>>> rng1 = sht.range('A1').expand('table') # or just .expand()
>>> rng2 = sht.range('A1').options(expand='table')
>>> rng1.value
[[1.0, 2.0], [3.0, 4.0]]
>>> rng2.value
[[1.0, 2.0], [3.0, 4.0]]
>>> sht.range('A3').value = [5, 6]
>>> rng1.value
[[1.0, 2.0], [3.0, 4.0]]
>>> rng2.value
[[1.0, 2.0], [3.0, 4.0], [5.0, 6.0]]
```

'table' expands to 'down' and 'right', the other available options which can be used for column or row only expansion, respectively.

Note: Using `expand()` together with a named Range as top left cell gives you a flexible setup in Excel: You can move around the table and change its size without having to adjust your code, e.g. by using something like `sht.range('NamedRange').expand().value`.

6.4 NumPy arrays

NumPy arrays work similar to nested lists. However, empty cells are represented by `nan` instead of `None`. If you want to read in a Range as array, set `convert=np.array` in the `options` method:

```
>>> import numpy as np
>>> sht = xw.Book().sheets[0]
>>> sht.range('A1').value = np.eye(3)
>>> sht.range('A1').options(np.array, expand='table').value
array([[ 1.,  0.,  0.],
       [ 0.,  1.,  0.],
       [ 0.,  0.,  1.]])
```

6.5 Pandas DataFrames

```
>>> sht = xw.Book().sheets[0]
>>> df = pd.DataFrame([[1.1, 2.2], [3.3, None]], columns=['one', 'two'])
>>> df
```

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```
    one  two
0  1.1  2.2
1  3.3  NaN
>>> sht.range('A1').value = df
>>> sht.range('A1:C3').options(pd.DataFrame).value
    one  two
0  1.1  2.2
1  3.3  NaN
# options: work for reading and writing
>>> sht.range('A5').options(index=False).value = df
>>> sht.range('A9').options(index=False, header=False).value = df
```

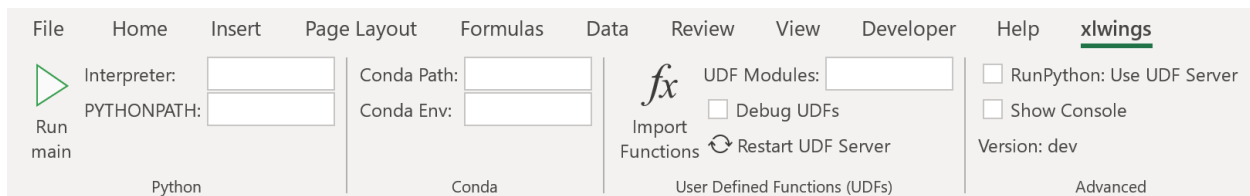
6.6 Pandas Series

```
>>> import pandas as pd
>>> import numpy as np
>>> sht = xw.Book().sheets[0]
>>> s = pd.Series([1.1, 3.3, 5., np.nan, 6., 8.], name='myseries')
>>> s
0    1.1
1    3.3
2    5.0
3    NaN
4    6.0
5    8.0
Name: myseries, dtype: float64
>>> sht.range('A1').value = s
>>> sht.range('A1:B7').options(pd.Series).value
0    1.1
1    3.3
2    5.0
3    NaN
4    6.0
5    8.0
Name: myseries, dtype: float64
```

Note: You only need to specify the top left cell when writing a list, a NumPy array or a Pandas DataFrame to Excel, e.g.: `sht.range('A1').value = np.eye(10)`

CHAPTER 7

Add-in & Settings



The xlwings add-in is the preferred way to be able to use the `Run main` button, `RunPython` or UDFs. Note that you don't need an add-in if you just want to manipulate Excel by running a Python script.

Note: The ribbon of the add-in is compatible with Excel ≥ 2007 on Windows and ≥ 2016 on Mac. On Mac, all UDF related functionality is not available.

Note: The add-in is password protected with the password `xlwings`. For debugging or to add new extensions, you need to unprotect it. Alternatively, you can also install the add-in via `xlwings addin install --unprotected`.

7.1 Run main

New in version 0.16.0.

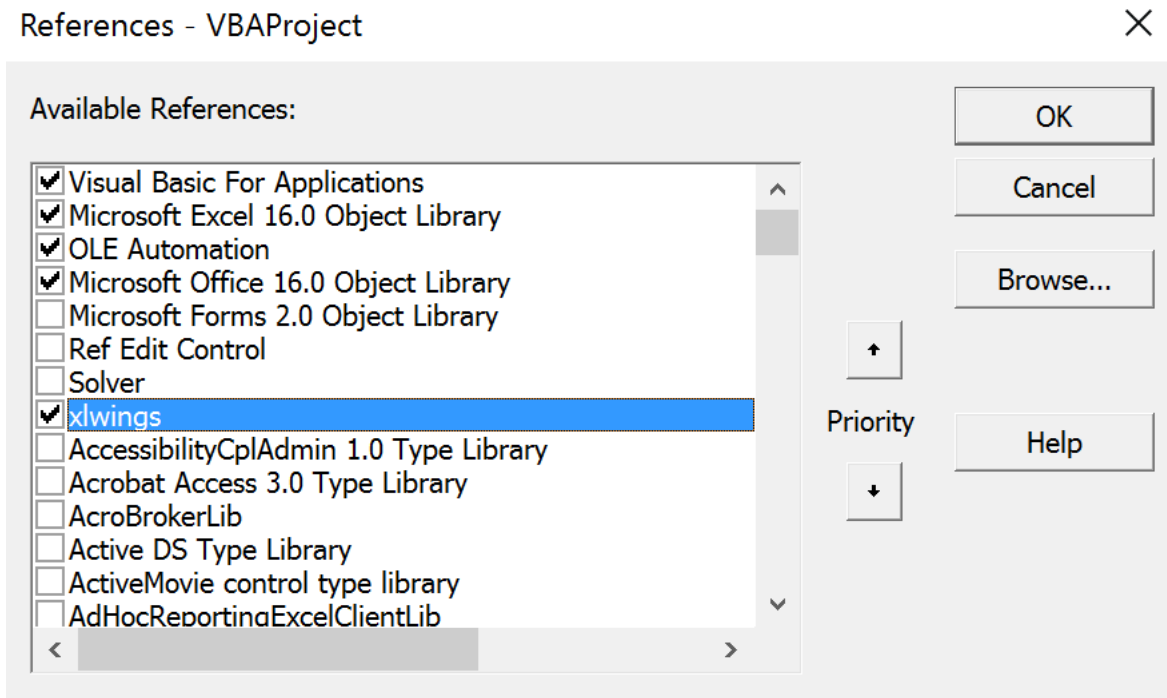
The `Run main` button is the easiest way to run your Python code: It runs a function called `main` in a Python module that has the same name as your workbook. This allows you to save your workbook as `xlsx` without enabling macros. The `xlwings quickstart` command will create a workbook that will automatically work with the `Run` button.

7.2 Installation

To install the add-in, use the command line client:

```
xlwings addin install
```

Technically, this copies the add-in from Python's installation directory to Excel's XLSTART folder. Then, to use RunPython or UDFs in a workbook, you need to set a reference to `xlwings` in the VBA editor, see screenshot (Windows: Tools > References..., Mac: it's on the lower left corner of the VBA editor). Note that when you create a workbook via `xlwings quickstart`, the reference should already be set.



7.3 User Settings

When you install the add-in for the first time, it will get auto-configured and therefore, a `quickstart` project should work out of the box. For fine-tuning, here are the available settings:

- **Interpreter:** This is the path to the Python interpreter. This works also with virtual or conda envs on Mac. If you use conda envs on Windows, then leave this empty and use `Conda Path` and `Conda Env` below instead. Examples: `"C:\Python39\pythonw.exe"` or `"/usr/local/bin/python3.9"`. Note that in the settings, this is stored as `Interpreter_Win` or `Interpreter_Mac`, respectively, see below!
- **PYTHONPATH:** If the source file of your code is not found, add the path to its directory here.
- **Conda Path:** If you are on Windows and use Anaconda or Miniconda, then type here the path to your installation, e.g. `C:\Users\Username\Miniconda3` or `%USERPROFILE%\Anaconda`.

NOTE that you need at least conda 4.6! You also need to set `Conda Env`, see next point.

- `Conda Env`: If you are on Windows and use Anaconda or Miniconda, type here the name of your conda env, e.g. `base` for the base installation or `myenv` for a conda env with the name `myenv`.
- `UDF Modules`: Names of Python modules (without `.py` extension) from which the UDFs are being imported. Separate multiple modules by “;”. Example: `UDF_MODULES = "common_udfs; myproject"` The default imports a file in the same directory as the Excel spreadsheet with the same name but ending in `.py`.
- `Debug UDFs`: Check this box if you want to run the xlwings COM server manually for debugging, see [Debugging](#).
- `RunPython: Use UDF Server`: Uses the same COM Server for RunPython as for UDFs. This will be faster, as the interpreter doesn’t shut down after each call.
- `Restart UDF Server`: This restarts the UDF Server/Python interpreter.
- `Show Console`: Check the box in the ribbon or set the config to `TRUE` if you want the command prompt to pop up. This currently only works on Windows.

7.3.1 Anaconda/Miniconda

If you use Anaconda or Miniconda on Windows, you will need to set your `Conda Path` and `Conda Env` settings, as you will otherwise get errors when using NumPy etc. In return, leave `Interpreter` empty.

7.4 Environment Variables

With environment variables, you can set dynamic paths e.g. to your interpreter or `PYTHONPATH`:

- On Windows, you can use all environment variables like so: `%USERPROFILE%\Anaconda`.
- On macOS, the following special variables are supported: `$HOME`, `$APPLICATIONS`, `$DOCUMENTS`, `$DESKTOP`.

7.5 User Config: Ribbon/Config File

The settings in the xlwings Ribbon are stored in a config file that can also be manipulated externally. The location is

- Windows: `.xlwings\xlwings.conf` in your home folder, that is usually `C:\Users\<username>`
- macOS: `~/Library/Containers/com.microsoft.Excel/Data/xlwings.conf`

The format is as follows (currently the keys are required to be all caps) - note the OS specific Interpreter settings!

```
"INTERPRETER_WIN", "C:\\path\\to\\python.exe"
"INTERPRETER_MAC", "/path/to/python"
"PYTHONPATH", ""
"CONDA_PATH", ""
"CONDA_ENV", ""
"UDF_MODULES", ""
"DEBUG_UDFS", ""
"USE_UDF_SERVER", ""
"SHOW_CONSOLE", ""
"ONEDRIVE", ""
```

Note: The ONEDRIVE setting has to be edited directly in the file, there is currently no possibility to edit it via the ribbon. Usually, it is only required if you are either on macOS or if your environment vars on Windows are not correctly set or if you have a private and corporate location and don't want to go with the default one. ONEDRIVE has to point to the root folder of your local OneDrive folder.

7.6 Workbook Directory Config: Config file

The global settings of the Ribbon/Config file can be overridden for one or more workbooks by creating a `xlwings.conf` file in the workbook's directory.

7.7 Workbook Config: xlwings.conf Sheet

Workbook specific settings will override global (Ribbon) and workbook directory config files: Workbook specific settings are set by listing the config key/value pairs in a sheet with the name `xlwings.conf`. When you create a new project with `xlwings quickstart`, it'll already have such a sheet but you need to rename it to `xlwings.conf` to make it active.

	A	B
1	Interpreter	pythonw
2	PYTHONPATH	
3	UDF Modules	
4	Debug UDFs	FALSE
5	Log File	
6	Use UDF Server	FALSE

7.8 Alternative: Standalone VBA module

Sometimes, it might be useful to run xlwings code without having to install an add-in first. To do so, you need to use the `standalone` option when creating a new project: `xlwings quickstart myproject --standalone`.

This will add the content of the add-in as a single VBA module so you don't need to set a reference to the add-in anymore. It will also include `Dictionary.cls` as this is required on macOS. It will still read in the settings from your `xlwings.conf` if you don't override them by using a sheet with the name `xlwings.conf`.

8.1 xlwings add-in

To get access to `Run main` (new in v0.16) button or the `RunPython` VBA function, you'll need the xlwings addin (or VBA module), see [Add-in & Settings](#).

For new projects, the easiest way to get started is by using the command line client with the quickstart command, see [Command Line Client \(CLI\)](#) for details:

```
$ xlwings quickstart myproject
```

8.2 Call Python with “RunPython”

In the VBA Editor (Alt-F11), write the code below into a VBA module. `xlwings quickstart` automatically adds a new module with a sample call. If you rather want to start from scratch, you can add a new module via `Insert > Module`.

```
Sub HelloWorld()  
    RunPython ("import hello; hello.world()")  
End Sub
```

This calls the following code in `hello.py`:

```
# hello.py  
import numpy as np  
import xlwings as xw  
  
def world():
```

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```
wb = xw.Book.caller()
wb.sheets[0].range('A1').value = 'Hello World!'
```

You can then attach HelloWorld to a button or run it directly in the VBA Editor by hitting F5.

Note: Place `xw.Book.caller()` within the function that is being called from Excel and not outside as global variable. Otherwise it prevents Excel from shutting down properly upon exiting and leaves you with a zombie process when you use `Use UDF Server = True`.

8.3 Function Arguments and Return Values

While it's technically possible to include arguments in the function call within `RunPython`, it's not very convenient. Also, `RunPython` does not allow you to return values. To overcome these issues, use UDFs, see *User Defined Functions (UDFs)* - however, this is currently limited to Windows only.

User Defined Functions (UDFs)

This tutorial gets you quickly started on how to write User Defined Functions.

Note:

- UDFs are currently only available on Windows.
 - For details of how to control the behaviour of the arguments and return values, have a look at *Converters and Options*.
 - For a comprehensive overview of the available decorators and their options, check out the corresponding API docs: *UDF decorators*.
-

9.1 One-time Excel preparations

1) Enable Trust access to the VBA project object model **under** File > Options > Trust Center > Trust Center Settings > Macro Settings

2) Install the add-in via command prompt: `xlwings addin install` (see *Add-in & Settings*).

9.2 Workbook preparation

The easiest way to start a new project is to run `xlwings quickstart myproject` on a command prompt (see *Command Line Client (CLI)*). This automatically adds the xlwings reference to the generated workbook.

9.3 A simple UDF

The default addin settings expect a Python source file in the way it is created by `quickstart`:

- in the same directory as the Excel file
- with the same name as the Excel file, but with a `.py` ending instead of `.xlsm`.

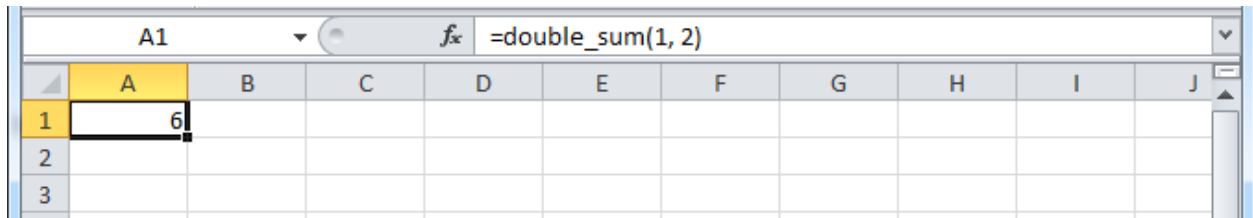
Alternatively, you can point to a specific module via `UDF Modules` in the xlwings ribbon.

Let's assume you have a Workbook `myproject.xlsm`, then you would write the following code in `myproject.py`:

```
import xlwings as xw

@xw.func
def double_sum(x, y):
    """Returns twice the sum of the two arguments"""
    return 2 * (x + y)
```

- Now click on `Import Python UDFs` in the xlwings tab to pick up the changes made to `myproject.py`.
- Enter the formula `=double_sum(1, 2)` into a cell and you will see the correct result:



- The docstring (in triple-quotes) will be shown as function description in Excel.

Note:

- You only need to re-import your functions if you change the function arguments or the function name.
 - Code changes in the actual functions are picked up automatically (i.e. at the next calculation of the formula, e.g. triggered by `Ctrl-Alt-F9`), but changes in imported modules are not. This is the very behaviour of how Python imports work. If you want to make sure everything is in a fresh state, click `Restart UDF Server`.
 - The `@xw.func` decorator is only used by xlwings when the function is being imported into Excel. It tells xlwings for which functions it should create a VBA wrapper function, otherwise it has no effect on how the functions behave in Python.
-

9.4 Array formulas: Get efficient

Calling one big array formula in Excel is much more efficient than calling many single-cell formulas, so it's generally a good idea to use them, especially if you hit performance problems.

You can pass an Excel Range as a function argument, as opposed to a single cell and it will show up in Python as list of lists.

For example, you can write the following function to add 1 to every cell in a Range:

```
@xw.func
def add_one(data):
    return [[cell + 1 for cell in row] for row in data]
```

To use this formula in Excel,

- Click on Import Python UDFs again
- Fill in the values in the range A1:B2
- Select the range D1:E2
- Type in the formula =add_one(A1:B2)
- Press Ctrl+Shift+Enter to create an array formula. If you did everything correctly, you'll see the formula surrounded by curly braces as in this screenshot:

	A	B	C	D	E	F	G	H	I	J
1	1	2		2	3					
2	3	4		4	5					
3										

9.4.1 Number of array dimensions: ndim

The above formula has the issue that it expects a “two dimensional” input, e.g. a nested list of the form `[[1, 2], [3, 4]]`. Therefore, if you would apply the formula to a single cell, you would get the following error: `TypeError: 'float' object is not iterable`.

To force Excel to always give you a two-dimensional array, no matter whether the argument is a single cell, a column/row or a two-dimensional Range, you can extend the above formula like this:

```
@xw.func
@xw.arg('data', ndim=2)
def add_one(data):
    return [[cell + 1 for cell in row] for row in data]
```

9.5 Array formulas with NumPy and Pandas

Often, you'll want to use NumPy arrays or Pandas DataFrames in your UDF, as this unlocks the full power of Python's ecosystem for scientific computing.

To define a formula for matrix multiplication using numpy arrays, you would define the following function:

```
import xlwings as xw
import numpy as np

@xw.func
@xw.arg('x', np.array, ndim=2)
@xw.arg('y', np.array, ndim=2)
def matrix_mult(x, y):
    return x @ y
```

Note: If you are not on Python >= 3.5 with NumPy >= 1.10, use `x.dot(y)` instead of `x @ y`.

A great example of how you can put Pandas at work is the creation of an array-based CORREL formula. Excel's version of CORREL only works on 2 datasets and is cumbersome to use if you want to quickly get the correlation matrix of a few time-series, for example. Pandas makes the creation of an array-based CORREL2 formula basically a one-liner:

```
import xlwings as xw
import pandas as pd

@xw.func
@xw.arg('x', pd.DataFrame, index=False, header=False)
@xw.ret(index=False, header=False)
def CORREL2(x):
    """Like CORREL, but as array formula for more than 2 data sets"""
    return x.corr()
```

9.6 @xw.arg and @xw.ret decorators

These decorators are to UDFs what the `options` method is to Range objects: they allow you to apply converters and their options to function arguments (`@xw.arg`) and to the return value (`@xw.ret`). For example, to convert the argument `x` into a pandas DataFrame and suppress the index when returning it, you would do the following:

```
@xw.func
@xw.arg('x', pd.DataFrame)
@xw.ret(index=False)
def myfunction(x):
    # x is a DataFrame, do something with it
    return x
```

For further details see the *Converters and Options* documentation.

9.7 Dynamic Array Formulas

Note: If your version of Excel supports the new native dynamic arrays, then you don't have to do anything special, and you shouldn't use the `expand` decorator! To check if your version of Excel supports it, see if you have the `=UNIQUE()` formula available. Native dynamic arrays were introduced in Office 365 Insider Fast at the end of September 2018.

As seen above, to use Excel's array formulas, you need to specify their dimensions up front by selecting the result array first, then entering the formula and finally hitting `Ctrl-Shift-Enter`. In practice, it often turns out to be a cumbersome process, especially when working with dynamic arrays such as time series data. Since v0.10, xlwings offers dynamic UDF expansion:

This is a simple example that demonstrates the syntax and effect of UDF expansion:

```
import numpy as np

@xw.func
@xw.ret(expand='table')
def dynamic_array(r, c):
    return np.random.randn(int(r), int(c))
```

File Home Insert Page Layout Formulas Data Review					
B4		fx		=dynamic_array(B2,C2)	
	A	B	C	D	E
1		rows:	columns:		
2		5	2		
3					
4		2.01156647	-0.0985618		
5		-0.2152179	-0.7541961		
6		0.37168657	-0.1978662		
7		-1.0643897	1.37592295		
8		0.5272535	-0.0508628		
9					

Note:

- Expanding array formulas will overwrite cells without prompting

	A	B	C	D	E	F
1		rows:	columns:			
2		2	5			
3						
4		-0.6788379	-1.0009999	-0.6342434	-0.9362773	1.02582914
5		-2.1803953	0.18511092	0.3121721	0.20600051	0.3799863
6						

- Pre v0.15.0 doesn't allow to have volatile functions as arguments, e.g. you cannot use functions like `=TODAY()` as arguments. Starting with v0.15.0, you can use volatile functions as input, but the UDF will be called more than 1x.
- Dynamic Arrays have been refactored with v0.15.0 to be proper legacy arrays: To edit a dynamic array with xlwings \geq v0.15.0, you need to hit **Ctrl-Shift-Enter** while in the top left cell. Note that you don't have to do that when you enter the formula for the first time.

9.8 Docstrings

The following sample shows how to include docstrings both for the function and for the arguments `x` and `y` that then show up in the function wizard in Excel:

```
import xlwings as xw

@xw.func
@xw.arg('x', doc='This is x.')
@xw.arg('y', doc='This is y.')
def double_sum(x, y):
    """Returns twice the sum of the two arguments"""
    return 2 * (x + y)
```

9.9 The “caller” argument

You often need to know which cell called the UDF. For this, xlwings offers the reserved argument `caller` which returns the calling cell as xlwings range object:

```
@xw.func
def get_caller_address(caller):
    # caller will not be exposed in Excel, so use it like so:
```

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```
# =get_caller_address()
return caller.address
```

Note that `caller` will not be exposed in Excel but will be provided by xlwings behind the scenes.

9.10 The “vba” keyword

By using the `vba` keyword, you can get access to any Excel VBA object in the form of a `pywin32` object. For example, if you wanted to pass the sheet object in the form of its `CodeName`, you can do it as follows:

```
@xw.func
@xw.arg('sheet1', vba='Sheet1')
def get_name(sheet1):
    # call this function in Excel with:
    # =get_name()
    return sheet1.Name
```

Note that `vba` arguments are not exposed in the UDF but automatically provided by xlwings.

9.11 Macros

On Windows, as an alternative to calling macros via *RunPython*, you can also use the `@xw.sub` decorator:

```
import xlwings as xw

@xw.sub
def my_macro():
    """Writes the name of the Workbook into Range("A1") of Sheet 1"""
    wb = xw.Book.caller()
    wb.sheets[0].range('A1').value = wb.name
```

After clicking on `Import Python UDFs`, you can then use this macro by executing it via `Alt + F8` or by binding it e.g. to a button. To do the latter, make sure you have the `Developer` tab selected under `File > Options > Customize Ribbon`. Then, under the `Developer` tab, you can insert a button via `Insert > Form Controls`. After drawing the button, you will be prompted to assign a macro to it and you can select `my_macro`.

9.12 Call UDFs from VBA

Imported functions can also be used from VBA. For example, for a function returning a 2d array:

```
Sub MySub()

Dim arr() As Variant
```

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```
Dim i As Long, j As Long

    arr = my_imported_function(...)

    For j = LBound(arr, 2) To UBound(arr, 2)
        For i = LBound(arr, 1) To UBound(arr, 1)
            Debug.Print "(" & i & ", " & j & ")", arr(i, j)
        Next i
    Next j

End Sub
```

9.13 Asynchronous UDFs

Note: This is an experimental feature

New in version v0.14.0.

xlwings offers an easy way to write asynchronous functions in Excel. Asynchronous functions return immediately with #N/A waiting... While the function is waiting for its return value, you can use Excel to do other stuff and whenever the return value is available, the cell value will be updated.

The only available mode is currently `async_mode='threading'`, meaning that it's useful for I/O-bound tasks, for example when you fetch data from an API over the web.

You make a function asynchronous simply by giving it the respective argument in the function decorator. In this example, the time consuming I/O-bound task is simulated by using `time.sleep`:

```
import xlwings as xw
import time

@xw.func(async_mode='threading')
def myfunction(a):
    time.sleep(5) # long running tasks
    return a
```

You can use this function like any other xlwings function, simply by putting `=myfunction("abcd")` into a cell (after you have imported the function, of course).

Note that xlwings doesn't use the native asynchronous functions that were introduced with Excel 2010, so xlwings asynchronous functions are supported with any version of Excel.

CHAPTER 10

Matplotlib & Plotly Charts

10.1 Matplotlib

Using `pictures.add()`, it is easy to paste a Matplotlib plot as picture in Excel.

10.1.1 Getting started

The easiest sample boils down to:

```
>>> import matplotlib.pyplot as plt
>>> import xlwings as xw

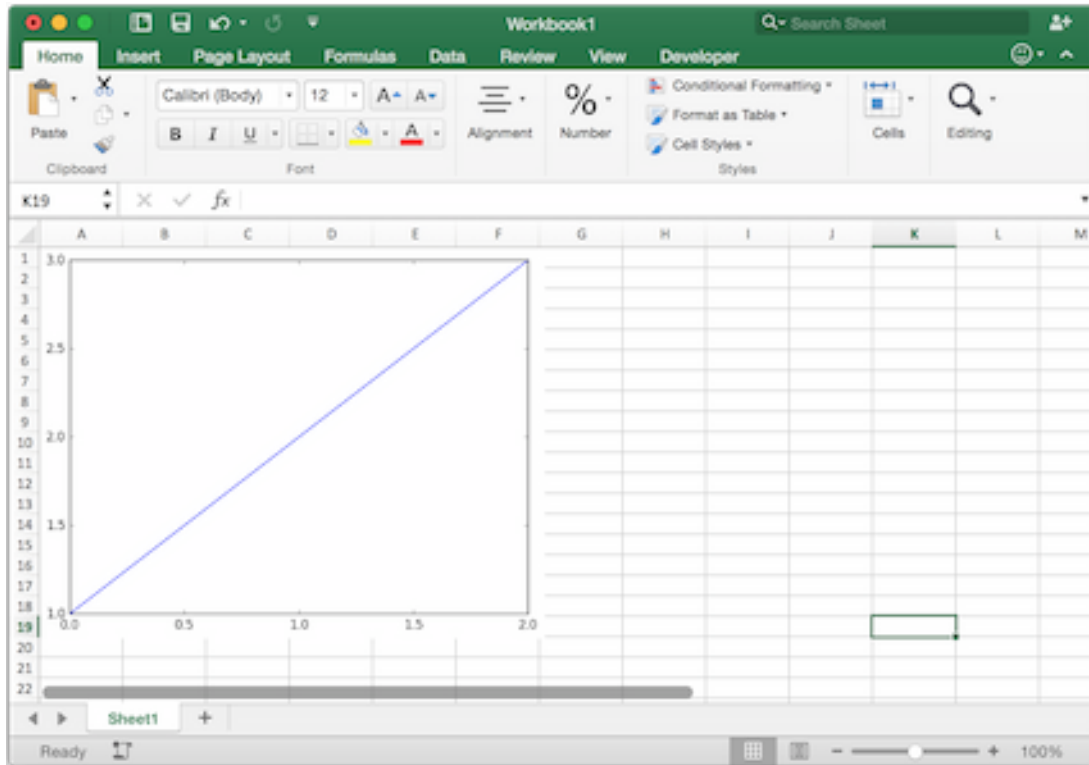
>>> fig = plt.figure()
>>> plt.plot([1, 2, 3])

>>> sht = xw.Book().sheets[0]
>>> sht.pictures.add(fig, name='MyPlot', update=True)
```

Note: If you set `update=True`, you can resize and position the plot on Excel: subsequent calls to `pictures.add()` with the same name ('MyPlot') will update the picture without changing its position or size.

10.1.2 Full integration with Excel

Calling the above code with *RunPython* and binding it e.g. to a button is straightforward and works cross-platform.



However, on Windows you can make things feel even more integrated by setting up a *UDF* along the following lines:

```
@xw.func
def myplot(n, caller):
    fig = plt.figure()
    plt.plot(range(int(n)))
    caller.sheet.pictures.add(fig, name='MyPlot', update=True)
    return 'Plotted with n={}'.format(n)
```

If you import this function and call it from cell B2, then the plot gets automatically updated when cell B1 changes:

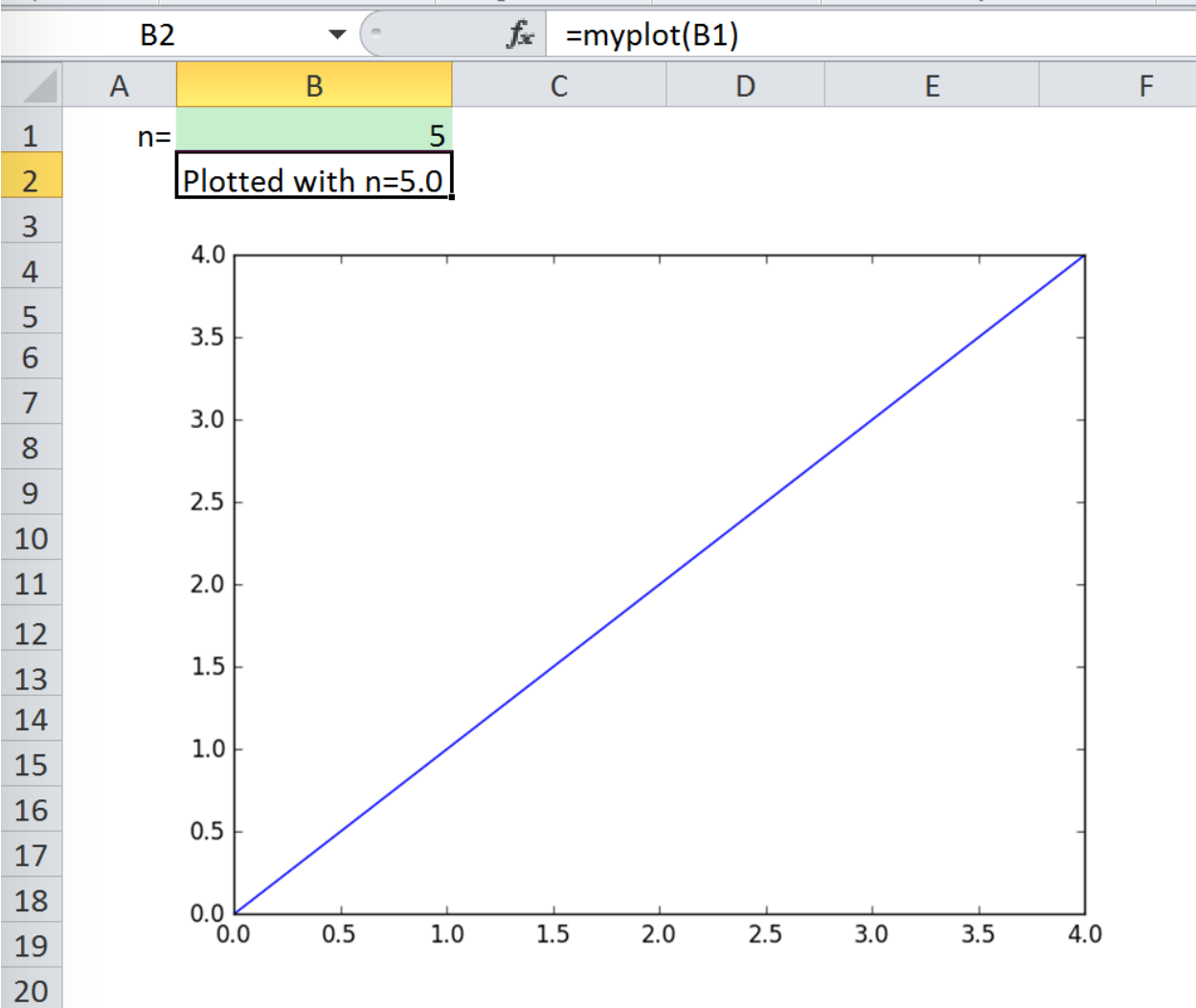
10.1.3 Properties

Size, position and other properties can either be set as arguments within `pictures.add()`, or by manipulating the picture object that is returned, see `xlwings.Picture()`.

For example:

```
>>> sht = xw.Book().sheets[0]
>>> sht.pictures.add(fig, name='MyPlot', update=True,
                     left=sht.range('B5').left, top=sht.range('B5').top)
```

or:



```
>>> plot = sht.pictures.add(fig, name='MyPlot', update=True)
>>> plot.height /= 2
>>> plot.width /= 2
```

10.1.4 Getting a Matplotlib figure

Here are a few examples of how you get a matplotlib figure object:

- via PyPlot interface:

```
import matplotlib.pyplot as plt
fig = plt.figure()
plt.plot([1, 2, 3, 4, 5])
```

or:

```
import matplotlib.pyplot as plt
plt.plot([1, 2, 3, 4, 5])
fig = plt.gcf()
```

- via object oriented interface:

```
from matplotlib.figure import Figure
fig = Figure(figsize=(8, 6))
ax = fig.add_subplot(111)
ax.plot([1, 2, 3, 4, 5])
```

- via Pandas:

```
import pandas as pd
import numpy as np

df = pd.DataFrame(np.random.rand(10, 4), columns=['a', 'b', 'c', 'd'])
ax = df.plot(kind='bar')
fig = ax.get_figure()
```

10.2 Plotly static charts

This feature requires xlwings *PRO*.

10.2.1 Prerequisites

In addition to plotly you will need orca. The easiest way to get it is via conda:

```
$ conda install -c plotly plotly-orca psutil requests
```

For alternative ways of installation, see: <https://plotly.com/python/static-image-export/>

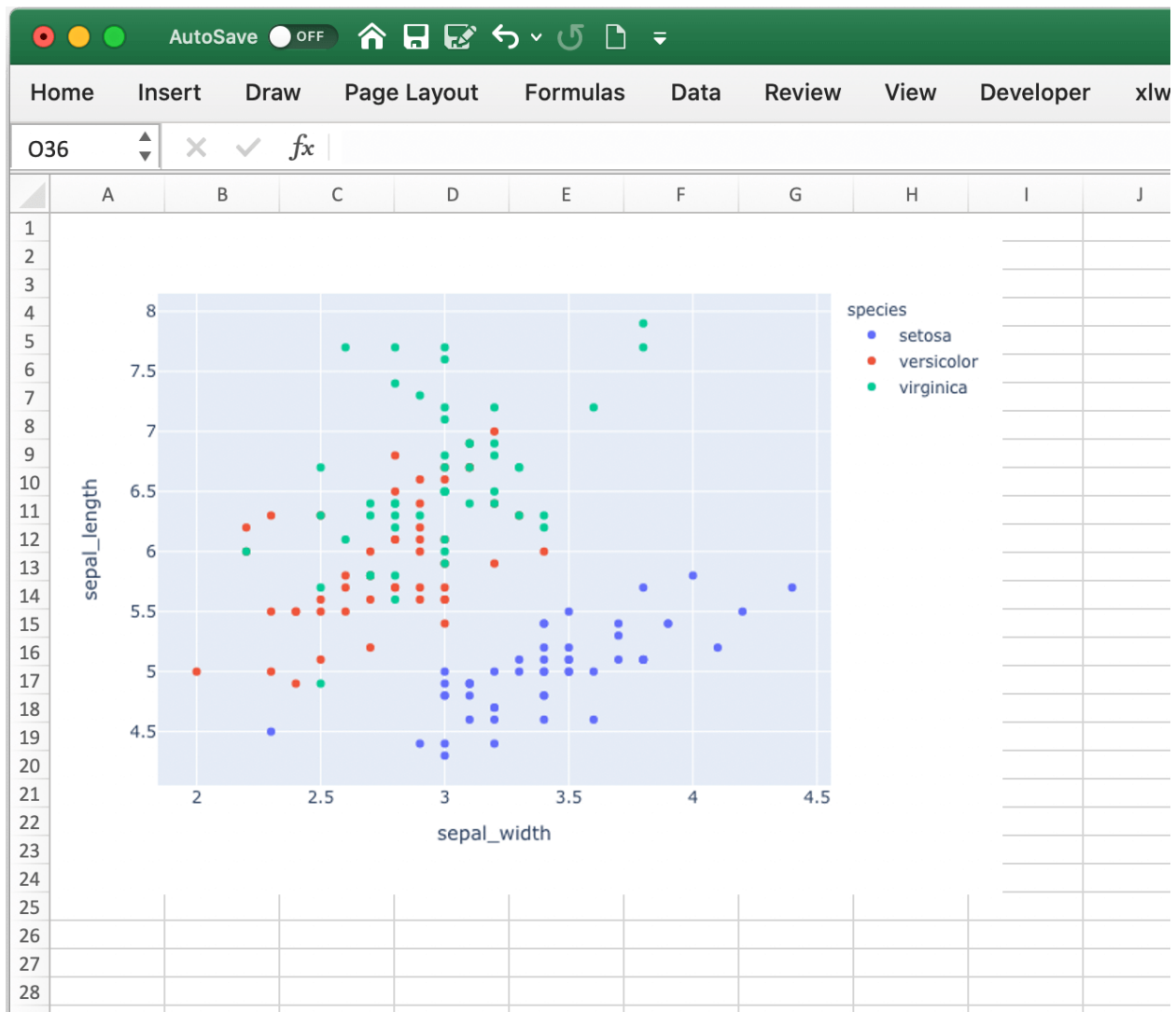
10.2.2 How to use

It works the same as with Matplotlib, however, rendering a Plotly chart takes slightly longer. Here is a sample:

```
import xlwings as xw
import plotly.express as px

# Plotly chart
df = px.data.iris()
fig = px.scatter(df, x="sepal_width", y="sepal_length", color="species")

# Add it to Excel
wb = xw.Book()
wb.sheets[0].pictures.add(fig, name='IrisScatterPlot', update=True)
```



Jupyter Notebooks: Interact with Excel

When you work with Jupyter notebooks, you may use Excel as an interactive data viewer or scratchpad from where you can load DataFrames. The two convenience functions `view` and `load` make this really easy.

Note: The `view` and `load` functions should exclusively be used for interactive work. If you write scripts, use the `xlwings` API as introduced under *Quickstart* and *Syntax Overview*.

11.1 The view function

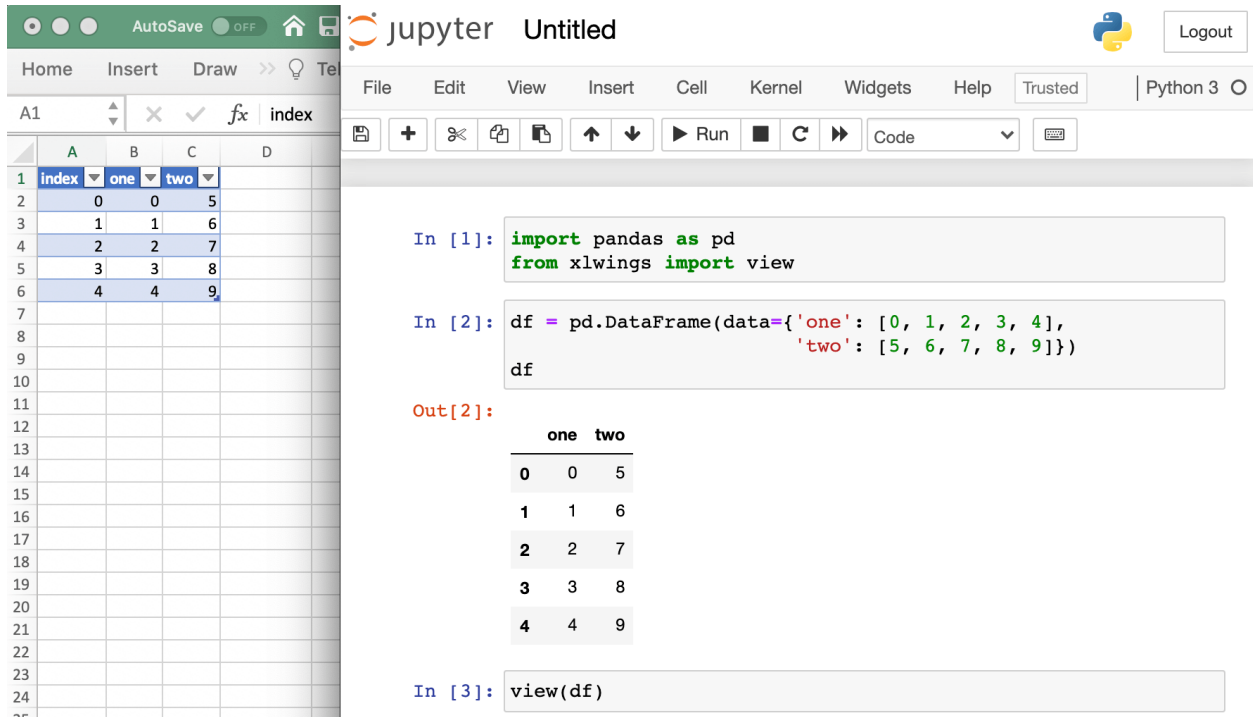
The `view` function accepts pretty much any object of interest, whether that's a number, a string, a nested list or a NumPy array or a pandas DataFrame. By default, it writes the data into an Excel table in a new workbook. If you wanted to reuse the same workbook, provide a `sheet` object, e.g. `view(df, sheet=xw.sheets.active)`, for further options see `view`.

Changed in version 0.22.0: Earlier versions were not formatting the output as Excel table

11.2 The load function

To load in a range in an Excel sheet as pandas DataFrame, use the `load` function. If you only select one cell, it will auto-expand to cover the whole range. If, however, you select a specific range that is bigger than one cell, it will load in only the selected cells. If the data in Excel does not have an index or header, set them to `False` like this: `xw.load(index=False)`, see also `load`.

New in version 0.22.0.



The screenshot shows a Jupyter Notebook titled "Untitled" with a Python 3 kernel. On the left, a small Excel spreadsheet is visible with the following data:

index	one	two
0	0	5
1	1	6
2	2	7
3	3	8
4	4	9

The notebook contains the following code cells:

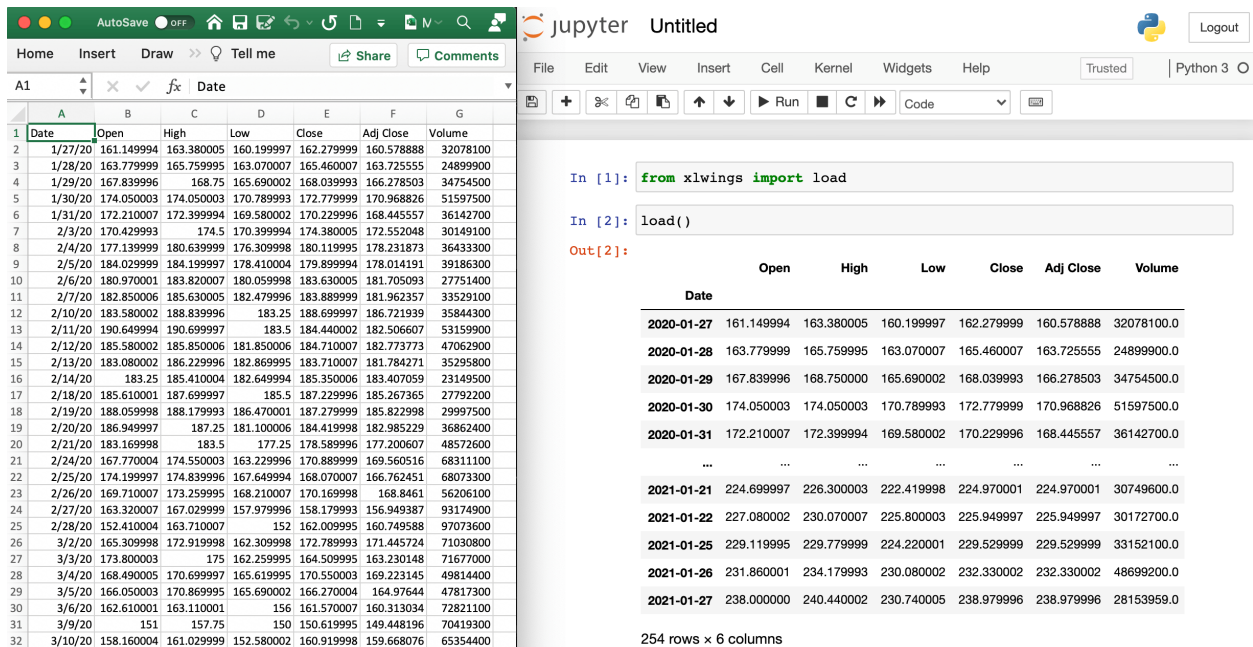
```
In [1]: import pandas as pd
        from xlwings import view

In [2]: df = pd.DataFrame(data={'one': [0, 1, 2, 3, 4],
                                'two': [5, 6, 7, 8, 9]})
        df

Out[2]:
```

	one	two
0	0	5
1	1	6
2	2	7
3	3	8
4	4	9

```
In [3]: view(df)
```



The screenshot shows a Jupyter Notebook titled "Untitled" with a Python 3 kernel. On the left, a large Excel spreadsheet is visible with the following data:

Date	Open	High	Low	Close	Adj Close	Volume
1/27/20	161.149994	163.380005	160.199997	162.279999	160.578888	32078100
1/28/20	163.779999	165.759995	163.070007	165.460007	163.725555	24899900
1/29/20	167.839996	168.75	165.690002	168.039993	166.278503	34754500
1/30/20	174.050003	174.050003	170.789993	172.779999	170.968826	51597500
1/31/20	172.210007	172.399994	169.580002	170.229996	168.445557	36142700
2/3/20	170.429993	174.5	170.399994	174.380005	172.552048	30149100
2/4/20	177.139999	180.639999	176.309998	180.119995	178.231873	36433300
2/5/20	184.029999	184.199997	178.410004	179.899994	178.014191	39186300
2/6/20	180.970001	183.820007	180.059998	183.630005	181.705093	27751400
2/7/20	182.850006	185.630005	182.479996	183.889999	181.962357	33529100
2/10/20	183.580002	188.839996	183.25	188.699997	186.721939	35844300
2/11/20	190.649994	190.699997	183.5	184.440002	182.506607	53159900
2/12/20	185.580002	185.850006	181.850006	184.710007	182.773773	47062900
2/13/20	183.080002	186.229996	182.869995	183.710007	181.784271	35295800
2/14/20	183.25	185.410004	182.649994	185.350006	183.407059	23149500
2/18/20	185.610001	187.699997	185.5	187.229996	185.267365	27792200
2/19/20	188.059998	188.179993	186.470001	187.279999	185.822998	29997500
2/20/20	186.949997	187.25	181.100006	184.419998	182.985229	36862400
2/21/20	183.169998	183.5	177.25	178.589996	177.200607	48572600
2/24/20	167.770004	174.550003	163.229996	170.889999	169.560516	68311100
2/25/20	174.199997	174.839996	167.649994	168.070007	166.762451	68073300
2/26/20	169.710007	173.259995	168.210007	170.169998	168.8461	56206100
2/27/20	163.320007	167.029999	157.979996	158.179993	156.949387	93174900
2/28/20	152.410004	163.710007	152	162.009995	160.749588	97073600
3/2/20	165.309998	172.919998	162.309998	172.789993	171.445724	71030800
3/3/20	173.800003	175	162.259995	164.509995	163.230148	71677000
3/4/20	168.490005	170.699997	165.619995	170.550003	169.223145	49814400
3/5/20	166.050003	170.869995	165.690002	166.270004	164.97644	47817300
3/6/20	162.610001	163.110001	156	161.570007	160.313034	72821100
3/9/20	151	157.75	150	150.619995	149.448196	70419300
3/10/20	158.160004	161.029999	152.580002	160.919998	159.668076	65354400

The notebook contains the following code cells:

```
In [1]: from xlwings import load

In [2]: load()

Out[2]:
```

Date	Open	High	Low	Close	Adj Close	Volume
2020-01-27	161.149994	163.380005	160.199997	162.279999	160.578888	32078100.0
2020-01-28	163.779999	165.759995	163.070007	165.460007	163.725555	24899900.0
2020-01-29	167.839996	168.750000	165.690002	168.039993	166.278503	34754500.0
2020-01-30	174.050003	174.050003	170.789993	172.779999	170.968826	51597500.0
2020-01-31	172.210007	172.399994	169.580002	170.229996	168.445557	36142700.0
...
2021-01-21	224.699997	226.300003	222.419998	224.970001	224.970001	30749600.0
2021-01-22	227.080002	230.070007	225.800003	225.949997	225.949997	30172700.0
2021-01-25	229.119995	229.779999	224.220001	229.529999	229.529999	33152100.0
2021-01-26	231.860001	234.179993	230.080002	232.330002	232.330002	48699200.0
2021-01-27	238.000000	240.440002	230.740005	238.979996	238.979996	28153950.0

254 rows x 6 columns

CHAPTER 12

Command Line Client (CLI)

xlwings comes with a command line client. On Windows, type the commands into a Command Prompt, on Mac, type them into a Terminal. To get an overview of all commands, simply type `xlwings` and hit Enter:

<code>addin</code>	Run " <code>xlwings addin install</code> " to install the Excel add-in (will be copied to the XLSTART folder). Instead of " <code>install</code> " you can also use " <code>update</code> ", " <code>remove</code> " or " <code>status</code> ". Note that this command may take a while. Use the " <code>--unprotected</code> " flag to install the add-in without password protection. You can install your custom add-in by providing the name or path via the <code>--file</code> flag, e.g. " <code>xlwings add-in install --file custom.xlam</code> " (New in 0.6.0, the unprotected flag was added in 0.20.4)
<code>quickstart</code>	Run " <code>xlwings quickstart myproject</code> " to create a folder called "myproject" in the current directory with an Excel file and a Python file, ready to be used. Use the " <code>--standalone</code> " flag to embed all VBA code in the Excel file and make it work without the xlwings add-in.
<code>runpython</code>	macOS only: run " <code>xlwings runpython install</code> " if you want to enable the RunPython calls without installing the add-in. This will create the following file: ~/Library/Application Scripts/com.microsoft.Excel/xlwings.applescript (new in 0.7.0)
<code>restapi</code>	Use " <code>xlwings restapi run</code> " to run the xlwings REST API via Flask dev server. Accepts " <code>--host</code> " and " <code>--port</code> " as optional arguments.
<code>license</code>	xlwings PRO: Use " <code>xlwings license update -k KEY</code> " where "KEY" is your personal (trial) license key. This will update ~/.xlwings/xlwings.conf with the LICENSE_KEY

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config	<p>entry. If you have a paid license, you can run "xlwings license deploy" to create a deploy key. This is not available for trial keys.</p> <p>Run "xlwings config create" to create the user config file (~/.xlwings/xlwings.conf) which is where the settings from the Ribbon add-in are stored. It will configure the Python interpreter that you are running this command with. To reset your configuration, run this with the "--force" flag which will overwrite your current configuration.</p> <p>(New in 0.19.5)</p>
code	<p>Run "xlwings code embed" to embed all Python modules of the current dir in your active Excel file. Use the "--file" flag to only import a single file by providing its path. To run embedded code, you need an xlwings PRO license.</p> <p>(New in 0.20.2)</p>

CHAPTER 13

xlwings Reports

This feature requires xlwings *PRO*.

13.1 Quickstart

xlwings Reports is part of xlwings PRO and a solution for template-based Excel and PDF reporting. It allows business users without Python knowledge to create & maintain Excel templates without having to go back to a Python developer for every change: xlwings Reports separates the Python code (that gets and prepares all the data) from the Excel template (that defines which data goes where and how it should be formatted). See also the [xlwings Reports homepage](#). You can render one sheet at the time via [mysheet.render_template](#) or use the higher-level convenience function [xw.create_report](#) which first copies the template workbook and then loops through all sheets.

13.1.1 Render Sheets

Let's first look at how to render a single sheet. This is a workbook stored as `Book1.xlsx`:

Running the following code:

```
import xlwings as xw
wb = xw.Book('Book1.xlsx')
sheet = wb.sheets['template'].copy(name='report')
sheet.render_template(title='A Demo!', table=[[1, 2], [3, 4]])
wb.to_pdf() # requires xlwings >=0.21.1
```

Leaves you with this:

See also the [API reference](#).

	A	B	C	
1	{{ title }}			
2				
3	{{ table }}			
4				
5				
6				
7				
8				
9				

◀ ▶
template
+

	A	B	C	
1	A Demo!			
2				
3	1	2		
4	3	4		
5				
6				
7				
8				
9				

◀ ▶
template
report

New in version 0.22.0.

13.1.2 Render Workbooks

If your template is a full workbook, you can use the `create_report` function. Start by creating the following Python script `my_template.py`:

```
from xlwings.pro.reports import create_report
import pandas as pd

df = pd.DataFrame(data=[[1,2],[3,4]])
wb = create_report('my_template.xlsx', 'my_report.xlsx', title='MyTitle',
    ↳df=df)
wb.to_pdf() # requires xlwings >=0.21.1
```

Then create the following Excel file called `my_template.xlsx`:

	A	B	C	D
1	{{ title }}			
2				
3	My DataFrame			
4	{{ df }}			
5				
6				

Now run the Python script:

```
python my_template.py
```

This will copy the template and create the following output by replacing the variables in double curly braces with the value from the Python variable:

	A	B	C	D
1	MyTitle			
2				
3	My DataFrame			
4		0	1	
5	0	1	2	
6	1	3	4	
7				

The last line (`wb.to_pdf()`) will print the workbook as PDF, for more details on the options, see [Book.to_pdf\(\)](#).

Apart from Strings and Pandas DataFrames, you can also use numbers, lists, simple dicts, NumPy arrays, Matplotlib figures and PIL Image objects that have a filename.

By default, xlwings Reports overwrites existing values in templates if there is not enough free space for your variable. If you want your rows to dynamically shift according to the height of your array, use [Frames](#).

See also the [API reference](#).

13.2 Frames

Frames are vertical containers in which content is being aligned according to their height. That is, within Frames:

- Variables do not overwrite existing cell values as they do without Frames.
- Formatting is applied dynamically, depending on the number of rows your object uses in Excel

To use Frames, insert `<frame>` into **row 1** of your Excel template wherever you want a new dynamic column to start. Row 1 will be removed automatically when creating the report. Frames go from one `<frame>` to the next `<frame>` or the right border of the used range.

How Frames behave is best demonstrated with an example: The following screenshot defines two frames. The first one goes from column A to column E and the second one goes from column F to column I, since this is the last column that is used.

You can define and format table-like objects by formatting exactly

- one header and
- one data row

as shown in the screenshot:

	A	B	C	D	E	F	G	H	I
1	<frame>					<frame>			
2	Table 1					Table 3			
3	{{ df1 }}					{{ df2 }}			
4									
5									
6	Table 2					Table 4			
7	{{ df2 }}					{{ df1 }}			
8									

However, also make sure to check out how to use Excel Tables below, as they make the formatting easier.

Running the following code:

```
from xlwings.pro.reports import create_report
import pandas as pd

df1 = pd.DataFrame([[1, 2, 3], [4, 5, 6], [7, 8, 9]])
df2 = pd.DataFrame([[1, 2, 3], [4, 5, 6], [7, 8, 9], [10, 11, 12], [13, 14, 15]])

data = dict(df1=df1, df2=df2)
```

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```
create_report('my_template.xlsx',
              'my_report.xlsx',
              **data)
```

will generate this report:

	A	B	C	D	E	F	G	H	I
1	Table 1					Table 3			
2		0	1	2			0	1	2
3		0	1	2	3		0	1	2
4		1	4	5	6		1	4	5
5		2	7	8	9		2	7	8
6							3	10	11
7	Table 2						4	13	14
8		0	1	2					
9		0	1	2	3	Table 4			
10		1	4	5	6		0	1	2
11		2	7	8	9		0	1	2
12		3	10	11	12		1	4	5
13		4	13	14	15		2	7	8

13.3 Excel Tables

Using Excel tables is the recommended way to format tables as the styling can be applied dynamically across columns and rows. You can also use themes and apply alternating colors to rows/columns. On top of that, they are the easiest way to make the source of a chart dynamic. Go to **Insert > Table** and make sure that you activate **My table has headers** before clicking on OK. Add the placeholder as usual on the top-left of your Excel table:

Running the following script:

```
from xlwings.pro.reports import create_report
import pandas as pd

nrows, ncols = 3, 3
df = pd.DataFrame(data=nrows * [ncols * ['test']],
                  columns=['col ' + str(i) for i in range(ncols)])

create_report('template.xlsx', 'output.xlsx', df=df.set_index('col 0'))
```

Will produce the following report:

Note:

- If you would like to exclude the DataFrame index, make sure to set the index to the first column e.g.:
df.set_index('column_name').

	A	B
1	<frame>	
2	Title	
3		
4	{{ df }}	
5		
6		
7	Some static text.	
8		

	A	B	C
1	Title		
2			
3	col 0	col 1	col 2
4	test	test	test
5	test	test	test
6	test	test	test
7			
8	Some static text.		

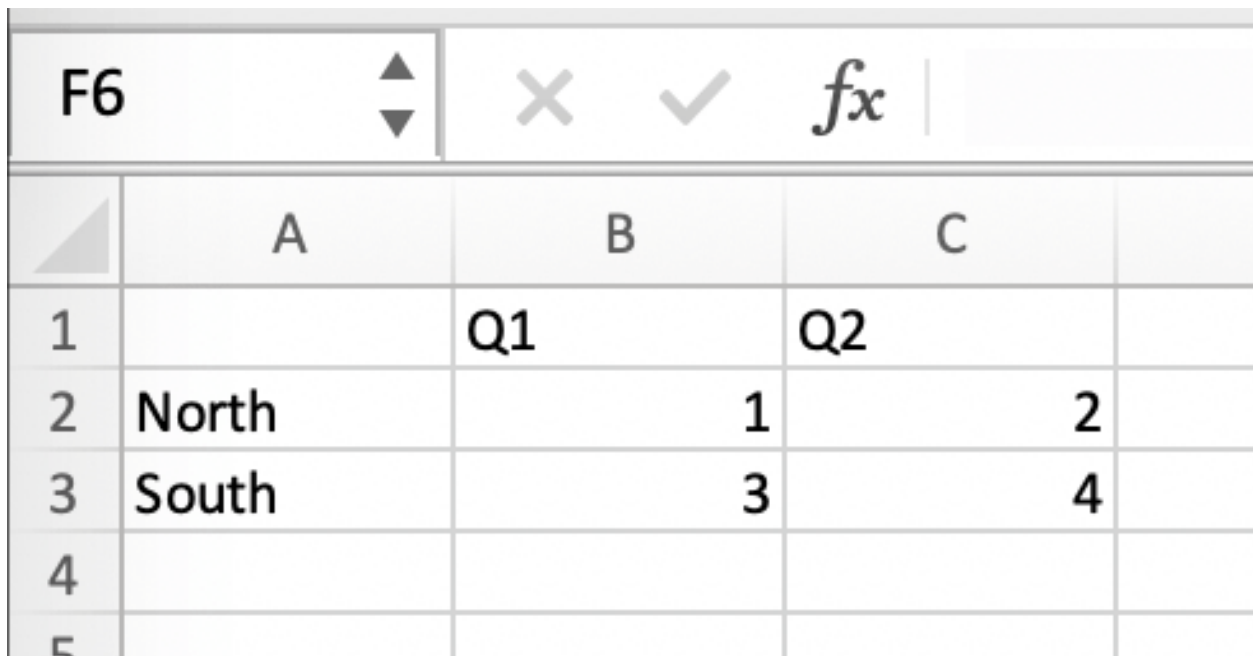
- At the moment, you can only assign pandas DataFrames to tables.
- For Excel table support, you need at least version 0.21.0 and the index behavior was changed in 0.21.3

13.4 Excel Charts

Note: To use charts with a dynamic source, you'll need at least xlwings version 0.22.1

To use Excel charts in your reports, follow this process:

1. Add some sample/dummy data to your Excel template:



	A	B	C
1		Q1	Q2
2	North	1	2
3	South	3	4
4			
5			

2. If your data source is dynamic, turn it into an Excel Table (Insert > Table). Make sure you do this *before* adding the chart in the next step.
3. Add your chart and style it:
4. Reduce the Excel table to a 2 x 2 range and add the placeholder in the top-left corner (in our example `chart_data`). You can leave in some dummy data or clear the values of the Excel table:
5. Assuming your file is called `mytemplate.xlsx` and your sheet `template` like on the previous screenshot, you can run the following code:

	A	B	C	D
1	Column1 ▼	Q1 ▼	Q2 ▼	
2	North	1	2	
3	South	3	4	
4				
5				

```
import xlwings as xw
import pandas as pd

df = pd.DataFrame(data={'Q1': [1000, 2000, 3000],
                        'Q2': [4000, 5000, 6000],
                        'Q3': [7000, 8000, 9000]},
                  index=['North', 'South', 'West'])

wb = xw.Book("mytemplate.xlsx")
sheet = wb.sheets['template'].copy(name='report')
sheet.render_template(chart_data=df)
```

This will produce the following report, with the chart source correctly adjusted:

Note: If you don't want the source data on your report, you might want to place it on a separate sheet. It's easiest if you add and design the chart on the separate sheet, before cutting the chart and pasting it on your report template.

13.5 Shape Text

New in version 0.21.4.

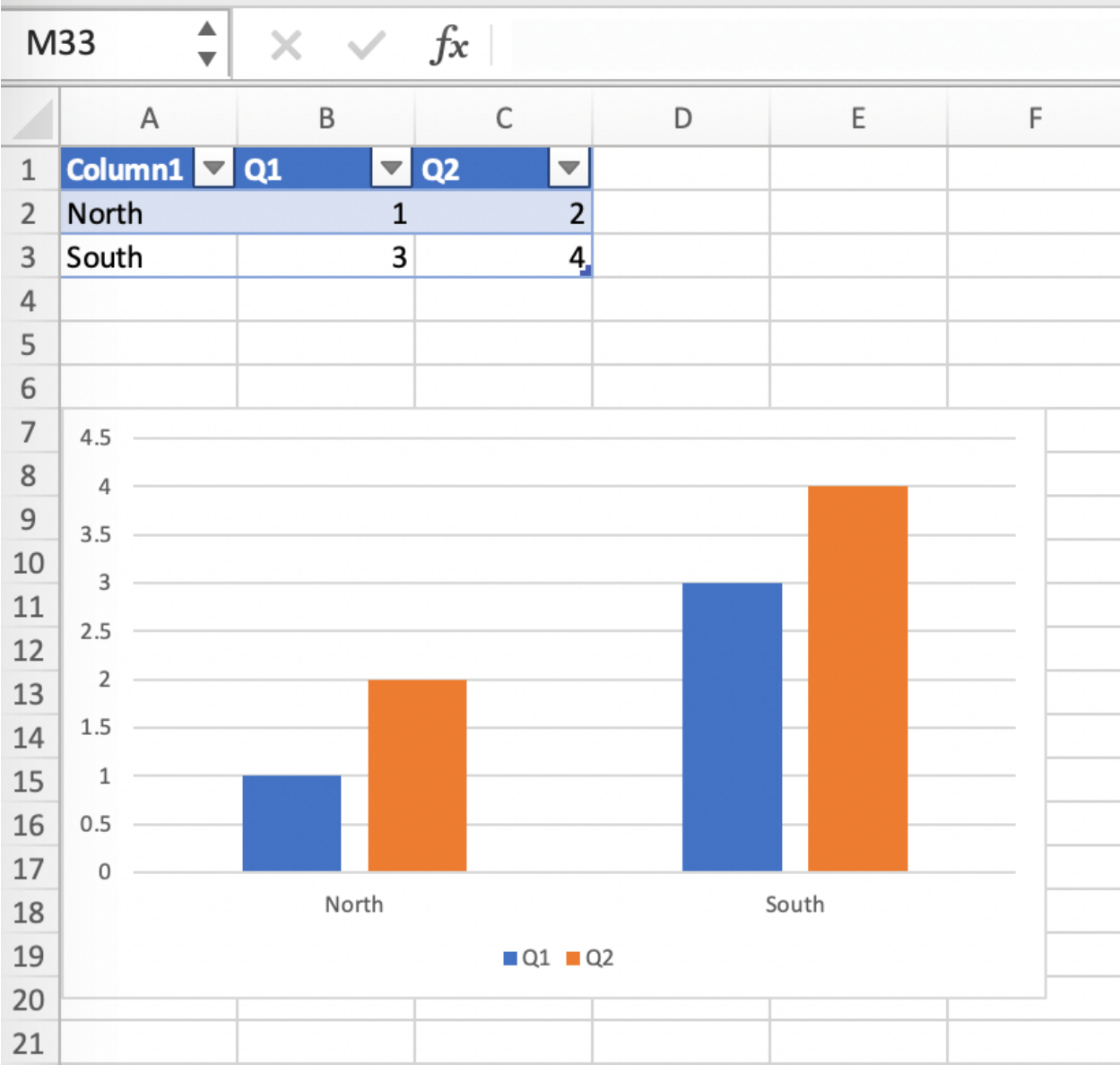
You can also use Shapes like Text Boxes or Rectangles with template text:

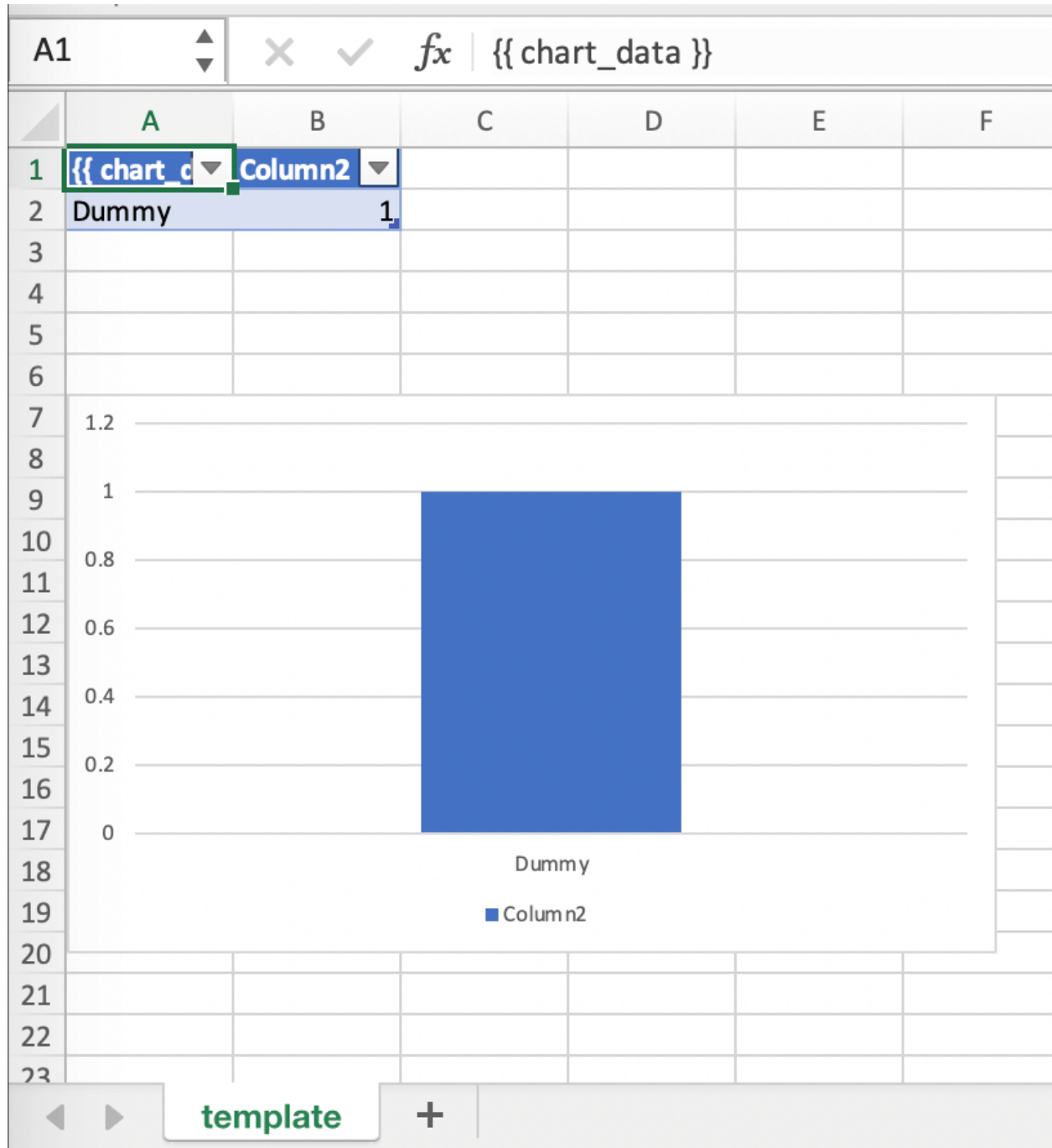
```
from xlwings.pro.reports import create_report

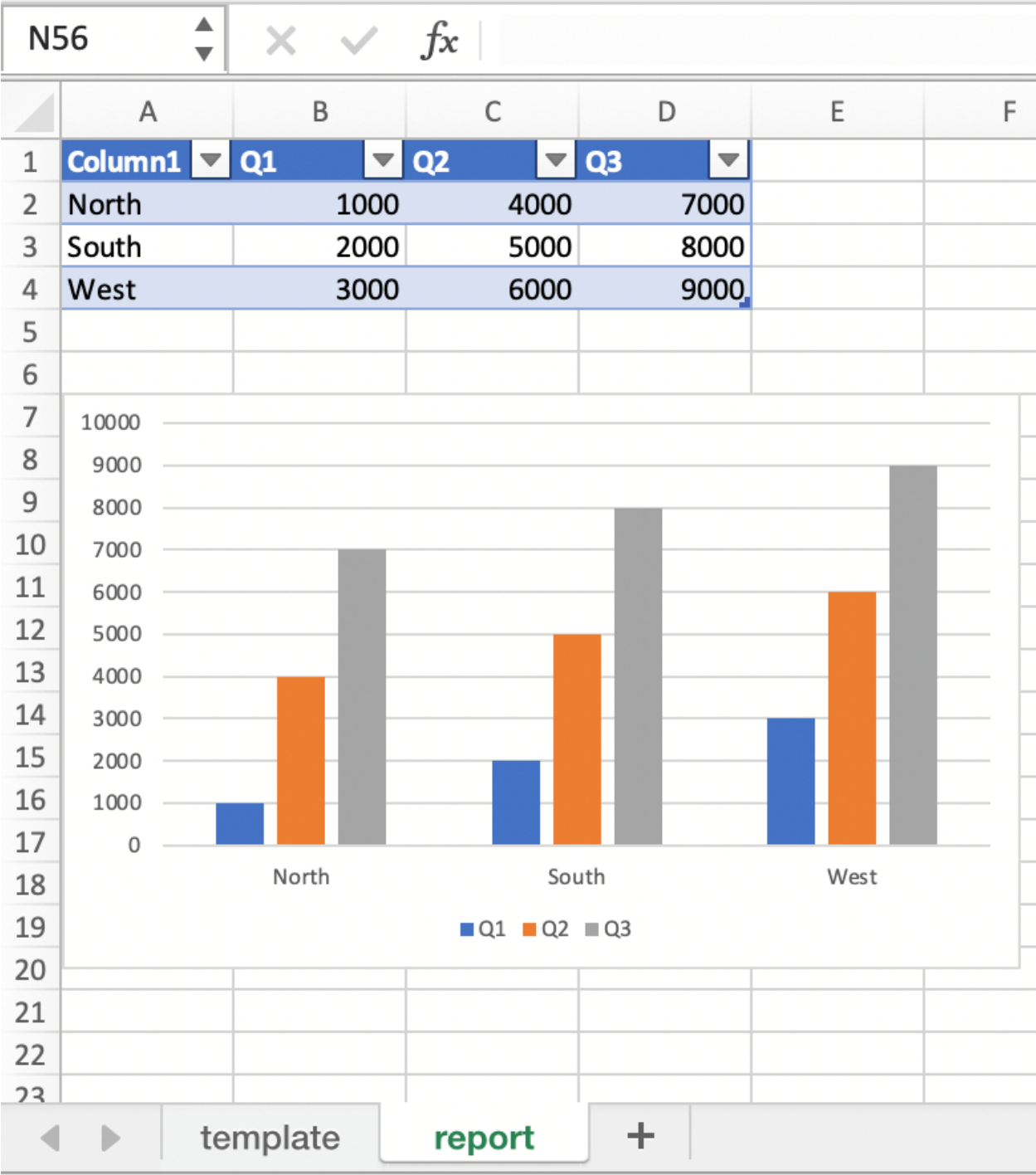
create_report('template.xlsx', 'output.xlsx', temperature=12.3)
```

This code turns this template:

into this report:







	A	B	C	D	E	F	G
1							
2							
3							
4							
5							
6							
7							

The temperature today is {{ temperature }} degrees celsius.

	A	B	C	D	E	F	G
1							
2							
3							
4							
5							
6							
7							

The temperature today is 12.3 degrees celsius.

While this works for simple text, you will lose the formatting if you have any. To prevent that, use a Markdown object, see below.

13.6 Markdown

New in version 0.23.0.

You can format text in cells or shapes via Markdown syntax:

```
from xlwings.pro import Markdown, MarkdownStyle

mytext = """\
# Title

Text bold and italic

* A first bullet
* A second bullet

# Another Title

This paragraph has a line break.
Another line.
"""

# The first sheet requires a shape as shown on the screenshot
sheet = xw.Book("MyTemplate.xlsx").sheets[0]
sheet.render_template(myplaceholder=Markdown(mytext, style))
```


This will render this template with the placeholder in a cell and a shape:

	A	B	C	D	E	F
	{{ myplaceholder }}	<div> {{ myplaceholder }} </div>				
1						
2						
3						

Like this (this uses the default formatting):

	A	B	C	D	E	F
	Title Text bold and <i>italic</i> <ul style="list-style-type: none"> • A first bullet • A second bullet Another Title This paragraph has a line break. Another line.	<div> Title Text bold and <i>italic</i> <ul style="list-style-type: none"> • A first bullet • A second bullet Another Title This paragraph has a line break. Another line. </div>				
1						
2						

For more on Markdown, especially how to change the styling, see [Markdown Formatting](#).

CHAPTER 14

Markdown Formatting

This feature requires xlwings *PRO*.

New in version 0.23.0.

Markdown offers an easy and intuitive way of styling text components in your cells and shapes. For an introduction to Markdown, see e.g., [Mastering Markdown](#).

Markdown support is in an early stage and currently only supports:

- First-level headings
- Bold (i.e., strong)
- Italic (i.e., emphasis)
- Unordered lists

It doesn't support nested objects yet such as 2nd-level headings, bold/italic within bullet points or nested bullet points.

Let's go through an example to see how everything works!

```
from xlwings.pro import Markdown, MarkdownStyle

mytext = """\
# Title

Text bold and italic

* A first bullet
* A second bullet

# Another Title
```

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```

This paragraph has a line break.
Another line.
"""

sheet = xw.Book("Book1.xlsx").sheets[0]

# Range
sheet['A1'].clear()
sheet['A1'].value = Markdown(mytext)

# Shape: The following expects a shape like a Rectangle on the sheet
sheet.shapes[0].text = ""
sheet.shapes[0].text = Markdown(mytext)

```

Running this code will give you this nicely formatted text:

	A	B	C	D	E	F
	Title	<div> Title Text bold and <i>italic</i> <ul style="list-style-type: none"> • A first bullet • A second bullet Another Title This paragraph has a line break. Another line. </div>				
	Text bold and <i>italic</i>					
	<ul style="list-style-type: none"> • A first bullet • A second bullet 					
	Another Title					
	This paragraph has a line break. Another line.					
1	Another line.					
2						

But why not make things a tad more stylish? By providing a `MarkdownStyle` object, you can define your style. Let's change the previous example like this:

```

from xlwings.pro import Markdown, MarkdownStyle

mytext = """\
# Title

Text bold and italic

* A first bullet
* A second bullet

# Another Title

This paragraph has a line break.
Another line.
"""

```

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```

sheet = xw.Book("Book1.xlsx").sheets[0]

# Styling
style = MarkdownStyle()
style.h1.font.color = (255, 0, 0)
style.h1.font.size = 14
style.h1.font.name = 'Comic Sans MS' # No, that's not a font recommendation..
style.h1.blank_lines_after = 0
style.unordered_list.bullet_character = '\N{heavy black heart}' # Emojis are fun!

# Range
sheet['A1'].clear()
sheet['A1'].value = Markdown(mytext, style) # <= provide your style object here

# Shape: The following expects a shape like a Rectangle on the sheet
sheet.shapes[0].text = ""
sheet.shapes[0].text = Markdown(mytext, style)

```

Here is the output of this:

	A	B	C	D	E	F
	Title Text bold and <i>italic</i> ♥ A first bullet ♥ A second bullet Another Title This paragraph has a line break. 1 Another line. 2	Title Text bold and <i>italic</i> ♥ A first bullet ♥ A second bullet Another Title This paragraph has a line break. Another line.				

You can override all properties, i.e., you can change the emphasis from italic to a red font or anything else you want:

Markdown objects can also be used with template-based reporting, see [xlwings Reports](#).

Note: macOS currently doesn't support the formatting (bold, italic, color etc.) of Markdown text due to a bug with AppleScript/Excel. The text will be rendered correctly though, including bullet points.

See also the API reference:

- [Markdown class](#)

- *MarkdownStyle class*

15.1 Zip files

New in version 0.15.2.

To make it easier to distribute, you can zip up your Python code into a zip file. If you use UDFs, this will disable the automatic code reload, so this is a feature meant for distribution, not development. In practice, this means that when your code is inside a zip file, you'll have to click on re-import to get any changes.

If you name your zip file like your Excel file (but with `.zip` extension) and place it in the same folder as your Excel workbook, xlwings will automatically find it (similar to how it works with a single python file).

If you want to use a different directory, make sure to add it to the `PYTHONPATH` in your config (Ribbon or config file):

```
PYTHONPATH, "C:\path\to\myproject.zip"
```

15.2 RunFrozenPython

Changed in version 0.15.2.

You can use a freezer like PyInstaller, cx_Freeze, py2exe etc. to freeze your Python module into an executable so that the recipient doesn't have to install a full Python distribution.

Note:

- This does not work with UDFs.
- Currently only available on Windows, but support for Mac should be easy to add.

- You need at least 0.15.2 to support arguments whereas the syntax changed in 0.15.6

Use it as follows:

```
Sub MySample()  
    RunFrozenPython "C:\path\to\dist\myproject\myproject.exe", "arg1 arg2"  
End Sub
```

15.3 Embedded Code

This feature requires xlwings *PRO*.

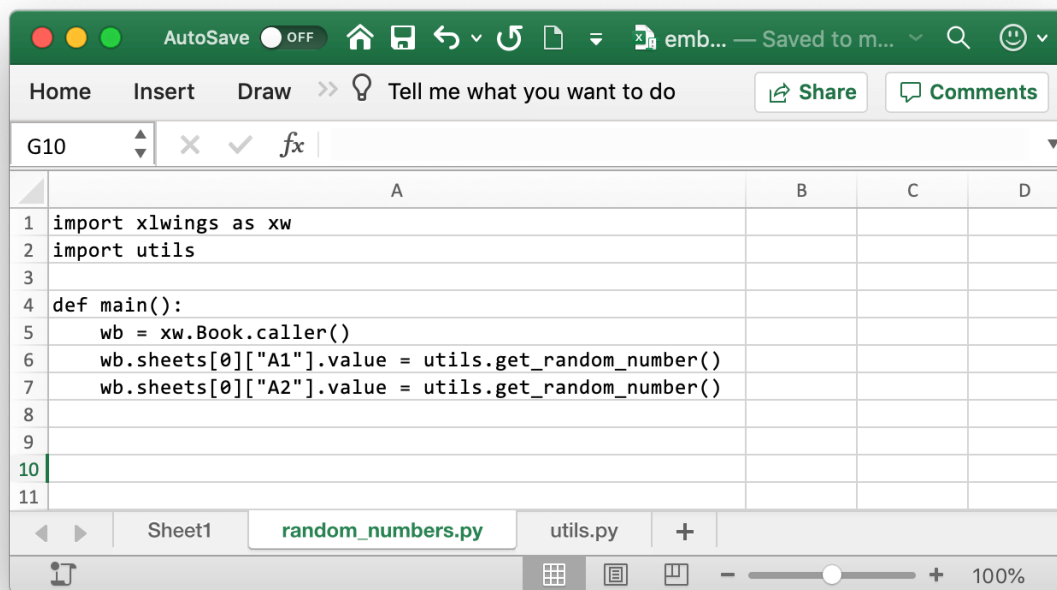
xlwings PRO allows you to store your Python code directly in Excel so you don't have to distribute separate Python files.

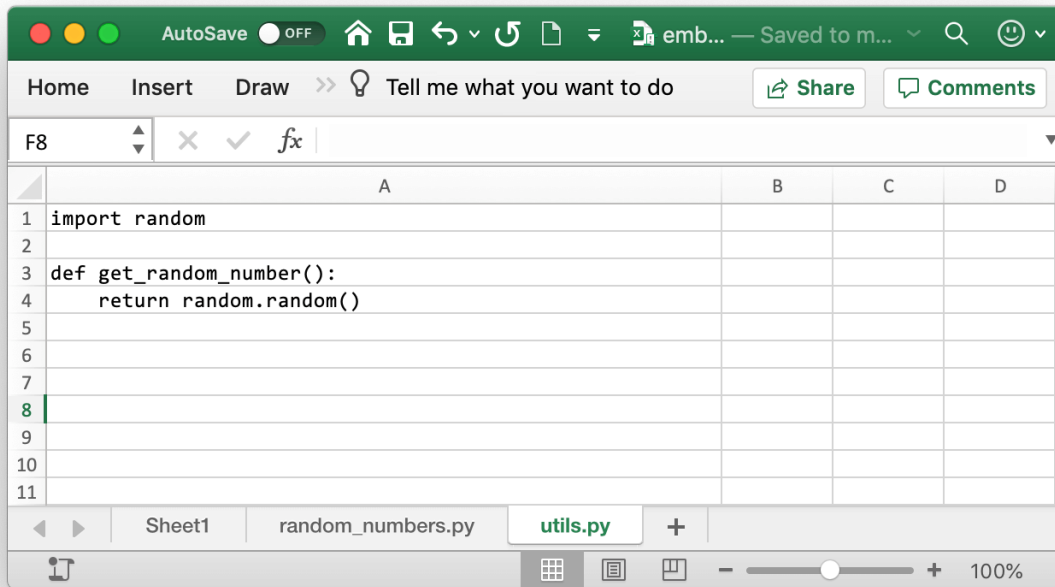
On a command line, run the following command which will import all Python files from the current directory and paste them into sheets with the same name of the currently active workbook:

```
$ xlwings code embed
```

Then, use the VBA function `RunPython ("import mymodule;mymodule.myfunction()")` as usual.

Note that you can have multiple Excel sheets and import them like normal Python files. Consider this example:





You can call this function from VBA like so:

```
Sub RandomNumbers()
    RunPython ("import random_numbers;random_numbers.main()")
End Sub
```

Note: UDFs modules don't have to be added to the UDF Modules explicitly when using embedded code. However, in contrast to how it works with external files, you currently need to re-import the functions when you change them.

Note: While you can hide your sheets with your code, they will be written to a temporary directory in clear text.

15.4 One-Click Zero-Config Installer

This feature requires xlwings *PRO*.

With xlwings PRO you get access to a private GitHub repository that will build your custom installer in the cloud — no local installation required. Using a custom installer to deploy the Python runtime has the following advantages:

- Zero Python knowledge required from end users
- Zero configuration required by end users
- No admin rights required
- Works for both UDFs and RunPython
- Works for external distribution
- Easy to deploy updates

15.4.1 End User Instructions

- **Installing**

Give the end user your Excel workbook and the installer. The user only has to double-click the installer and confirm a few prompts — no configuration is required.

- **Updating**

If you use the embedded code feature (see: *Embedded Code*), you can deploy updates by simply giving the user a new Excel file. Only when you change a dependency, you will need to create a new installer.

- **Uninstalling**

The application can be uninstalled again via Windows Settings > Apps & Features.

15.4.2 Build the Installer

Before you can build the installer, the project needs to be configured correctly, see below.

In the GitHub repo, go to `x releases > Draft/Create a new release`. Add a version like `1.0.0` to `Tag version`, then hit `Publish release`.

Wait a few minutes and refresh the page: the installer will appear under the release from where you can download it. You can follow the progress under the `Actions` tab.

15.4.3 Configuration

Excel file

You can add your Excel file to the repository if you like but it's not a requirement. Configure the Excel file as follows:

- Add the standalone xlwings VBA module, e.g. via `xlwings quickstart project --standalone`
- Make sure that in the VBA editor (`Alt-F11`) under `Tools > References` xlwings is unchecked
- Rename the `_xlwings.conf` sheet into `xlwings.conf`

- In the `xlwings.conf` sheet, as Interpreter, set the following value:
`%LOCALAPPDATA%\project` while replacing `project` with the name of your project
- If you like, you can hide the `xlwings.conf` sheet

Source code

Source code can either be embedded in the Excel file (see [Embedded Code](#)) or added to the `src` directory. The first option requires `xlwings-pro` in `requirements.txt`, the second option will also work with `xlwings`.

Dependencies

Add your dependencies to `requirements.txt`. For example:

```
xlwings==0.18.0
numpy==1.18.2
```

Code signing (optional)

Using a code sign certificate will show a verified publisher in the installation prompt. Without it, it will show an unverified publisher.

- Store your code sign certificate as `sign_cert_file` in the root of this repository (make sure your repo is private).
- Go to Settings > Secrets and add the password as `code_sign_password`.

Project details

Update the following under `.github/main.yml`:

```
PROJECT:
APP_PUBLISHER:
```

Python version

Set your Python version under `.github/main.yml`:

```
python-version: '3.7'
architecture: 'x64'
```

15.5 Deployment Key

This feature requires `xlwings PRO`.

If you have an `xlwings PRO` developer license, you can generate a deployment key. A deployment key allows you to send an `xlwings PRO` tool to an end user without them requiring a paid license. A deployment key is also perpetual, i.e. doesn't expire like a developer license.

In return, a deployment key only works with the version of `xlwings` that was used to generate the deployment key. A developer can generate new deployment keys for new versions of `xlwings` as long as they have an active `xlwings PRO` subscription.

Note: You need a paid developer license to generate a deployment key. A trial license won't work.

To create a deployment key, run the following command:

```
xlwings license deploy
```

Then paste the generated key into the xlwings config as `LICENSE_KEY`. For deployment purposes, usually the best place to do that is on a sheet called `xlwings.conf`, but you can also use an `xlwings.conf` file in either the same folder or in the `.xlwings` folder within the user's home folder. To use an environment variable, use `XLWINGS_LICENSE_KEY`. See also *User Settings*.

16.1 Issue: dll not found

Solution:

- 1) `xlwings32-<version>.dll` and `xlwings64-<version>.dll` are both in the same directory as your `python.exe`. If not, something went wrong with your installation. Reinstall it with `pip` or `conda`, see *Installation*.
- 2) Check your Interpreter in the add-in or config sheet. If it is empty, then you need to be able to open a windows command prompt and type `python` to start an interactive Python session. If you get the error '`python`' is not recognized as an internal or external command, operable program or batch file., then you have two options: Either add the path of where your `python.exe` lives to your Windows path (see <https://www.computerhope.com/issues/ch000549.htm>) or set the full path to your interpreter in the add-in or your config sheet, e.g. `C:\Users\MyUser\anaconda\pythonw.exe`

16.2 Issue: Couldn't find the local location of your OneDrive

Solution:

On either the `xlwings.conf` sheet or on the `xlwings.conf` file under your home folder (for location see *User Config: Ribbon/Config File*), add the following setting:

```
"ONEDRIVE", "C:\path\to\OneDrive"
```

Note: Don't use quotes on the `xlwings.conf` sheet.

The purpose of xlwings PRO is to finance the continued maintenance and enhancement of xlwings. This will allow you to rely on the package without being left with the dreaded “[this library currently has no active maintainers](#)” message that happens to too many open-source packages after a couple of years.

xlwings PRO offers access to additional functionality. All PRO features are marked with xlwings *PRO* in the docs.

Note: To get access to the additional functionality of xlwings PRO, you need a license key and at least xlwings v0.19.0. Everything under the `xlwings.pro` subpackage is distributed under a commercial license.

17.1 PRO Features

- *Table.update()*: An easy way to keep an Excel table in sync with a pandas DataFrame
- *Embedded Code*: Store your Python source code directly in Excel for easy deployment.
- *xlwings Reports*: A template based reporting mechanism, allows business users to change the layout of the report without having to change Python code.
- *Plotly static charts*: Support for Plotly static charts.
- *One-Click Zero-Config Installer*: Guarantees that the end user does not need to know anything about Python.

17.2 More Infos

- Pricing: <https://www.xlwings.org/pricing>
- Trial license key: <https://www.xlwings.org/trial>

CHAPTER 18

Converters and Options

Introduced with v0.7.0, converters define how Excel ranges and their values are converted both during **reading** and **writing** operations. They also provide a consistent experience across **xlwings.Range** objects and **User Defined Functions** (UDFs).

Converters are explicitly set in the `options` method when manipulating Range objects or in the `@xw.arg` and `@xw.ret` decorators when using UDFs. If no converter is specified, the default converter is applied when reading. When writing, xlwings will automatically apply the correct converter (if available) according to the object's type that is being written to Excel. If no converter is found for that type, it falls back to the default converter.

All code samples below depend on the following import:

```
>>> import xlwings as xw
```

Syntax:

	xw.Range	UDFs
read- ing	<code>xw.Range.options(convert=None, **kwargs).value</code>	<code>@arg('x', convert=None, **kwargs)</code>
writ- ing	<code>xw.Range.options(convert=None, **kwargs).value = myvalue</code>	<code>@ret(convert=None, **kwargs)</code>

Note: Keyword arguments (`kwargs`) may refer to the specific converter or the default converter. For example, to set the `numbers` option in the default converter and the `index` option in the DataFrame converter, you would write:

```
xw.Range('A1:C3').options(pd.DataFrame, index=False, numbers=int).value
```

18.1 Default Converter

If no options are set, the following conversions are performed:

- single cells are read in as `floats` in case the Excel cell holds a number, as `unicode` in case it holds text, as `datetime` if it contains a date and as `None` in case it is empty.
- columns/rows are read in as lists, e.g. `[None, 1.0, 'a string']`
- 2d cell ranges are read in as list of lists, e.g. `[[None, 1.0, 'a string'], [None, 2.0, 'another string']]`

The following options can be set:

- **ndim**

Force the value to have either 1 or 2 dimensions regardless of the shape of the range:

```
>>> import xlwings as xw
>>> sht = xw.Book().sheets[0]
>>> sht.range('A1').value = [[1, 2], [3, 4]]
>>> sht.range('A1').value
1.0
>>> sht.range('A1').options(ndim=1).value
[1.0]
>>> sht.range('A1').options(ndim=2).value
[[1.0]]
>>> sht.range('A1:A2').value
[1.0 3.0]
>>> sht.range('A1:A2').options(ndim=2).value
[[1.0], [3.0]]
```

- **numbers**

By default cells with numbers are read as `float`, but you can change it to `int`:

```
>>> sht.range('A1').value = 1
>>> sht.range('A1').value
1.0
>>> sht.range('A1').options(numbers=int).value
1
```

Alternatively, you can specify any other function or type which takes a single float argument.

Using this on UDFs looks like this:

```
@xw.func
@xw.arg('x', numbers=int)
def myfunction(x):
```

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```
# all numbers in x arrive as int
return x
```

Note: Excel always stores numbers internally as floats, which is the reason why the *int* converter rounds numbers first before turning them into integers. Otherwise it could happen that e.g. 5 might be returned as 4 in case it is represented as a floating point number that is slightly smaller than 5. Should you require Python's original *int* in your converter, use *raw int* instead.

- **dates**

By default cells with dates are read as `datetime.datetime`, but you can change it to `datetime.date`:

- Range:

```
>>> import datetime as dt
>>> sht.range('A1').options(dates=dt.date).value
```

- UDFs: `@xw.arg('x', dates=dt.date)`

Alternatively, you can specify any other function or type which takes the same keyword arguments as `datetime.datetime`, for example:

```
>>> my_date_handler = lambda year, month, day, **kwargs: "%04i-%02i-%02i" % (year, month, day)
>>> sht.range('A1').options(dates=my_date_handler).value
'2017-02-20'
```

- **empty**

Empty cells are converted per default into `None`, you can change this as follows:

- Range: `>>> sht.range('A1').options(empty='NA').value`
- UDFs: `@xw.arg('x', empty='NA')`

- **transpose**

This works for reading and writing and allows us to e.g. write a list in column orientation to Excel:

- Range: `sht.range('A1').options(transpose=True).value = [1, 2, 3]`
- UDFs:

```
@xw.arg('x', transpose=True)
@xw.ret(transpose=True)
def myfunction(x):
    # x will be returned unchanged as transposed both when reading
    and writing
    return x
```

- **expand**

This works the same as the Range properties table, vertical and horizontal but is only evaluated when getting the values of a Range:

```
>>> import xlwings as xw
>>> sht = xw.Book().sheets[0]
>>> sht.range('A1').value = [[1,2], [3,4]]
>>> rng1 = sht.range('A1').expand()
>>> rng2 = sht.range('A1').options(expand='table')
>>> rng1.value
[[1.0, 2.0], [3.0, 4.0]]
>>> rng2.value
[[1.0, 2.0], [3.0, 4.0]]
>>> sht.range('A3').value = [5, 6]
>>> rng1.value
[[1.0, 2.0], [3.0, 4.0]]
>>> rng2.value
[[1.0, 2.0], [3.0, 4.0], [5.0, 6.0]]
```

Note: The `expand` method is only available on `Range` objects as UDFs only allow to manipulate the calling cells.

18.2 Built-in Converters

xlwings offers several built-in converters that perform type conversion to **dictionaries**, **NumPy arrays**, **Pandas Series** and **DataFrames**. These build on top of the default converter, so in most cases the options described above can be used in this context, too (unless they are meaningless, for example the `ndim` in the case of a dictionary).

It is also possible to write and register a custom converter for additional types, see below.

The samples below can be used with both `xlwings.Range` objects and UDFs even though only one version may be shown.

18.2.1 Dictionary converter

The dictionary converter turns two Excel columns into a dictionary. If the data is in row orientation, use `transpose`:

	A	B
1	a	1
2	b	2
3		
4	a	b
5	1	2

```
>>> sht = xw.sheets.active
>>> sht.range('A1:B2').options(dict).value
{'a': 1.0, 'b': 2.0}
>>> sht.range('A4:B5').options(dict, transpose=True).value
{'a': 1.0, 'b': 2.0}
```

Note: instead of `dict`, you can also use `OrderedDict` from `collections`.

18.2.2 Numpy array converter

options: `dtype=None`, `copy=True`, `order=None`, `ndim=None`

The first 3 options behave the same as when using `np.array()` directly. Also, `ndim` works the same as shown above for lists (under default converter) and hence returns either numpy scalars, 1d arrays or 2d arrays.

Example:

```
>>> import numpy as np
>>> sht = xw.Book().sheets[0]
>>> sht.range('A1').options(transpose=True).value = np.array([1, 2, 3])
>>> sht.range('A1:A3').options(np.array, ndim=2).value
array([[ 1.],
       [ 2.],
       [ 3.]])
```

18.2.3 Pandas Series converter

options: `dtype=None`, `copy=False`, `index=1`, `header=True`

The first 2 options behave the same as when using `pd.Series()` directly. `ndim` doesn't have an effect on Pandas series as they are always expected and returned in column orientation.

index: `int` or `Boolean`

When reading, it expects the number of index columns shown in Excel.

When writing, include or exclude the index by setting it to `True` or `False`.

header: `Boolean`

When reading, set it to `False` if Excel doesn't show either index or series names.

When writing, include or exclude the index and series names by setting it to `True` or `False`.

For `index` and `header`, `1` and `True` may be used interchangeably.

Example:

```
>>> sht = xw.Book().sheets[0]
>>> s = sht.range('A1').options(pd.Series, expand='table').value
>>> s
date
```

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	A	B	C	D	E
1	date	series name		01/01/01	1
2	01/01/01	1		02/01/01	2
3	02/01/01	2		03/01/01	3
4	03/01/01	3		04/01/01	4
5	04/01/01	4		05/01/01	5
6	05/01/01	5		06/01/01	6
7	06/01/01	6			

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```
2001-01-01    1
2001-01-02    2
2001-01-03    3
2001-01-04    4
2001-01-05    5
2001-01-06    6
Name: series name, dtype: float64
>>> sht.range('D1', header=False).value = s
```

18.2.4 Pandas DataFrame converter

options: dtype=None, copy=False, index=1, header=1

The first 2 options behave the same as when using `pd.DataFrame()` directly. `ndim` doesn't have an effect on Pandas DataFrames as they are automatically read in with `ndim=2`.

index: int or Boolean

When reading, it expects the number of index columns shown in Excel.

When writing, include or exclude the index by setting it to `True` or `False`.

header: int or Boolean

When reading, it expects the number of column headers shown in Excel.

When writing, include or exclude the index and series names by setting it to `True` or `False`.

For `index` and `header`, 1 and `True` may be used interchangeably.

Example:

```
>>> sht = xw.Book().sheets[0]
>>> df = sht.range('A1:D5').options(pd.DataFrame, header=2).value
>>> df
   a  b
   c  d  e
ix
10  1  2  3
20  4  5  6
```

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B13		fx {=myfunction(A1:D5)}		
	A	B	C	D
1	ix 10 20 30	a	a	b
2		c	d	e
3		1	2	3
4		4	5	6
5		7	8	9
6				
7		a	a	b
8		c	d	e
9		1	2	3
10		4	5	6
11		7	8	9
12				
13		a	a	b
14		c	d	e
15		1	2	3
16		4	5	6
17		7	8	9
18				

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```
30  7  8  9

# Writing back using the defaults:
>>> sht.range('A1').value = df

# Writing back and changing some of the options, e.g. getting rid of the
↳ index:
>>> sht.range('B7').options(index=False).value = df
```

The same sample for UDF (starting in Range ('A13')) on screenshot looks like this:

```
@xw.func
@xw.arg('x', pd.DataFrame, header=2)
@xw.ret(index=False)
def myfunction(x):
    # x is a DataFrame, do something with it
    return x
```

18.2.5 xw.Range and ‘raw’ converters

Technically speaking, these are “no-converters”.

- If you need access to the `xlwings.Range` object directly, you can do:

```
@xw.func
@xw.arg('x', 'range')
def myfunction(x):
    return x.formula
```

This returns `x` as `xlwings.Range` object, i.e. without applying any converters or options.

- The `raw` converter delivers the values unchanged from the underlying libraries (`pywin32` on Windows and `appscript` on Mac), i.e. no sanitizing/cross-platform harmonizing of values are being made. This might be useful in a few cases for efficiency reasons. E.g:

```
>>> sht.range('A1:B2').value
[[1.0, 'text'], [datetime.datetime(2016, 2, 1, 0, 0), None]]

>>> sht.range('A1:B2').options('raw').value # or sht.range('A1:B2').raw_
↳ value
((1.0, 'text'), (pywintypes.datetime(2016, 2, 1, 0, 0,
↳ tzinfo=TimeZoneInfo('GMT Standard Time', True)), None))
```

18.3 Custom Converter

Here are the steps to implement your own converter:

- Inherit from `xlwings.conversion.Converter`

- Implement both a `read_value` and `write_value` method as static- or classmethod:
 - In `read_value`, `value` is what the base converter returns: hence, if no base has been specified it arrives in the format of the default converter.
 - In `write_value`, `value` is the original object being written to Excel. It must be returned in the format that the base converter expects. Again, if no base has been specified, this is the default converter.

The `options` dictionary will contain all keyword arguments specified in the `xw.Range.options` method, e.g. when calling `xw.Range('A1').options(myoption='some value')` or as specified in the `@arg` and `@ret` decorator when using UDFs. Here is the basic structure:

```
from xlwings.conversion import Converter

class MyConverter(Converter):

    @staticmethod
    def read_value(value, options):
        myoption = options.get('myoption', default_value)
        return_value = value # Implement your conversion here
        return return_value

    @staticmethod
    def write_value(value, options):
        myoption = options.get('myoption', default_value)
        return_value = value # Implement your conversion here
        return return_value
```

- Optional: set a base converter (base expects a class name) to build on top of an existing converter, e.g. for the built-in ones: `DictConverter`, `NumpyArrayConverter`, `PandasDataFrameConverter`, `PandasSeriesConverter`
- Optional: register the converter: you can **(a)** register a type so that your converter becomes the default for this type during write operations and/or **(b)** you can register an alias that will allow you to explicitly call your converter by name instead of just by class name

The following examples should make it much easier to follow - it defines a `DataFrame` converter that extends the built-in `DataFrame` converter to add support for dropping nan's:

```
from xlwings.conversion import Converter, PandasDataFrameConverter

class DataFrameDropna(Converter):

    base = PandasDataFrameConverter

    @staticmethod
    def read_value(builtin_df, options):
        dropna = options.get('dropna', False) # set default to False
        if dropna:
            converted_df = builtin_df.dropna()
        else:
            converted_df = builtin_df
```

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```

    # This will arrive in Python when using the DataFrameDropna converter
    ↪for reading
    return converted_df

    @staticmethod
    def write_value(df, options):
        dropna = options.get('dropna', False)
        if dropna:
            converted_df = df.dropna()
        else:
            converted_df = df
        # This will be passed to the built-in PandasDataFrameConverter when
    ↪writing
    return converted_df

```

Now let's see how the different converters can be applied:

```

# Fire up a Workbook and create a sample DataFrame
sht = xw.Book().sheets[0]
df = pd.DataFrame([[1., 10.], [2., np.nan], [3., 30.]])

```

- Default converter for DataFrames:

```

# Write
sht.range('A1').value = df

# Read
sht.range('A1:C4').options(pd.DataFrame).value

```

- DataFrameDropna converter:

```

# Write
sht.range('A7').options(DataFrameDropna, dropna=True).value = df

# Read
sht.range('A1:C4').options(DataFrameDropna, dropna=True).value

```

- Register an alias (optional):

```

DataFrameDropna.register('df_dropna')

# Write
sht.range('A12').options('df_dropna', dropna=True).value = df

# Read
sht.range('A1:C4').options('df_dropna', dropna=True).value

```

- Register DataFrameDropna as default converter for DataFrames (optional):

```

DataFrameDropna.register(pd.DataFrame)

```

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```
# Write
sht.range('A13').options(dropna=True).value = df

# Read
sht.range('A1:C4').options(pd.DataFrame, dropna=True).value
```

These samples all work the same with UDFs, e.g.:

```
@xw.func
@arg('x', DataFrameDropna, dropna=True)
@ret(DataFrameDropna, dropna=True)
def myfunction(x):
    # ...
    return x
```

Note: Python objects run through multiple stages of a transformation pipeline when they are being written to Excel. The same holds true in the other direction, when Excel/COM objects are being read into Python.

Pipelines are internally defined by `Accessor` classes. A `Converter` is just a special `Accessor` which converts to/from a particular type by adding an extra stage to the pipeline of the default `Accessor`. For example, the `PandasDataFrameConverter` defines how a list of lists (as delivered by the default `Accessor`) should be turned into a `Pandas DataFrame`.

The `Converter` class provides basic scaffolding to make the task of writing a new `Converter` easier. If you need more control you can subclass `Accessor` directly, but this part requires more work and is currently undocumented.

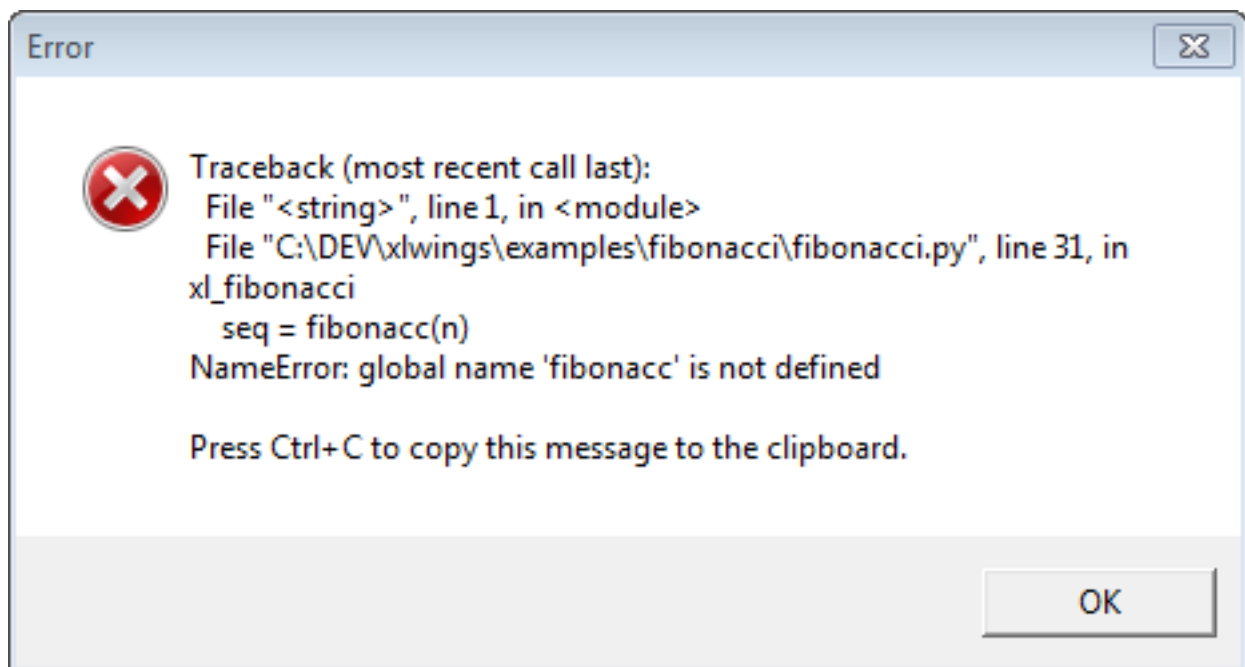
CHAPTER 19

Debugging

Since xlwings runs in every Python environment, you can use your preferred way of debugging.

- **RunPython:** When calling Python through `RunPython`, you can set a `mock_caller` to make it easy to switch back and forth between calling the function from Excel and Python.
- **UDFs:** For debugging User Defined Functions, xlwings offers a convenient debugging server

To begin with, Excel will show Python errors in a Message Box:



Note: On Mac, if the `import` of a module/package fails before `xlwings` is imported, the popup will

not be shown and the StatusBar will not be reset. However, the error will still be logged in the log file (`/Users/<User>/Library/Containers/com.microsoft.Excel/Data/xlwings.log`).

19.1 RunPython

Consider the following sample code of your Python source code `my_module.py`:

```
# my_module.py
import os
import xlwings as xw

def my_macro():
    wb = xw.Book.caller()
    wb.sheets[0].range('A1').value = 1

if __name__ == '__main__':
    # Expects the Excel file next to this source file, adjust accordingly.
    xw.Book('myfile.xlsm').set_mock_caller()
    my_macro()
```

`my_macro()` can now easily be run from Python for debugging and from Excel via RunPython without having to change the source code:

```
Sub my_macro()
    RunPython "import my_module; my_module.my_macro()"
End Sub
```

19.2 UDF debug server

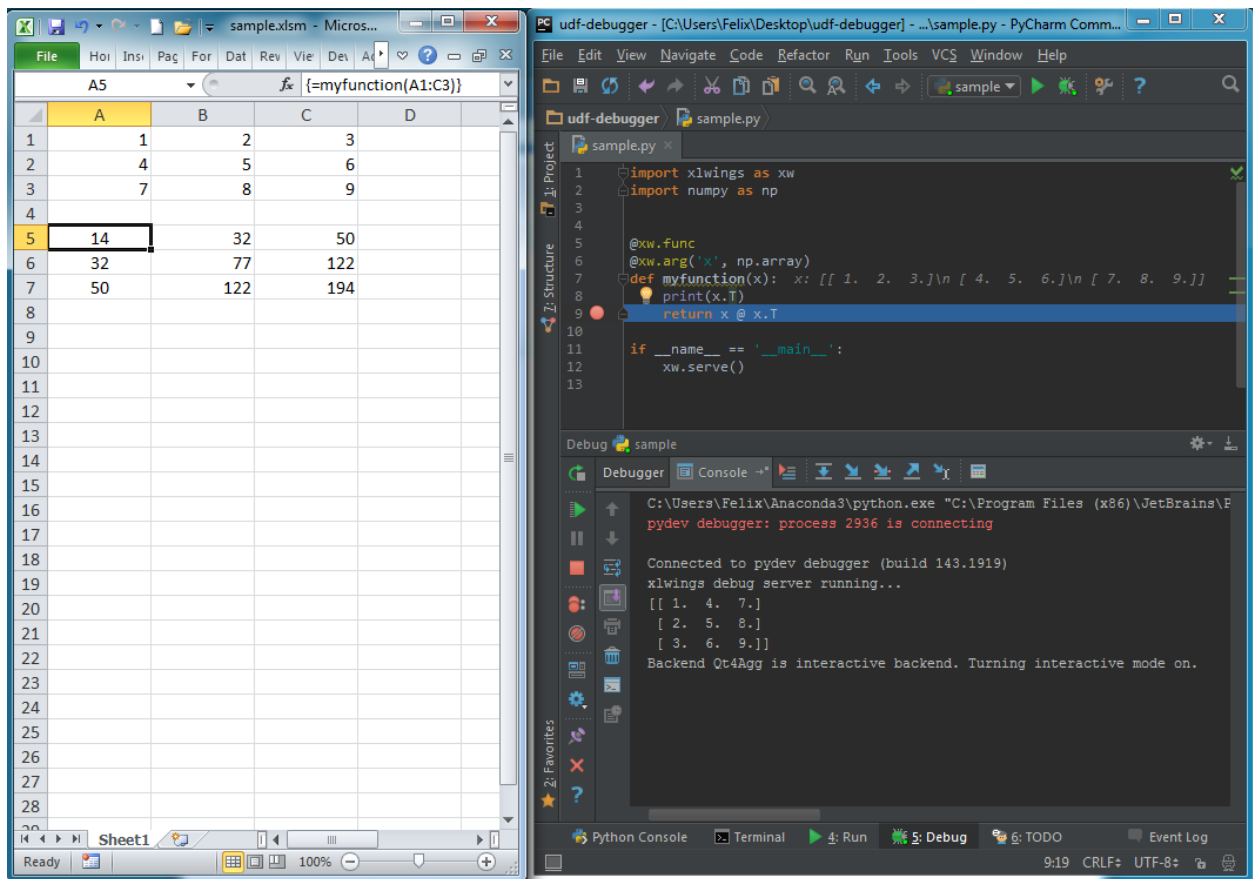
Windows only: To debug UDFs, just check the Debug UDFs in the *Add-in & Settings*, at the top of the xlwings VBA module. Then add the following lines at the end of your Python source file and run it. Depending on which IDE you use, you might need to run the code in “debug” mode (e.g. in case you’re using PyCharm or PyDev):

```
if __name__ == '__main__':
    xw.serve()
```

When you recalculate the Sheet (Ctrl-Alt-F9), the code will stop at breakpoints or output any print calls that you may have.

The following screenshot shows the code stopped at a breakpoint in the community version of PyCharm:

Note: When running the debug server from a command prompt, there is currently no gracious way to terminate it, but closing the command prompt will kill it.



It's easy to extend the xlwings add-in with own code like UDFs or RunPython macros, so that they can be deployed without end users having to import or write the functions themselves. Just add another VBA module to the xlwings addin with the respective code.

UDF extensions can be used from every workbook without having to set a reference.

20.1 In-Excel SQL

The xlwings addin comes with a built-in extension that adds in-Excel SQL syntax (sqlite dialect):

```
=sql(SQL Statement, table a, table b, ...)
```

As this extension uses UDFs, it's only available on Windows right now.

A16					=sql(A14,A1:D11,G1:H8)				
	A	B	C	D	E	F	G	H	
1	id	first_name	last_name	age			id	email	
2	1	Mariam	Alt	12			1	Mariam@Alt	
3	2	Shenita	Truelove	55			2	Shenita@Truelove	
4	3	Evelyn	Braddy	30			3	Evelyn@Braddy	
5	4	Shery	Sam	35			5	Rogello@Mote	
6	5	Rogello	Mote	88			6	Solomon@Okamura	
7	6	Solomon	Okamura	33			8	Latashia@Alire	
8	7	Jessica	Buelow	10			9	Roselee@Tarwater	
9	8	Latashia	Alire	19					
10	9	Roselee	Tarwater	28					
11	10	Kiera	Saulsbury	55					
12									
13									
14	SELECT a.id, a.first_name, a.last_name, b.email FROM a INNER JOIN b ON a.id = b.id								
15									
16	id	first_name	last_name	email					
17	1	Mariam	Alt	Mariam@Alt					
18	2	Shenita	Truelove	Shenita@Truelove					
19	3	Evelyn	Braddy	Evelyn@Braddy					
20	5	Rogello	Mote	Rogello@Mote					
21	6	Solomon	Okamura	Solomon@Okamura					
22	8	Latashia	Alire	Latashia@Alire					
23	9	Roselee	Tarwater	Roselee@Tarwater					

CHAPTER 21

Custom Add-ins

New in version 0.22.0.

Custom add-ins work on Windows and macOS and are white-labeled xlwings add-ins that include all your `RunPython` functions and UDFs (as usual, UDFs work on Windows only). You can build add-ins with and without an Excel ribbon.

The useful thing about add-in is that UDFs and `RunPython` calls will be available in all workbooks right out of the box without having to add any references via the VBA editor's `Tools > References...` You can also work with standard `xlsx` files rather than `xlsm` files. This tutorial assumes you're familiar with how xlwings and its configuration works.

21.1 Quickstart

Start by running the following command on a command line (to create an add-in without a ribbon, you would leave away the `--ribbon` flag):

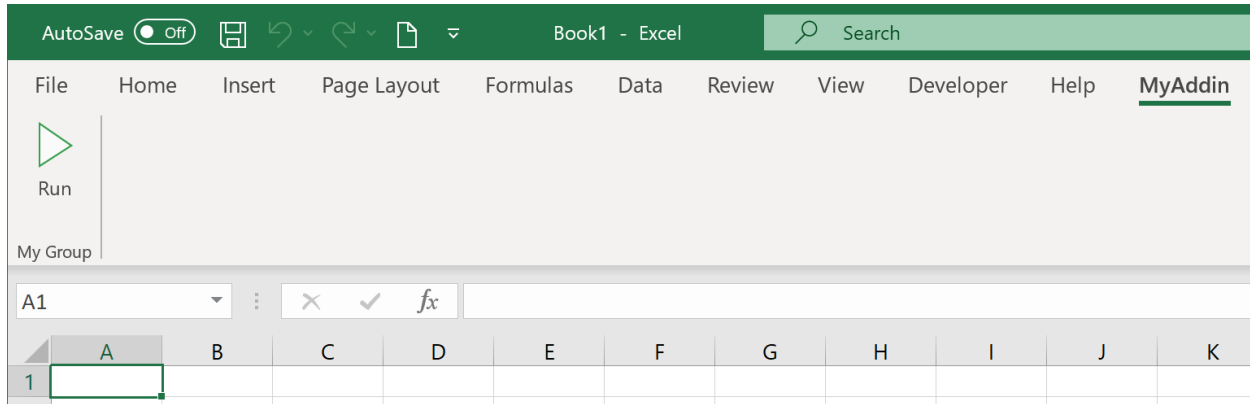
```
$ xlwings quickstart myproject --addin --ribbon
```

This will create the familiar quickstart folder with a Python file and an Excel file, but this time, the Excel file is in the `xlam` format.

- Double-click the Excel add-in to open it in Excel
- Add a new empty workbook (`Ctrl+N` on Windows or `Command+N` on macOS)

You should see a new ribbon tab called `MyAddin` like this:

The add-in and VBA project are currently always called `myaddin`, no matter what name you chose in the quickstart command. We'll see towards the end of this tutorial how we can change that, but for now we'll stick with it.



Compared to the xlwings add-in, the custom add-in offers an additional level of configuration: the configuration sheet of the add-in itself which is the easiest way to configure simple add-ins with a static configuration.

Let's open the VBA editor by clicking on `Alt+F11` (Windows) or `Option+F11` (macOS). In our project, select `ThisWorkbook`, then change the `Property IsAddin` from `True` to `False`, see the following screenshot:

This will make the sheet `_myaddin.conf` visible (again, we'll see how to change the name of `myaddin` at the end of this tutorial):

- Activate the sheet `config` by renaming it from `_myaddin.conf` to `myaddin.conf`
- Set your `Interpreter_Win/_Mac` or `Conda` settings (you may want to take them over from the xlwings settings for now)

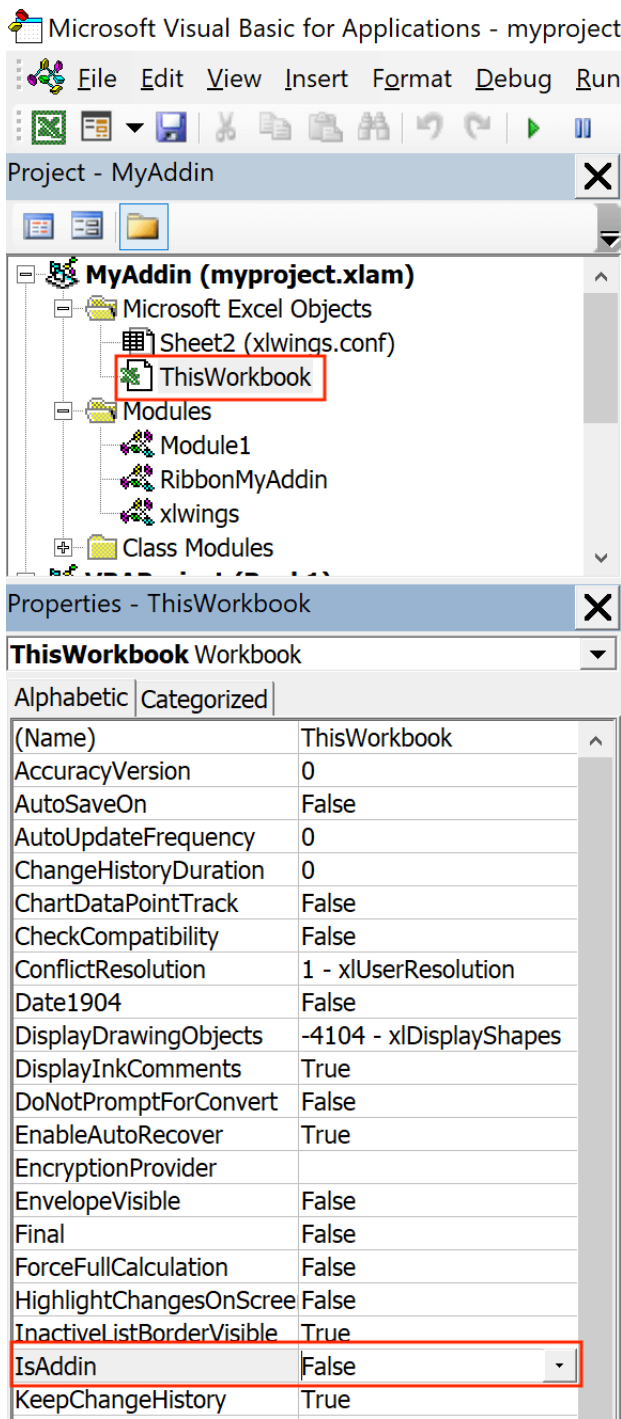
Once done, switch back to the VBA editor, select `ThisWorkbook` again, and change `IsAddin` back to `True` before you save your add-in from the VBA editor. Switch back to Excel and click the `Run` button under the `My Addin` ribbon tab and if you've configured the Python interpreter correctly, it will print `Hello xlwings!` into cell `A1` of the active workbook.

21.2 Changing the Ribbon menu

To change the buttons and items in the ribbon menu or the Backstage View, download and install the [Office RibbonX Editor](#). While it is only available for Windows, the created ribbons will also work on macOS. Open your add-in with it so you can change the XML code that defines your buttons etc. You will find a good tutorial [here](#). The callback function for the demo `Run` button is in the `RibbonMyAddin` VBA module that you'll find in the VBA editor.

21.3 Importing UDFs

To import your UDFs into the custom add-in, run the `ImportPythonUDFsToAddin` Sub towards the end of the `xlwings` module (click into the Sub and hit `F5`). Remember, you only have to do this whenever you change the function name, argument or decorator, so your end users won't have to deal with this.



If you are only deploying UDFs via your add-in, you probably don't need a Ribbon menu and can leave away the `--ribbon` flag in the `quickstart` command.

21.4 Configuration

As mentioned before, configuration works the same as with `xlwings`, so you could have your users override the default configuration we did above by adding a `myaddin.conf` sheet on their workbook or you could use the `myaddin.conf` file in the user's home directory. For details see [Add-in & Settings](#).

21.5 Installation

If you want to permanently install your add-in, you can do so by using the `xlwings` CLI:

```
$ xlwings addin install --file C:\path\to\your\myproject.xlam
```

This, however, means that you will need to adjust the `PYTHONPATH` for it to find your Python code (or move your Python code to somewhere where Python looks for it—more about that below under deployment). The command will copy your add-in to the `XLSTART` folder, a special folder from where Excel will open all files everytime you start it.

21.6 Renaming your add-in

Admittedly, this part is a bit cumbersome for now. Let's assume, we would like to rename the addin from `MyAddin` to `Demo`:

- In the `xlwings` VBA module, change `Public Const PROJECT_NAME As String = "myaddin"` to `Public Const PROJECT_NAME As String = "demo"`. You'll find this line at the top, right after the `Declare` statements.
- If you rely on the `myaddin.conf` sheet for your configuration, rename it to `demo.conf`
- Right-click the VBA project, select `MyAddin Properties...` and rename the `Project Name` from `MyAddin` to `Demo`.
- If you use the ribbon, you want to rename the `RibbonMyAddin` VBA module to `RibbonDemo`. To do this, select the module in the VBA editor, then rename it in the `Properties` window. If you don't see the `Properties` window, hit `F4`.
- Open the add-in in the Office RibbonX Editor (see above) and replace all occurrences of `MyAddin` with `Demo` in the XML code.

And finally, you may want to rename your `myproject.xlam` file in the Windows explorer, but I assume you have already run the `quickstart` command with the correct name, so this won't be necessary.

21.7 Deployment

By far the easiest way to deploy your add-in to your end-users is to build an installer via the xlwings PRO offering. This will take care of everything and your end users literally just need to double-click the installer and they are all set (no existing Python installation required and no manual installation of the add-in or adjusting of settings required).

If you want it the free (but hard) way, you either need to build an installer yourself or you need your users to install Python and the add-in and take care of placing the Python code in the correct directory. This normally involves tweaking the following settings, for example in the `myaddin.conf` sheet:

- `Interpreter_Win/_Mac`: if your end-users have a working version of Python, you can use environment variables to dynamically resolve to the correct path. For example, if they have Anaconda installed in the default location, you could use the following configuration:

```
Conda Path: %USERPROFILE%\anaconda3
Conda Env: base
Interpreter_Mac: $HOME/opt/anaconda3/bin/python
```

- `PYTHONPATH`: since you can't have your Python source code in the `XLSTART` folder next to the add-in, you'll need to adjust the `PYTHONPATH` setting and add the folder to where the Python code will be. You could point this to a shared drive or again make use of environment variables so the users can place the file into a folder called `MyAddin` in their home directory, for example. However, you can also place your Python code where Python looks for it, for example by placing them in the `site-packages` directory of the Python distribution—an easy way to achieve this is to build a Python package that you can install via `pip`.

Threading and Multiprocessing

New in version 0.13.0.

22.1 Threading

While xlwings is not technically thread safe, it's still easy to use it in threads as long as you have at least v0.13.0 and stick to a simple rule: Do not pass xlwings objects to threads. This rule isn't a requirement on macOS, but it's still recommended if you want your programs to be cross-platform.

Consider the following example that will **NOT** work:

```
import threading
from queue import Queue
import xlwings as xw

num_threads = 4

def write_to_workbook():
    while True:
        rng = q.get()
        rng.value = rng.address
        print(rng.address)
        q.task_done()

q = Queue()

for i in range(num_threads):
    t = threading.Thread(target=write_to_workbook)
```

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```
t.daemon = True
t.start()

for cell in ['A1', 'A2', 'A3', 'A4', 'A5', 'A6', 'A7', 'A8', 'A9', 'A10']:
    # THIS DOESN'T WORK - passing xlwings objects to threads will fail!
    rng = xw.Book('Book1.xlsx').sheets[0].range(cell)
    q.put(rng)

q.join()
```

To make it work, you simply have to fully qualify the cell reference in the thread instead of passing a Book object:

```
import threading
from queue import Queue
import xlwings as xw

num_threads = 4

def write_to_workbook():
    while True:
        cell_ = q.get()
        xw.Book('Book1.xlsx').sheets[0].range(cell_).value = cell_
        print(cell_)
        q.task_done()

q = Queue()

for i in range(num_threads):
    t = threading.Thread(target=write_to_workbook)
    t.daemon = True
    t.start()

for cell in ['A1', 'A2', 'A3', 'A4', 'A5', 'A6', 'A7', 'A8', 'A9', 'A10']:
    q.put(cell)

q.join()
```

22.2 Multiprocessing

Note: Multiprocessing is only supported on Windows!

The same rules apply to multiprocessing as for threading, here's a working example:

```
from multiprocessing import Pool
import xlwings as xw

def write_to_workbook(cell):
    xw.Book('Book1.xlsx').sheets[0].range(cell).value = cell
    print(cell)

if __name__ == '__main__':
    with Pool(4) as p:
        p.map(write_to_workbook,
              ['A1', 'A2', 'A3', 'A4', 'A5', 'A6', 'A7', 'A8', 'A9', 'A10'])
```

Missing Features

If you're missing a feature in `xlwings`, do the following:

- 1) Most importantly, open an issue on [GitHub](#). Adding functionality should be user driven, so only if you tell us about what you're missing, it's eventually going to find its way into the library. By the way, we also appreciate pull requests!
- 2) Workaround: in essence, `xlwings` is just a smart wrapper around `pywin32` on Windows and `appscript` on Mac. You can access the underlying objects by calling the `api` property:

```
>>> sheet = xw.Book().sheets[0]
>>> sheet.api
<COMObject <unknown>> # Windows/pywin32
app(pid=2319).workbooks['Workbook1'].worksheets[1] # Mac/appscript
```

This works accordingly for the other objects like `sheet.range('A1').api` etc.

The underlying objects will offer you pretty much everything you can do with VBA, using the syntax of `pywin32` (which pretty much feels like VBA) and `appscript` (which doesn't feel like VBA). But apart from looking ugly, keep in mind that **it makes your code platform specific (!)**, i.e. even if you go for option 2), you should still follow option 1) and open an issue so the feature finds its way into the library (cross-platform and with a Pythonic syntax).

23.1 Example: Workaround to use VBA's `Range.WrapText`

```
# Windows
sheet.range('A1').api.WrapText = True

# Mac
sheet.range('A1').api.wrap_text.set(True)
```

xlwings with other Office Apps

xlwings can also be used to call Python functions from VBA within Office apps other than Excel (like Outlook, Access etc.).

Note: New in v0.12.0 and still in a somewhat early stage that involves a bit of manual work. Currently, this functionality is only available on Windows for UDFs. The `RunPython` functionality is currently not supported.

24.1 How To

- 1) As usual, write your Python function and import it into Excel (see *User Defined Functions (UDFs)*).
- 2) Press `Alt-F11` to get into the VBA editor, then right-click on the `xlwings_udfs` VBA module and select `Export File...` Save the `xlwings_udfs.bas` file somewhere.
- 3) Switch into the other Office app, e.g. Microsoft Access and click again `Alt-F11` to get into the VBA editor. Right-click on the VBA Project and `Import File...`, then select the file that you exported in the previous step. Once imported, replace the app name in the first line to the one that you are using, i.e. `Microsoft Access` or `Microsoft Outlook` etc. so that the first line then reads: `#Const App = "Microsoft Access"`
- 4) Now import the standalone xlwings VBA module (`xlwings.bas`). You can find it in your xlwings installation folder. To know where that is, do:

```
>>> import xlwings as xw
>>> xlwings.__path__
```

And finally do the same as in the previous step and replace the App name in the first line with the name of the corresponding app that you are using. You are now able to call the Python function from VBA.

24.2 Config

The other Office apps will use the same global config file as you are editing via the Excel ribbon add-in. When it makes sense, you'll be able to use the directory config file (e.g. you can put it next to your Access or Word file) or you can hardcode the path to the config file in the VBA standalone module, e.g. in the function `GetDirectoryConfigFilePath` (e.g. suggested when using Outlook that doesn't really have the same concept of files like the other Office apps). NOTE: For Office apps without file concept, you need to make sure that the `PYTHONPATH` points to the directory with the Python source file. For details on the different config options, see [Config](#).

While xlwings is a pure Python package, there are cross-language packages that allow for a relatively straightforward use from/with other languages. This means, however, that you'll always need to have Python with xlwings installed in addition to R or Julia. We recommend the [Anaconda](#) distribution, see also [Installation](#).

25.1 R

The R instructions are for Windows, but things work accordingly on Mac except that calling the R functions as User Defined Functions is not supported at the moment (but `RunPython` works, see [Call Python with "RunPython"](#)).

Setup:

- Install R and Python
- Add `R_HOME` environment variable to base directory of installation, .e.g `C:\Program Files\R\R-x.x.x`
- Add `R_USER` environment variable to user folder, e.g. `C:\Users\<user>`
- Add `C:\Program Files\R\R-x.x.x\bin` to `PATH`
- Restart Windows because of the environment variables (!)

25.1.1 Simple functions with R

Original R function that we want to access from Excel (saved in `r_file.R`):

```
myfunction <- function(x, y){  
  return(x * y)  
}
```

Python wrapper code:

```
import xlwings as xw  
import rpy2.robj as robjects  
# you might want to use some relative path or place the file in R's current_  
# working dir  
robjects.r.source(r"C:\path\to\r_file.R")  
  
@xw.func  
def myfunction(x, y):  
    myfunc = robjects.r['myfunction']  
    return tuple(myfunc(x, y))
```

After importing this function (see: *User Defined Functions (UDFs)*), it will be available as UDF from Excel.

25.1.2 Array functions with R

Original R function that we want to access from Excel (saved in `r_file.R`):

```
array_function <- function(m1, m2){  
  # Matrix multiplication  
  return(m1 %*% m2)  
}
```

Python wrapper code:

```
import xlwings as xw  
import numpy as np  
import rpy2.robj as robjects  
from rpy2.robj import numpy2ri  
  
robjects.r.source(r"C:\path\to\r_file.R")  
numpy2ri.activate()  
  
@xw.func  
@xw.arg("x", np.array, ndim=2)  
@xw.arg("y", np.array, ndim=2)  
def array_function(x, y):  
    array_func = robjects.r['array_function']  
    return np.array(array_func(x, y))
```

After importing this function (see: *User Defined Functions (UDFs)*), it will be available as UDF from Excel.

25.2 Julia

Setup:

- Install Julia and Python
- Run `Pkg.add("PyCall")` from an interactive Julia interpreter

xlwings can then be called from Julia with the following syntax (the colons take care of automatic type conversion):

```
julia> using PyCall
julia> @pyimport xlwings as xw

julia> xw.Book()
PyObject <Book [Workbook1]>

julia> xw.Range("A1")[:value] = "Hello World"
julia> xw.Range("A1")[:value]
"Hello World"
```


26.1 Top-level functions

`xlwings.view(obj, sheet=None, table=True)`

Opens a new workbook and displays an object on its first sheet by default. If you provide a sheet object, it will clear the sheet before displaying the object on the existing sheet.

Parameters

- **obj** (*any type with built-in converter*) – the object to display, e.g. numbers, strings, lists, numpy arrays, pandas dataframes
- **sheet** (*Sheet, default None*) – Sheet object. If none provided, the first sheet of a new workbook is used.
- **table** (*bool, default True*) – If your object is a pandas DataFrame, by default it is formatted as an Excel Table

Examples

```
>>> import xlwings as xw
>>> import pandas as pd
>>> import numpy as np
>>> df = pd.DataFrame(np.random.rand(10, 4), columns=['a', 'b', 'c', 'd
↳'])
>>> xw.view(df)
```

See also: [load](#)

Changed in version 0.22.0.

`xlwings.load(index=1, header=1)`

Loads the selected cell(s) of the active workbook into a pandas DataFrame. If you select a single cell that has adjacent cells, the range is auto-expanded and turned into a pandas DataFrame. If you don't have pandas installed, it returns the values as nested lists.

Parameters

- **index** (*bool or int, default 1*) – Defines the number of columns on the left that will be turned into the DataFrame's index
- **header** (*bool or int, default 1*) – Defines the number of rows at the top that will be turned into the DataFrame's columns

Examples

```
>>> import xlwings as xw
>>> xw.load()
```

See also: [view](#)

New in version 0.22.0.

26.2 Object model

26.2.1 Apps

class `xlwings.main.Apps` (*impl*)

A collection of all app objects:

```
>>> import xlwings as xw
>>> xw.apps
Apps([<Excel App 1668>, <Excel App 1644>])
```

active

Returns the active app.

New in version 0.9.0.

add()

Creates a new App. The new App becomes the active one. Returns an App object.

count

Returns the number of apps.

New in version 0.9.0.

keys()

Provides the PIDs of the Excel instances that act as keys in the Apps collection.

New in version 0.13.0.

26.2.2 App

class `xlwings.App` (*visible=None, spec=None, add_book=True, impl=None*)

An app corresponds to an Excel instance. New Excel instances can be fired up like so:

```
>>> import xlwings as xw
>>> app1 = xw.App()
>>> app2 = xw.App()
```

An app object is a member of the `apps` collection:

```
>>> xw.apps
Apps([<Excel App 1668>, <Excel App 1644>])
>>> xw.apps[1668] # get the available PIDs via xw.apps.keys()
<Excel App 1668>
>>> xw.apps.active
<Excel App 1668>
```

Parameters

- **visible** (*bool, default None*) – Returns or sets a boolean value that determines whether the app is visible. The default leaves the state unchanged or sets `visible=True` if the object doesn't exist yet.
- **spec** (*str, default None*) – Mac-only, use the full path to the Excel application, e.g. `/Applications/Microsoft Office 2011/Microsoft Excel` or `/Applications/Microsoft Excel`

On Windows, if you want to change the version of Excel that xlwings talks to, go to Control Panel > Programs and Features and Repair the Office version that you want as default.

Note: On Mac, while xlwings allows you to run multiple instances of Excel, it's a feature that is not officially supported by Excel for Mac: Unlike on Windows, Excel will not ask you to open a read-only version of a file if it is already open in another instance. This means that you need to watch out yourself so that the same file is not being overwritten from different instances.

activate (*steal_focus=False*)

Activates the Excel app.

Parameters **steal_focus** (*bool, default False*) – If True, make front-most application and hand over focus from Python to Excel.

New in version 0.9.0.

api

Returns the native object (pywin32 or applescript obj) of the engine being used.

New in version 0.9.0.

books

A collection of all Book objects that are currently open.

New in version 0.9.0.

calculate()

Calculates all open books.

New in version 0.3.6.

calculation

Returns or sets a calculation value that represents the calculation mode. Modes: 'manual', 'automatic', 'semiautomatic'

Examples

```
>>> import xlwings as xw
>>> wb = xw.Book()
>>> wb.app.calculation = 'manual'
```

Changed in version 0.9.0.

display_alerts

The default value is True. Set this property to False to suppress prompts and alert messages while code is running; when a message requires a response, Excel chooses the default response.

New in version 0.9.0.

hwnd

Returns the Window handle (Windows-only).

New in version 0.9.0.

kill()

Forces the Excel app to quit by killing its process.

New in version 0.9.0.

macro(name)

Runs a Sub or Function in Excel VBA that are not part of a specific workbook but e.g. are part of an add-in.

Parameters name (Name of Sub or Function with or without module name, e.g. 'Module1.MyMacro' or 'MyMacro') –

Examples

This VBA function:

```
Function MySum(x, y)
    MySum = x + y
End Function
```


can be accessed like this:

```
>>> import xlwings as xw
>>> app = xw.App()
>>> my_sum = app.macro('MySum')
>>> my_sum(1, 2)
3
```

See also: [Book.macro\(\)](#)

New in version 0.9.0.

pid

Returns the PID of the app.

New in version 0.9.0.

quit()

Quits the application without saving any workbooks.

New in version 0.3.3.

range(cell1, cell2=None)

Range object from the active sheet of the active book, see [Range\(\)](#).

New in version 0.9.0.

screen_updating

Turn screen updating off to speed up your script. You won't be able to see what the script is doing, but it will run faster. Remember to set the `screen_updating` property back to `True` when your script ends.

New in version 0.3.3.

selection

Returns the selected cells as `Range`.

New in version 0.9.0.

startup_path

Returns the path to `XLSTART` which is where the xlwings add-in gets copied to by doing `xlwings addin install`.

New in version 0.19.4.

status_bar

Gets or sets the value of the status bar. Returns `False` if Excel has control of it.

New in version 0.20.0.

version

Returns the Excel version number object.

Examples

```
>>> import xlwings as xw
>>> xw.App().version
VersionNumber('15.24')
>>> xw.apps[10559].version.major
15
```

Changed in version 0.9.0.

visible

Gets or sets the visibility of Excel to True or False.

New in version 0.3.3.

26.2.3 Books

class `xlwings.main.Books` (*impl*)

A collection of all book objects:

```
>>> import xlwings as xw
>>> xw.books # active app
Books([<Book [Book1]>, <Book [Book2]>])
>>> xw.apps[10559].books # specific app, get the PIDs via xw.apps.keys()
Books([<Book [Book1]>, <Book [Book2]>])
```

New in version 0.9.0.

active

Returns the active Book.

add()

Creates a new Book. The new Book becomes the active Book. Returns a Book object.

open (*fullname*, *update_links=None*, *read_only=None*, *format=None*, *password=None*, *write_res_password=None*, *ignore_read_only_recommended=None*, *origin=None*, *delimiter=None*, *editable=None*, *notify=None*, *converter=None*, *add_to_mru=None*, *local=None*, *corrupt_load=None*)

Opens a Book if it is not open yet and returns it. If it is already open, it doesn't raise an exception but simply returns the Book object.

Parameters

- **fullname** (*str* or *path-like object*) – filename or fully qualified filename, e.g. `r'C:\path\to\file.xlsx'` or `'file.xlsm'`. Without a full path, it looks for the file in the current working directory.
- **Parameters** (*Other*) – see: `xlwings.Book()`

Returns Book

Return type Book that has been opened.

26.2.4 Book

```
class xlwings.Book(fullname=None, update_links=None, read_only=None, format=None, password=None, write_res_password=None, ignore_read_only_recommended=None, origin=None, delimiter=None, editable=None, notify=None, converter=None, add_to_mru=None, local=None, corrupt_load=None, impl=None)
```

A book object is a member of the `books` collection:

```
>>> import xlwings as xw
>>> xw.books[0]
<Book [Book1]>
```

The easiest way to connect to a book is offered by `xw.Book`: it looks for the book in all app instances and returns an error, should the same book be open in multiple instances. To connect to a book in the active app instance, use `xw.books` and to refer to a specific app, use:

```
>>> app = xw.App() # or something like xw.apps[10559] for existing apps,
↪ get the PIDs via xw.apps.keys()
>>> app.books['Book1']
```

	<code>xw.Book</code>	<code>xw.books</code>
New book	<code>xw.Book()</code>	<code>xw.books.add()</code>
Unsaved book	<code>xw.Book('Book1')</code>	<code>xw.books['Book1']</code>
Book by (fullname)	<code>xw.Book(r'C:/path/to/file.xlsx')</code>	<code>xw.books.open(r'C:/path/to/file.xlsx')</code>

Parameters

- **fullname** (*str* or *path-like object*, *default None*) – Full path or name (incl. `xlsx`, `xlsm` etc.) of existing workbook or name of an unsaved workbook. Without a full path, it looks for the file in the current working directory.
- **update_links** (*bool*, *default None*) – If this argument is omitted, the user is prompted to specify how links will be updated
- **read_only** (*bool*, *default False*) – True to open workbook in read-only mode
- **format** (*str*) – If opening a text file, this specifies the delimiter character
- **password** (*str*) – Password to open a protected workbook
- **write_res_password** (*str*) – Password to write to a write-reserved workbook
- **ignore_read_only_recommended** (*bool*, *default False*) – Set to True to mute the read-only recommended message
- **origin** (*int*) – For text files only. Specifies where it originated. Use `XIPlatform` constants.

- **delimiter** (*str*) – If format argument is 6, this specifies the delimiter.
- **editable** (*bool*, *default False*) – This option is only for legacy Microsoft Excel 4.0 addins.
- **notify** (*bool*, *default False*) – Notify the user when a file becomes available If the file cannot be opened in read/write mode.
- **converter** (*int*) – The index of the first file converter to try when opening the file.
- **add_to_mru** (*bool*, *default False*) – Add this workbook to the list of recently added workbooks.
- **local** (*bool*, *default False*) – If True, saves files against the language of Excel, otherwise against the language of VBA. Not supported on macOS.
- **corrupt_load** (*int*, *default xlNormalLoad*) – Can be one of `xlNormalLoad`, `xlRepairFile` or `xlExtractData`. Not supported on macOS.

activate (*steal_focus=False*)

Activates the book.

Parameters **steal_focus** (*bool*, *default False*) – If True, make front-most window and hand over focus from Python to Excel.

api

Returns the native object (`pywin32` or `appscript` obj) of the engine being used.

New in version 0.9.0.

app

Returns an app object that represents the creator of the book.

New in version 0.9.0.

classmethod caller ()

References the calling book when the Python function is called from Excel via `RunPython`. Pack it into the function being called from Excel, e.g.:

```
import xlwings as xw

def my_macro():
    wb = xw.Book.caller()
    wb.sheets[0].range('A1').value = 1
```

To be able to easily invoke such code from Python for debugging, use `xw.Book.set_mock_caller()`.

New in version 0.3.0.

close ()

Closes the book without saving it.

New in version 0.1.1.

fullname

Returns the name of the object, including its path on disk, as a string. Read-only String.

macro (*name*)

Runs a Sub or Function in Excel VBA.

Parameters **name** (Name of Sub or Function with or without module name, e.g. 'Module1.MyMacro' or 'MyMacro') –

Examples

This VBA function:

```
Function MySum(x, y)
    MySum = x + y
End Function
```

can be accessed like this:

```
>>> import xlwings as xw
>>> wb = xw.books.active
>>> my_sum = wb.macro('MySum')
>>> my_sum(1, 2)
3
```

See also: [*App.macro\(\)*](#)

New in version 0.7.1.

name

Returns the name of the book as str.

names

Returns a names collection that represents all the names in the specified book (including all sheet-specific names).

Changed in version 0.9.0.

save (*path=None*)

Saves the Workbook. If a path is being provided, this works like SaveAs() in Excel. If no path is specified and if the file hasn't been saved previously, it's being saved in the current working directory with the current filename. Existing files are overwritten without prompting.

Parameters **path** (*str or path-like object, default None*) – Full path to the workbook

Example

```
>>> import xlwings as xw
>>> wb = xw.Book()
>>> wb.save()
>>> wb.save(r'C:\path\to\new_file_name.xlsx')
```

New in version 0.3.1.

selection

Returns the selected cells as Range.

New in version 0.9.0.

set_mock_caller()

Sets the Excel file which is used to mock `xw.Book.caller()` when the code is called from Python and not from Excel via RunPython.

Examples

```
# This code runs unchanged from Excel via RunPython and from Python,
↳ directly
import os
import xlwings as xw

def my_macro():
    sht = xw.Book.caller().sheets[0]
    sht.range('A1').value = 'Hello xlwings!'

if __name__ == '__main__':
    xw.Book('file.xlsm').set_mock_caller()
    my_macro()
```

New in version 0.3.1.

sheets

Returns a sheets collection that represents all the sheets in the book.

New in version 0.9.0.

to_pdf(path=None, include=None, exclude=None)

Exports the whole Excel workbook or a subset of the sheets to a PDF file. If you want to print hidden sheets, you will need to list them explicitly under `include`.

Parameters

- **path** (*str or path-like object, default None*) – Path to the PDF file, defaults to the same name as the workbook, in the same directory. For unsaved workbooks, it defaults to the current working directory instead.
- **include** (*int or str or list, default None*) – Which sheets to include: provide a selection of sheets in the form of sheet indices (1-based like in Excel) or sheet names. Can be an int/str for a single sheet or a list of int/str for multiple sheets.
- **exclude** (*int or str or list, default None*) – Which sheets to exclude: provide a selection of sheets in the form of sheet indices (1-based like in Excel) or sheet names. Can be an int/str for a single sheet or a list of int/str for multiple sheets.

Examples

```
>>> wb = xw.Book()
>>> wb.sheets[0]['A1'].value = 'PDF'
>>> wb.to_pdf()
```

See also `xlwings.Sheet.to_pdf()`

New in version 0.21.1.

26.2.5 Sheets

class `xlwings.main.Sheets` (*impl*)

A collection of all sheet objects:

```
>>> import xlwings as xw
>>> xw.sheets # active book
Sheets([<Sheet [Book1]Sheet1>, <Sheet [Book1]Sheet2>])
>>> xw.Book('Book1').sheets # specific book
Sheets([<Sheet [Book1]Sheet1>, <Sheet [Book1]Sheet2>])
```

New in version 0.9.0.

active

Returns the active Sheet.

add (*name=None, before=None, after=None*)

Creates a new Sheet and makes it the active sheet.

Parameters

- **name** (*str, default None*) – Name of the new sheet. If None, will default to Excel's default name.
- **before** (*Sheet, default None*) – An object that specifies the sheet before which the new sheet is added.
- **after** (*Sheet, default None*) – An object that specifies the sheet after which the new sheet is added.

26.2.6 Sheet

class `xlwings.Sheet` (*sheet=None, impl=None*)

A sheet object is a member of the `sheets` collection:

```
>>> import xlwings as xw
>>> wb = xw.Book()
>>> wb.sheets[0]
<Sheet [Book1]Sheet1>
>>> wb.sheets['Sheet1']
<Sheet [Book1]Sheet1>
```

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```
>>> wb.sheets.add()  
<Sheet [Book1]Sheet2>
```

Changed in version 0.9.0.

activate()

Activates the Sheet and returns it.

api

Returns the native object (pywin32 or appscript obj) of the engine being used.

New in version 0.9.0.

autofit (*axis=None*)

Autofits the width of either columns, rows or both on a whole Sheet.

Parameters **axis** (*string, default None*) –

- To autofit rows, use one of the following: `rows` or `r`
- To autofit columns, use one of the following: `columns` or `c`
- To autofit rows and columns, provide no arguments

Examples

```
>>> import xlwings as xw  
>>> wb = xw.Book()  
>>> wb.sheets['Sheet1'].autofit('c')  
>>> wb.sheets['Sheet1'].autofit('r')  
>>> wb.sheets['Sheet1'].autofit()
```

New in version 0.2.3.

book

Returns the Book of the specified Sheet. Read-only.

cells

Returns a Range object that represents all the cells on the Sheet (not just the cells that are currently in use).

New in version 0.9.0.

charts

See [Charts](#)

New in version 0.9.0.

clear()

Clears the content and formatting of the whole sheet.

clear_contents()

Clears the content of the whole sheet but leaves the formatting.

copy (*before=None, after=None, name=None*)

Copy a sheet to the current or a new Book. By default, it places the copied sheet after all existing sheets in the current Book. Returns the copied sheet.

New in version 0.22.0.

Parameters

- **before** (*sheet object, default None*) – The sheet object before which you want to place the sheet
- **after** (*sheet object, default None*) – The sheet object after which you want to place the sheet, by default it is placed after all existing sheets
- **name** (*str, default None*) – The sheet name of the copy

Returns **Sheet object** – The copied sheet

Return type *Sheet*

Examples

```
# Create two books and add a value to the first sheet of the first_
↪book
first_book = xw.Book()
second_book = xw.Book()
first_book.sheets[0]['A1'].value = 'some value'

# Copy to same Book with the default location and name
first_book.sheets[0].copy()

# Copy to same Book with custom sheet name
first_book.sheets[0].copy(name='copied')

# Copy to second Book requires to use before or after
first_book.sheets[0].copy(after=second_book.sheets[0])
```

delete()

Deletes the Sheet.

index

Returns the index of the Sheet (1-based as in Excel).

name

Gets or sets the name of the Sheet.

names

Returns a names collection that represents all the sheet-specific names (names defined with the “SheetName!” prefix).

New in version 0.9.0.

pictures

See *Pictures*

New in version 0.9.0.

range (*cell1*, *cell2=None*)

Returns a Range object from the active sheet of the active book, see [Range\(\)](#).

New in version 0.9.0.

render_template (***data*)

This method requires xlwings *PRO*.

Replaces all Jinja variables (e.g. `{{ myvar }}`) in the sheet with the keyword argument that has the same name. Following variable types are supported:

strings, numbers, lists, simple dicts, NumPy arrays, Pandas DataFrames, PIL Image objects that have a filename and Matplotlib figures.

New in version 0.22.0.

Parameters **data** (*kwargs*) – All key/value pairs that are used in the template.

Returns **sheet**

Return type xlwings Sheet

Examples

```
>>> import xlwings as xw
>>> book = xw.Book()
>>> book.sheets[0]['A1:A2'].value = '{{ myvar }}'
>>> book.sheets[0].render_template(myvar='test')
```

See also `xlwings.pro.reports.create_report()`

select ()

Selects the Sheet. Select only works on the active book.

New in version 0.9.0.

shapes

See [Shapes](#)

New in version 0.9.0.

tables

See [Tables](#)

New in version 0.21.0.

to_pdf (*path=None*)

Exports the sheet to a PDF file.

Parameters **path** (*str or path-like object, default None*) – Path to the PDF file, defaults to the name of the sheet in the same directory of the workbook. For unsaved workbooks, it defaults to the current working directory instead.

Examples

```
>>> wb = xw.Book()
>>> sheet = wb.sheets[0]
>>> sheet['A1'].value = 'PDF'
>>> sheet.to_pdf()
```

See also `xlwings.Book.to_pdf()`

New in version 0.22.3.

used_range

Used Range of Sheet.

Returns

Return type `xw.Range`

New in version 0.13.0.

visible

Gets or sets the visibility of the Sheet (bool).

New in version 0.21.1.

26.2.7 Range

class `xlwings.Range` (*cell1=None, cell2=None, **options*)

Returns a Range object that represents a cell or a range of cells.

Parameters

- **cell1** (*str or tuple or Range*) – Name of the range in the upper-left corner in A1 notation or as index-tuple or as name or as `xw.Range` object. It can also specify a range using the range operator (a colon), .e.g. 'A1:B2'
- **cell2** (*str or tuple or Range, default None*) – Name of the range in the lower-right corner in A1 notation or as index-tuple or as name or as `xw.Range` object.

Examples

Active Sheet:

```
import xlwings as xw
xw.Range('A1')
xw.Range('A1:C3')
xw.Range((1,1))
xw.Range((1,1), (3,3))
xw.Range('NamedRange')
xw.Range(xw.Range('A1'), xw.Range('B2'))
```

Specific Sheet:

```
xw.books['MyBook.xlsx'].sheets[0].range('A1')
```

add_hyperlink (*address*, *text_to_display=None*, *screen_tip=None*)

Adds a hyperlink to the specified Range (single Cell)

Parameters

- **address** (*str*) – The address of the hyperlink.
- **text_to_display** (*str*, *default None*) – The text to be displayed for the hyperlink. Defaults to the hyperlink address.
- **screen_tip** (*str*, *default None*) – The screen tip to be displayed when the mouse pointer is paused over the hyperlink. Default is set to '<address> - Click once to follow. Click and hold to select this cell.'

New in version 0.3.0.

address

Returns a string value that represents the range reference. Use `get_address()` to be able to provide parameters.

New in version 0.9.0.

api

Returns the native object (pywin32 or appscript obj) of the engine being used.

New in version 0.9.0.

autofit()

Autofits the width and height of all cells in the range.

- To autofit only the width of the columns use `xw.Range('A1:B2').columns.autofit()`
- To autofit only the height of the rows use `xw.Range('A1:B2').rows.autofit()`

Changed in version 0.9.0.

clear()

Clears the content and the formatting of a Range.

clear_contents()

Clears the content of a Range but leaves the formatting.

color

Gets and sets the background color of the specified Range.

To set the color, either use an RGB tuple (0, 0, 0) or a color constant. To remove the background, set the color to `None`, see Examples.

Returns RGB

Return type tuple

Examples

```
>>> import xlwings as xw
>>> wb = xw.Book()
>>> xw.Range('A1').color = (255,255,255)
>>> xw.Range('A2').color
(255, 255, 255)
>>> xw.Range('A2').color = None
>>> xw.Range('A2').color is None
True
```

New in version 0.3.0.

column

Returns the number of the first column in the in the specified range. Read-only.

Returns

Return type Integer

New in version 0.3.5.

column_width

Gets or sets the width, in characters, of a Range. One unit of column width is equal to the width of one character in the Normal style. For proportional fonts, the width of the character 0 (zero) is used.

If all columns in the Range have the same width, returns the width. If columns in the Range have different widths, returns None.

column_width must be in the range: $0 \leq \text{column_width} \leq 255$

Note: If the Range is outside the used range of the Worksheet, and columns in the Range have different widths, returns the width of the first column.

Returns

Return type float

New in version 0.4.0.

columns

Returns a *RangeColumns* object that represents the columns in the specified range.

New in version 0.9.0.

copy (destination=None)

Copy a range to a destination range or clipboard.

Parameters **destination** (*xlwings.Range*) – xlwings Range to which the specified range will be copied. If omitted, the range is copied to the Clipboard.

Returns

Return type None

count

Returns the number of cells.

current_region

This property returns a Range object representing a range bounded by (but not including) any combination of blank rows and blank columns or the edges of the worksheet. It corresponds to Ctrl-* on Windows and Shift-Ctrl-Space on Mac.

Returns

Return type Range object

delete (*shift=None*)

Deletes a cell or range of cells.

Parameters **shift** (*str, default None*) – Use left or up. If omitted, Excel decides based on the shape of the range.

Returns

Return type None

end (*direction*)

Returns a Range object that represents the cell at the end of the region that contains the source range. Equivalent to pressing Ctrl+Up, Ctrl+down, Ctrl+left, or Ctrl+right.

Parameters **direction** (*One of 'up', 'down', 'right', 'left'*) –

Examples

```
>>> import xlwings as xw
>>> wb = xw.Book()
>>> xw.Range('A1:B2').value = 1
>>> xw.Range('A1').end('down')
<Range [Book1]Sheet1!$A$2>
>>> xw.Range('B2').end('right')
<Range [Book1]Sheet1!$B$2>
```

New in version 0.9.0.

expand (*mode='table'*)

Expands the range according to the mode provided. Ignores empty top-left cells (unlike Range.end()).

Parameters **mode** (*str, default 'table'*) – One of 'table' (=down and right), 'down', 'right'.

Returns

Return type *Range*

Examples

```
>>> import xlwings as xw
>>> wb = xw.Book()
>>> xw.Range('A1').value = [[None, 1], [2, 3]]
>>> xw.Range('A1').expand().address
$A$1:$B$2
>>> xw.Range('A1').expand('right').address
$A$1:$B$1
```

New in version 0.9.0.

formula

Gets or sets the formula for the given Range.

formula2

Gets or sets the formula2 for the given Range.

formula_array

Gets or sets an array formula for the given Range.

New in version 0.7.1.

get_address (*row_absolute=True, column_absolute=True, include_sheetname=False, external=False*)

Returns the address of the range in the specified format. `address` can be used instead if none of the defaults need to be changed.

Parameters

- **row_absolute** (*bool, default True*) – Set to True to return the row part of the reference as an absolute reference.
- **column_absolute** (*bool, default True*) – Set to True to return the column part of the reference as an absolute reference.
- **include_sheetname** (*bool, default False*) – Set to True to include the Sheet name in the address. Ignored if `external=True`.
- **external** (*bool, default False*) – Set to True to return an external reference with workbook and worksheet name.

Returns

Return type str

Examples

```
>>> import xlwings as xw
>>> wb = xw.Book()
>>> xw.Range((1,1)).get_address()
'$A$1'
>>> xw.Range((1,1)).get_address(False, False)
```

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```
'A1'  
>>> xw.Range((1,1), (3,3)).get_address(True, False, True)  
'Sheet1!A$1:C$3'  
>>> xw.Range((1,1), (3,3)).get_address(True, False, external=True)  
'[Book1]Sheet1!A$1:C$3'
```

New in version 0.2.3.

has_array

Are we part of an Array formula?

height

Returns the height, in points, of a Range. Read-only.

Returns

Return type float

New in version 0.4.0.

hyperlink

Returns the hyperlink address of the specified Range (single Cell only)

Examples

```
>>> import xlwings as xw  
>>> wb = xw.Book()  
>>> xw.Range('A1').value  
'www.xlwings.org'  
>>> xw.Range('A1').hyperlink  
'http://www.xlwings.org'
```

New in version 0.3.0.

insert (*shift=None, copy_origin='format_from_left_or_above'*)

Insert a cell or range of cells into the sheet.

Parameters

- **shift** (*str, default None*) – Use right or down. If omitted, Excel decides based on the shape of the range.
- **copy_origin** (*str, default format_from_left_or_above*)
– Use `format_from_left_or_above` or `format_from_right_or_below`. Note that this is not supported on macOS.

Returns

Return type None

last_cell

Returns the bottom right cell of the specified range. Read-only.

Returns**Return type** *Range***Example**

```
>>> import xlwings as xw
>>> wb = xw.Book()
>>> rng = xw.Range('A1:E4')
>>> rng.last_cell.row, rng.last_cell.column
(4, 5)
```

New in version 0.3.5.

left

Returns the distance, in points, from the left edge of column A to the left edge of the range.
Read-only.

Returns**Return type** float

New in version 0.6.0.

merge (*across=False*)

Creates a merged cell from the specified Range object.

Parameters **across** (*bool, default False*) – True to merge cells in each row of the specified Range as separate merged cells.

merge_area

Returns a Range object that represents the merged Range containing the specified cell. If the specified cell isn't in a merged range, this property returns the specified cell.

merge_cells

Returns True if the Range contains merged cells, otherwise False

name

Sets or gets the name of a Range.

New in version 0.4.0.

number_format

Gets and sets the number_format of a Range.

Examples

```
>>> import xlwings as xw
>>> wb = xw.Book()
>>> xw.Range('A1').number_format
'General'
>>> xw.Range('A1:C3').number_format = '0.00%'
```

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```
>>> xw.Range('A1:C3').number_format  
'0.00%'
```

New in version 0.2.3.

offset (*row_offset=0, column_offset=0*)

Returns a Range object that represents a Range that's offset from the specified range.

Returns Range object

Return type *Range*

New in version 0.3.0.

options (*convert=None, **options*)

Allows you to set a converter and their options. Converters define how Excel Ranges and their values are being converted both during reading and writing operations. If no explicit converter is specified, the base converter is being applied, see *Converters and Options*.

Parameters **convert** (*object, default None*) – A converter, e.g. dict, np.array, pd.DataFrame, pd.Series, defaults to default converter

Keyword Arguments

- **ndim** (*int, default None*) – number of dimensions
- **numbers** (*type, default None*) – type of numbers, e.g. int
- **dates** (*type, default None*) – e.g. datetime.date defaults to datetime.datetime
- **empty** (*object, default None*) – transformation of empty cells
- **transpose** (*Boolean, default False*) – transpose values
- **expand** (*str, default None*) – One of 'table', 'down', 'right'
=> For converter-specific options, see *Converters and Options*.

Returns

Return type Range object

New in version 0.7.0.

paste (*paste=None, operation=None, skip_blanks=False, transpose=False*)

Pastes a range from the clipboard into the specified range.

Parameters

- **paste** (*str, default None*) – One of all_merging_conditional_formats, all_except_borders, all_using_source_theme, column_widths, comments, formulas, formulas_and_number_formats, validation, values, values_and_number_formats.

- **operation** (*str*, *default None*) – One of “add”, “divide”, “multiply”, “subtract”.
- **skip_blanks** (*bool*, *default False*) – Set to True to skip over blank cells
- **transpose** (*bool*, *default False*) – Set to True to transpose rows and columns.

Returns**Return type** None**raw_value**

Gets and sets the values directly as delivered from/accepted by the engine that is being used (pywin32 or appscript) without going through any of xlwings’ data cleaning/converting. This can be helpful if speed is an issue but naturally will be engine specific, i.e. might remove the cross-platform compatibility.

resize (*row_size=None*, *column_size=None*)

Resizes the specified Range

Parameters

- **row_size** (*int > 0*) – The number of rows in the new range (if None, the number of rows in the range is unchanged).
- **column_size** (*int > 0*) – The number of columns in the new range (if None, the number of columns in the range is unchanged).

Returns Range object**Return type** *Range*

New in version 0.3.0.

row

Returns the number of the first row in the specified range. Read-only.

Returns**Return type** Integer

New in version 0.3.5.

row_height

Gets or sets the height, in points, of a Range. If all rows in the Range have the same height, returns the height. If rows in the Range have different heights, returns None.

row_height must be in the range: $0 \leq \text{row_height} \leq 409.5$

Note: If the Range is outside the used range of the Worksheet, and rows in the Range have different heights, returns the height of the first row.

Returns**Return type** float

New in version 0.4.0.

rows

Returns a *RangeRows* object that represents the rows in the specified range.

New in version 0.9.0.

select ()

Selects the range. Select only works on the active book.

New in version 0.9.0.

shape

Tuple of Range dimensions.

New in version 0.3.0.

sheet

Returns the Sheet object to which the Range belongs.

New in version 0.9.0.

size

Number of elements in the Range.

New in version 0.3.0.

table

Returns a Table object if the range is part of one, otherwise None.

New in version 0.21.0.

top

Returns the distance, in points, from the top edge of row 1 to the top edge of the range. Read-only.

Returns

Return type float

New in version 0.6.0.

unmerge ()

Separates a merged area into individual cells.

value

Gets and sets the values for the given Range.

Returns object

Return type returned object depends on the converter being used, see *xlwings.Range.options()*

width

Returns the width, in points, of a Range. Read-only.

Returns

Return type float

New in version 0.4.0.

26.2.8 RangeRows

class `xlwings.RangeRows` (*rng*)

Represents the rows of a range. Do not construct this class directly, use `Range.rows` instead.

Example

```
import xlwings as xw

rng = xw.Range('A1:C4')

assert len(rng.rows) == 4 # or rng.rows.count

rng.rows[0].value = 'a'

assert rng.rows[2] == xw.Range('A3:C3')
assert rng.rows(2) == xw.Range('A2:C2')

for r in rng.rows:
    print(r.address)
```

autofit()

Autofits the height of the rows.

count

Returns the number of rows.

New in version 0.9.0.

26.2.9 RangeColumns

class `xlwings.RangeColumns` (*rng*)

Represents the columns of a range. Do not construct this class directly, use `Range.columns` instead.

Example

```
import xlwings as xw

rng = xw.Range('A1:C4')

assert len(rng.columns) == 3 # or rng.columns.count

rng.columns[0].value = 'a'

assert rng.columns[2] == xw.Range('C1:C4')
assert rng.columns(2) == xw.Range('B1:B4')
```

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```
for c in rng.columns:
    print(c.address)
```

autofit()

Autofits the width of the columns.

count

Returns the number of columns.

New in version 0.9.0.

26.2.10 Shapes

class xlwings.main.Shapes (*impl*)

A collection of all shape objects on the specified sheet:

```
>>> import xlwings as xw
>>> xw.books['Book1'].sheets[0].shapes
Shapes([<Shape 'Oval 1' in <Sheet [Book1]Sheet1>>, <Shape 'Rectangle 1'
↳in <Sheet [Book1]Sheet1>>])
```

New in version 0.9.0.

api

Returns the native object (pywin32 or appscript obj) of the engine being used.

count

Returns the number of objects in the collection.

26.2.11 Shape

class xlwings.Shape (*args, **options)The shape object is a member of the *shapes* collection:

```
>>> import xlwings as xw
>>> sht = xw.books['Book1'].sheets[0]
>>> sht.shapes[0] # or sht.shapes['ShapeName']
<Shape 'Rectangle 1' in <Sheet [Book1]Sheet1>>
```

Changed in version 0.9.0.

activate()

Activates the shape.

New in version 0.5.0.

api

Returns the native object (pywin32 or appscript obj) of the engine being used.

New in version 0.19.2.

delete()

Deletes the shape.

New in version 0.5.0.

height

Returns or sets the number of points that represent the height of the shape.

New in version 0.5.0.

left

Returns or sets the number of points that represent the horizontal position of the shape.

New in version 0.5.0.

name

Returns or sets the name of the shape.

New in version 0.5.0.

parent

Returns the parent of the shape.

New in version 0.9.0.

scale_height (*factor, relative_to_original_size=False, scale='scale_from_top_left'*)

factor [float] For example 1.5 to scale it up to 150%

relative_to_original_size [bool, optional] If `False`, it scales relative to current height (default). For `True` must be a picture or OLE object.

scale [str, optional] One of `scale_from_top_left` (default), `scale_from_bottom_right`, `scale_from_middle`

New in version 0.19.2.

scale_width (*factor, relative_to_original_size=False, scale='scale_from_top_left'*)

factor [float] For example 1.5 to scale it up to 150%

relative_to_original_size [bool, optional] If `False`, it scales relative to current width (default). For `True` must be a picture or OLE object.

scale [str, optional] One of `scale_from_top_left` (default), `scale_from_bottom_right`, `scale_from_middle`

New in version 0.19.2.

text

Returns or sets the text of a shape.

New in version 0.21.4.

top

Returns or sets the number of points that represent the vertical position of the shape.

New in version 0.5.0.

type

Returns the type of the shape.

New in version 0.9.0.

width

Returns or sets the number of points that represent the width of the shape.

New in version 0.5.0.

26.2.12 Charts

class `xlwings.main.Charts` (*impl*)

A collection of all chart objects on the specified sheet:

```
>>> import xlwings as xw
>>> xw.books['Book1'].sheets[0].charts
Charts([<Chart 'Chart 1' in <Sheet [Book1]Sheet1>>, <Chart 'Chart 1' in
↪<Sheet [Book1]Sheet1>>])
```

New in version 0.9.0.

add (*left=0, top=0, width=355, height=211*)

Creates a new chart on the specified sheet.

Parameters

- **left** (*float, default 0*) – left position in points
- **top** (*float, default 0*) – top position in points
- **width** (*float, default 355*) – width in points
- **height** (*float, default 211*) – height in points

Returns

Return type *Chart*

Examples

```
>>> import xlwings as xw
>>> sht = xw.Book().sheets[0]
>>> sht.range('A1').value = [['Foo1', 'Foo2'], [1, 2]]
>>> chart = sht.charts.add()
>>> chart.set_source_data(sht.range('A1').expand())
>>> chart.chart_type = 'line'
>>> chart.name
'Chart1'
```

api

Returns the native object (pywin32 or appscript obj) of the engine being used.

count

Returns the number of objects in the collection.

26.2.13 Chart

class `xlwings.Chart` (*name_or_index=None, impl=None*)

The chart object is a member of the `charts` collection:

```
>>> import xlwings as xw
>>> sht = xw.books['Book1'].sheets[0]
>>> sht.charts[0] # or sht.charts['ChartName']
<Chart 'Chart 1' in <Sheet [Book1]Sheet1>>
```

api

Returns the native object (pywin32 or appscript obj) of the engine being used.

New in version 0.9.0.

chart_type

Returns and sets the chart type of the chart. The following chart types are available:

```
3d_area, 3d_area_stacked, 3d_area_stacked_100, 3d_bar_clustered,
3d_bar_stacked, 3d_bar_stacked_100, 3d_column, 3d_column_clustered,
3d_column_stacked, 3d_column_stacked_100, 3d_line, 3d_pie,
3d_pie_exploded, area, area_stacked, area_stacked_100, bar_clustered,
bar_of_pie, bar_stacked, bar_stacked_100, bubble, bubble_3d_effect,
column_clustered, column_stacked, column_stacked_100,
combination, cone_bar_clustered, cone_bar_stacked,
cone_bar_stacked_100, cone_col, cone_col_clustered,
cone_col_stacked, cone_col_stacked_100, cylinder_bar_clustered,
cylinder_bar_stacked, cylinder_bar_stacked_100,
cylinder_col, cylinder_col_clustered, cylinder_col_stacked,
cylinder_col_stacked_100, doughnut, doughnut_exploded, line,
line_markers, line_markers_stacked, line_markers_stacked_100,
line_stacked, line_stacked_100, pie, pie_exploded,
pie_of_pie, pyramid_bar_clustered, pyramid_bar_stacked,
pyramid_bar_stacked_100, pyramid_col, pyramid_col_clustered,
pyramid_col_stacked, pyramid_col_stacked_100, radar,
radar_filled, radar_markers, stock_hlc, stock_ohlc,
stock_vhlc, stock_vohlc, surface, surface_top_view,
surface_top_view_wireframe, surface_wireframe, xy_scatter,
xy_scatter_lines, xy_scatter_lines_no_markers, xy_scatter_smooth,
xy_scatter_smooth_no_markers
```

New in version 0.1.1.

delete()

Deletes the chart.

height

Returns or sets the number of points that represent the height of the chart.

left

Returns or sets the number of points that represent the horizontal position of the chart.

name

Returns or sets the name of the chart.

parent

Returns the parent of the chart.

New in version 0.9.0.

set_source_data (*source*)

Sets the source data range for the chart.

Parameters **source** (*Range*) – Range object, e.g. `xw.books['Book1'].sheets[0].range('A1')`

top

Returns or sets the number of points that represent the vertical position of the chart.

width

Returns or sets the number of points that represent the width of the chart.

26.2.14 Pictures

class `xlwings.main.Pictures` (*impl*)

A collection of all picture objects on the specified sheet:

```
>>> import xlwings as xw
>>> xw.books['Book1'].sheets[0].pictures
Pictures([<Picture 'Picture 1' in <Sheet [Book1]Sheet1>>, <Picture
↪ 'Picture 2' in <Sheet [Book1]Sheet1>>])
```

New in version 0.9.0.

add (*image*, *link_to_file=False*, *save_with_document=True*, *left=0*, *top=0*, *width=None*, *height=None*, *name=None*, *update=False*, *scale=1*)
Adds a picture to the specified sheet.

Parameters

- **image** (*str* or *path-like object* or *matplotlib.figure.Figure*) – Either a filepath or a Matplotlib figure object.
- **left** (*float*, *default 0*) – Left position in points.
- **top** (*float*, *default 0*) – Top position in points.
- **width** (*float*, *default None*) – Width in points. If PIL/Pillow is installed, it defaults to the width of the picture. Otherwise it defaults to 100 points.
- **height** (*float*, *default None*) – Height in points. If PIL/Pillow is installed, it defaults to the height of the picture. Otherwise it defaults to 100 points.

- **name** (*str*, *default None*) – Excel picture name. Defaults to Excel standard name if not provided, e.g. 'Picture 1'.
- **update** (*bool*, *default False*) – Replace an existing picture with the same name. Requires name to be set.

Returns**Return type** *Picture***Examples**

1. Picture

```
>>> import xlwings as xw
>>> sht = xw.Book().sheets[0]
>>> sht.pictures.add(r'C:\path\to\file.jpg')
<Picture 'Picture 1' in <Sheet [Book1]Sheet1>>
```

2. Matplotlib

```
>>> import matplotlib.pyplot as plt
>>> fig = plt.figure()
>>> plt.plot([1, 2, 3, 4, 5])
>>> sht.pictures.add(fig, name='MyPlot', update=True)
<Picture 'MyPlot' in <Sheet [Book1]Sheet1>>
```

api

Returns the native object (pywin32 or appscript obj) of the engine being used.

count

Returns the number of objects in the collection.

26.2.15 Picture**class** `xlwings.Picture` (*impl=None*)The picture object is a member of the *pictures* collection:

```
>>> import xlwings as xw
>>> sht = xw.books['Book1'].sheets[0]
>>> sht.pictures[0] # or sht.charts['PictureName']
<Picture 'Picture 1' in <Sheet [Book1]Sheet1>>
```

Changed in version 0.9.0.

api

Returns the native object (pywin32 or appscript obj) of the engine being used.

New in version 0.9.0.

delete()

Deletes the picture.

New in version 0.5.0.

height

Returns or sets the number of points that represent the height of the picture.

New in version 0.5.0.

left

Returns or sets the number of points that represent the horizontal position of the picture.

New in version 0.5.0.

name

Returns or sets the name of the picture.

New in version 0.5.0.

parent

Returns the parent of the picture.

New in version 0.9.0.

top

Returns or sets the number of points that represent the vertical position of the picture.

New in version 0.5.0.

update(image)

Replaces an existing picture with a new one, taking over the attributes of the existing picture.

Parameters image (*str or path-like object or matplotlib.figure.Figure*) – Either a filepath or a Matplotlib figure object.

New in version 0.5.0.

width

Returns or sets the number of points that represent the width of the picture.

New in version 0.5.0.

26.2.16 Names

class xlwings.main.Names (*impl*)

A collection of all name objects in the workbook:

```
>>> import xlwings as xw
>>> sht = xw.books['Book1'].sheets[0]
>>> sht.names
[<Name 'MyName': =Sheet1!$A$3>]
```

New in version 0.9.0.

add (*name*, *refers_to*)

Defines a new name for a range of cells.

Parameters

- **name** (*str*) – Specifies the text to use as the name. Names cannot include spaces and cannot be formatted as cell references.
- **refers_to** (*str*) – Describes what the name refers to, in English, using A1-style notation.

Returns

Return type *Name*

New in version 0.9.0.

api

Returns the native object (pywin32 or appscript obj) of the engine being used.

New in version 0.9.0.

count

Returns the number of objects in the collection.

26.2.17 Name

class `xlwings.Name` (*impl*)

The name object is a member of the *names* collection:

```
>>> import xlwings as xw
>>> sht = xw.books['Book1'].sheets[0]
>>> sht.names[0] # or sht.names['MyName']
<Name 'MyName': =Sheet1!$A$3>
```

New in version 0.9.0.

api

Returns the native object (pywin32 or appscript obj) of the engine being used.

New in version 0.9.0.

delete ()

Deletes the name.

New in version 0.9.0.

name

Returns or sets the name of the name object.

New in version 0.9.0.

refers_to

Returns or sets the formula that the name is defined to refer to, in A1-style notation, beginning with an equal sign.

New in version 0.9.0.

refers_to_range

Returns the Range object referred to by a Name object.

New in version 0.9.0.

26.2.18 Tables

class xlwings.main.Tables (*impl*)

A collection of all *table* objects on the specified sheet:

```
>>> import xlwings as xw
>>> xw.books['Book1'].sheets[0].tables
Tables([<Table 'Table1' in <Sheet [Book1]Sheet1>>, <Table 'Table2' in
↳<Sheet [Book1]Sheet1>>])
```

New in version 0.21.0.

add (*source=None, name=None, source_type=None, link_source=None, has_headers=True, destination=None, table_style_name='TableStyleMedium2'*)
Creates a Table to the specified sheet.

Parameters

- **source** (*xlwings range, default None*) – An xlwings range object, representing the data source.
- **name** (*str, default None*) – The name of the Table. By default, it uses the autogenerated name that is assigned by Excel.
- **source_type** (*str, default None*) – This currently defaults to `xlSrcRange`, i.e. expects an xlwings range object. No other options are allowed at the moment.
- **link_source** (*bool, default None*) – Currently not implemented as this is only in case `source_type` is `xlSrcExternal`.
- **has_headers** (*bool or str, default True*) – Indicates whether the data being imported has column labels. Defaults to `True`. Possible values: `True`, `False`, `'guess'`
- **destination** (*xlwings range, default None*) – Currently not implemented as this is used in case `source_type` is `xlSrcExternal`.
- **table_style_name** (*str, default 'TableStyleMedium2'*) – Possible strings: `'TableStyleLightN'` (where N is 1-21), `'TableStyleMediumN'` (where N is 1-28), `'TableStyleDarkN'` (where N is 1-11)

Returns

Return type *Table*

Examples

```
>>> import xlwings as xw
>>> sheet = xw.Book().sheets[0]
>>> sheet['A1'].value = [['a', 'b'], [1, 2]]
>>> table = sheet.tables.add(source=sheet['A1'].expand(), name=
↳ 'MyTable')
>>> table
<Table 'MyTable' in <Sheet [Book1]Sheet1>>
```

26.2.19 Table

class xlwings.main.Table(*args, **options)

The table object is a member of the *tables* collection:

```
>>> import xlwings as xw
>>> sht = xw.books['Book1'].sheets[0]
>>> sht.tables[0] # or sht.tables['TableName']
<Table 'Table 1' in <Sheet [Book1]Sheet1>>
```

New in version 0.21.0.

api

Returns the native object (pywin32 or appscript obj) of the engine being used.

data_body_range

Returns an xlwings range object that represents the range of values, excluding the header row

display_name

Returns or sets the display name for the specified Table object

header_row_range

Returns an xlwings range object that represents the range of the header row

insert_row_range

Returns an xlwings range object representing the row where data is going to be inserted. This is only available for empty tables, otherwise it'll return `None`

name

Returns or sets the name of the Table.

parent

Returns the parent of the table.

range

Returns an xlwings range object of the table.

show_autofilter

Turn the autofilter on or off by setting it to `True` or `False` (read/write boolean)

show_headers

Show or hide the header (read/write)

show_table_style_column_stripes

Returns or sets if the Column Stripes table style is used for (read/write boolean)

show_table_style_first_column

Returns or sets if the first column is formatted (read/write boolean)

show_table_style_last_column

Returns or sets if the last column is displayed (read/write boolean)

show_table_style_row_stripes

Returns or sets if the Row Stripes table style is used (read/write boolean)

show_totals

Gets or sets a boolean to show/hide the Total row.

table_style

Gets or sets the table style. See [Tables.add](#) for possible values.

totals_row_range

Returns an xlwings range object representing the Total row

update (*data*)

This method requires xlwings *PRO*

Updates the Excel table with the provided data. Currently restricted to DataFrames.

Changed in version 0.21.3.

Parameters **data** (*pandas DataFrame*) – Currently restricted to pandas DataFrames. If you want to hide the index, set the first column as the index, e.g. `df.set_index('column_name')`.

Returns

Return type *Table*

Examples

```
import pandas as pd
import xlwings as xw

sheet = xw.Book('Book1.xlsx').sheets[0]
table_name = 'mytable'

# Sample DataFrame
nrows, ncols = 3, 3
df = pd.DataFrame(data=nrows * [ncols * ['test']],
                  columns=['col ' + str(i) for i in range(ncols)])

# Hide the index, then insert a new table if it doesn't exist yet,
# otherwise update the existing one
df = df.set_index('col 0')
if table_name in [table.name for table in sheet.tables]:
    sheet.tables[table_name].update(df)
```

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```

else:
    mytable = sheet.tables.add(source=sheet['A1'], name=table_name).
    ↪update(df)

```

26.2.20 Font

class xlwings.main.**Font** (*impl*)

The font object can be accessed as an attribute of the range or shape object.

- `mysheet['A1'].font`
- `mysheet.shapes[0].font`

New in version 0.23.0.

api

Returns the native object (pywin32 or appscript obj) of the engine being used.

New in version 0.23.0.

bold

Returns or sets the bold property (boolean).

```

>>> sheet['A1'].font.bold = True
>>> sheet['A1'].font.bold
True

```

New in version 0.23.0.

color

Returns or sets the color property (tuple).

```

>>> sheet['A1'].font.color = (255, 0, 0) # RGB tuple
>>> sheet['A1'].font.color
(255, 0, 0)

```

New in version 0.23.0.

italic

Returns or sets the italic property (boolean).

```

>>> sheet['A1'].font.italic = True
>>> sheet['A1'].font.italic
True

```

New in version 0.23.0.

name

Returns or sets the name of the font (str).

```
>>> sheet['A1'].font.name = 'Calibri'
>>> sheet['A1'].font.name
Calibri
```

New in version 0.23.0.

size

Returns or sets the size (float).

```
>>> sheet['A1'].font.size = 13
>>> sheet['A1'].font.size
13
```

New in version 0.23.0.

26.2.21 Characters

class `xlwings.main.Characters` (*impl*)

The characters object can be accessed as an attribute of the range or shape object.

- `mysheet['A1'].characters`
- `mysheet.shapes[0].characters`

Note: On macOS, `characters` are currently not supported due to bugs/lack of support in AppleScript.

New in version 0.23.0.

api

Returns the native object (pywin32 or applescript obj) of the engine being used.

New in version 0.23.0.

font

Returns or sets the text property of a characters object.

```
>>> sheet['A1'].characters[1:3].font.bold = True
>>> sheet['A1'].characters[1:3].font.bold
True
```

New in version 0.23.0.

text

Returns or sets the text property of a characters object.

```
>>> sheet['A1'].value = 'Python'
>>> sheet['A1'].characters[:3].text
Pyt
```

New in version 0.23.0.

26.2.22 Markdown

```
class xlwings.pro.Markdown(text, style=<MarkdownStyle> h1.font: .bold: True
                        h1.blank_lines_after: 1 paragraph.blank_lines_after:
                        1 unordered_list.bullet_character: • un-
                        ordered_list.blank_lines_after: 1 strong.bold: True
                        emphasis.italic: True)
```

Markdown objects can be assigned to a single cell or shape via `myrange.value` or `myshape.text`. They accept a string in Markdown format which will cause the text in the cell to be formatted accordingly. They can also be used in `mysheet.render_template()`.

Note: On macOS, formatting is currently not supported, but things like bullet points will still work.

Parameters

- **text** (*str*) – The text in Markdown syntax
- **style** (*MarkdownStyle object, optional*) – The `MarkdownStyle` object defines how the text will be formatted.

Examples

```
>>> mysheet['A1'].value = Markdown("A text with *emphasis* and_
↪**strong** style.")
>>> myshape.text = Markdown("A text with *emphasis* and **strong** style.
↪")
```

New in version 0.23.0.

26.2.23 MarkdownStyle

```
class xlwings.pro.MarkdownStyle
```

`MarkdownStyle` defines how Markdown objects are being rendered in Excel cells or shapes. Start by instantiating a `MarkdownStyle` object. Printing it will show you the current (default) style:

```
>>> style = MarkdownStyle()
>>> style
<MarkdownStyle>
h1.font: .bold: True
h1.blank_lines_after: 1
paragraph.blank_lines_after: 1
unordered_list.bullet_character: •
unordered_list.blank_lines_after: 1
strong.bold: True
emphasis.italic: True
```

You can override the defaults, e.g., to make `**strong**` text red instead of bold, do this:

```
>>> style.strong.bold = False
>>> style.strong.color = (255, 0, 0)
>>> style.strong
strong.color: (255, 0, 0)
```

New in version 0.23.0.

26.3 UDF decorators

`xlwings.func(category="xlwings", volatile=False, call_in_wizard=True)`

Functions decorated with `xlwings.func` will be imported as `Function` to Excel when running “Import Python UDFs”.

category [int or str, default “xlwings”] 1-14 represent built-in categories, for user-defined categories use strings

New in version 0.10.3.

volatile [bool, default False] Marks a user-defined function as volatile. A volatile function must be recalculated whenever calculation occurs in any cells on the worksheet. A nonvolatile function is recalculated only when the input variables change. This method has no effect if it’s not inside a user-defined function used to calculate a worksheet cell.

New in version 0.10.3.

call_in_wizard [bool, default True] Set to False to suppress the function call in the function wizard.

New in version 0.10.3.

`xlwings.sub()`

Functions decorated with `xlwings.sub` will be imported as `Sub` (i.e. macro) to Excel when running “Import Python UDFs”.

`xlwings.arg(arg, convert=None, **options)`

Apply converters and options to arguments, see also `Range.options()`.

Examples:

Convert `x` into a 2-dimensional numpy array:

```
import xlwings as xw
import numpy as np

@xw.func
@xw.arg('x', np.array, ndim=2)
def add_one(x):
    return x + 1
```

`xlwings.ret(convert=None, **options)`

Apply converters and options to return values, see also `Range.options()`.

Examples

1) Suppress the index and header of a returned DataFrame:

```
import pandas as pd

@xw.func
@xw.ret(index=False, header=False)
def get_dataframe(n, m):
    return pd.DataFrame(np.arange(n * m).reshape((n, m)))
```

2) Dynamic array:

Note: If your version of Excel supports the new native dynamic arrays, then you don't have to do anything special, and you shouldn't use the `expand` decorator! To check if your version of Excel supports it, see if you have the `=UNIQUE()` formula available. Native dynamic arrays were introduced in Office 365 Insider Fast at the end of September 2018.

`expand='table'` turns the UDF into a dynamic array. Currently you must not use volatile functions as arguments of a dynamic array, e.g. you cannot use `=TODAY()` as part of a dynamic array. Also note that a dynamic array needs an empty row and column at the bottom and to the right and will overwrite existing data without warning.

Unlike standard Excel arrays, dynamic arrays are being used from a single cell like a standard function and auto-expand depending on the dimensions of the returned array:

```
import xlwings as xw
import numpy as np

@xw.func
@xw.ret(expand='table')
def dynamic_array(n, m):
    return np.arange(n * m).reshape((n, m))
```

New in version 0.10.0.

26.4 Reports

```
xlwings.pro.reports.create_report(template, output, book_settings=None,
                                  app=None, **data)
```

This function requires xlwings *PRO*.

This is a convenience wrapper around `mysheet.render_template`

Writes the values of all key word arguments to the `output` file according to the `template` and the variables contained in there (Jinja variable syntax). Following variable types are supported:

strings, numbers, lists, simple dicts, NumPy arrays, Pandas DataFrames, PIL Image objects that have a filename and Matplotlib figures.

Parameters

- **template** (*str*) – Path to your Excel template, e.g. `r'C:\Path\to\my_template.xlsx'`
- **output** (*str*) – Path to your Report, e.g. `r'C:\Path\to\my_report.xlsx'`
- **book_settings** (*dict*, default *None*) – A dictionary of xlwings Book parameters, for details see: `xlwings.Book`. For example: `book_settings={'update_links': False}`.
- **app** (*xlwings App*, default *None*) – By passing in an xlwings App instance, you can control where your report runs and configure things like `visible=False`. For details see `xlwings.App`. By default, it creates the report in the currently active instance of Excel.
- **data** (*kwargs*) – All key/value pairs that are used in the template.

Returns `wb`

Return type `xlwings Book`

Examples

In `my_template.xlsx`, put the following Jinja variables in two cells: `{{ title }}` and `{{ df }}`

```
>>> from xlwings.pro.reports import create_report
>>> import pandas as pd
>>> df = pd.DataFrame(data=[[1,2],[3,4]])
>>> wb = create_report('my_template.xlsx', 'my_report.xlsx', title=
↪ 'MyTitle', df=df)
```

With many template variables it may be useful to collect the data first:

```
>>> data = dict(title='MyTitle', df=df)
>>> wb = create_report('my_template.xlsx', 'my_report.xlsx', **data)
```

If you need to handle external links or a password, use it like so:

```
>>> wb = create_report('my_template.xlsx', 'my_report.xlsx',
                      book_settings={'update_links': True, 'password':
↪ 'mypassword'},
                      **data)
```

You can control the Excel instance by passing in an xlwings App instance. For example, to run the report in a separate and hidden instance of Excel, do the following:

```
>>> import xlwings as xw
>>> from xlwings.pro.reports import create_report
>>> app = xw.App(visible=False) # Separate and hidden Excel instance
>>> wb = create_report('my_template.xlsx', 'my_report.xlsx', app=app,
↪ **data)
>>> app.quit() # Close the wb and quit the Excel instance
```

New in version 0.13.0.

27.1 Quickstart

xlwings offers an easy way to expose an Excel workbook via REST API both on Windows and macOS. This can be useful when you have a workbook running on a single computer and want to access it from another computer. Or you can build a Linux based web app that can interact with a legacy Excel application while you are in the progress of migrating the Excel functionality into your web app (if you need help with that, [give us a shout](#)).

You can run the REST API server from a command prompt or terminal as follows (this requires Flask>=1.0, so make sure to `pip install Flask`):

```
xlwings restapi run
```

Then perform a GET request e.g. via PowerShell on Windows or Terminal on Mac (while having an unsaved “Book1” open). Note that you need to run the server and the GET request from two separate terminals (or you can use something more convenient like [Postman](#) or [Insomnia](#) for testing the API):

```
$ curl "http://127.0.0.1:5000/book/book1/sheets/0/range/A1:B2"
{
  "address": "$A$1:$B$2",
  "color": null,
  "column": 1,
  "column_width": 10.0,
  "count": 4,
  "current_region": "$A$1:$B$2",
  "formula": [
```

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```
[
  "1",
  "2"
],
[
  "3",
  "4"
]
],
"formula_array": null,
"height": 32.0,
"last_cell": "$B$2",
"left": 0.0,
"name": null,
"number_format": "General",
"row": 1,
"row_height": 16.0,
"shape": [
  2,
  2
],
"size": 4,
"top": 0.0,
"value": [
  [
    1.0,
    2.0
  ],
  [
    3.0,
    4.0
  ]
],
"width": 130.0
}
```

In the command prompt where your server is running, press `Ctrl-C` to shut it down again.

The xlwings REST API is a thin wrapper around the *Python API* which makes it very easy if you have worked previously with xlwings. It also means that the REST API does require the Excel application to be up and running which makes it a great choice if the data in your Excel workbook is constantly changing as the REST API will always deliver the current state of the workbook without the need of saving it first.

Note: Currently, we only provide the GET methods to read the workbook. If you are also interested in the POST methods to edit the workbook, let us know via GitHub issues. Some other things will also need improvement, most notably exception handling.

27.2 Run the server

`xlwings restapi run` will run a Flask development server on <http://127.0.0.1:5000>. You can provide `--host` and `--port` as command line args and it also respects the Flask environment variables like `FLASK_ENV=development`.

If you want to have more control, you can run the server directly with Flask, see the [Flask docs](#) for more details:

```
set FLASK_APP=xlwings.rest.api
flask run
```

If you are on Mac, use `export FLASK_APP=xlwings.rest.api` instead of `set FLASK_APP=xlwings.rest.api`.

For production, you can use any WSGI HTTP Server like [gunicorn](#) (on Mac) or [waitress](#) (on Mac/Windows) to serve the API. For example, with gunicorn you would do: `gunicorn xlwings.rest.api:api`. Or with waitress (adjust the host accordingly if you want to make the api accessible from outside of localhost):

```
from xlwings.rest.api import api
from waitress import serve
serve(wsgiapp, host='127.0.0.1', port=5000)
```

27.3 Indexing

While the Python API offers Python's 0-based indexing (e.g. `xw.books[0]`) as well as Excel's 1-based indexing (e.g. `xw.books(1)`), the REST API only offers 0-based indexing, e.g. `/books/0`.

27.4 Range Options

The REST API accepts Range options as query parameters, see `xlwings.Range.options()` e.g.

`/book/book1/sheets/0/range/A1?expand=table&transpose=true`

Remember that options only affect the value property.

27.5 Endpoint overview

End-point	Corresponds to	Short Description
<i>/book</i>	<i>Book</i>	Finds your workbook across all open instances of Excel and will open it if it can't find it
<i>/books</i>	<i>Books</i>	Books collection of the active Excel instance
<i>/apps</i>	<i>Apps</i>	This allows you to specify the Excel instance you want to work with

27.6 Endpoint details

27.6.1 /book

GET /book/<fullname_or_name>

Example response:

```
{
  "app": 1104,
  "fullname": "C:\\Users\\felix\\DEV\\xlwings\\scripts\\Book1.xlsx",
  "name": "Book1.xlsx",
  "names": [
    "Sheet1!myname1",
    "myname2"
  ],
  "selection": "Sheet2!$A$1",
  "sheets": [
    "Sheet1",
    "Sheet2"
  ]
}
```

GET /book/<fullname_or_name>/names

Example response:

```
{
  "names": [
    {
      "name": "Sheet1!myname1",
      "refers_to": "=Sheet1!$B$2:$C$3"
    },
    {
      "name": "myname2",
      "refers_to": "=Sheet1!$A$1"
    }
  ]
}
```

GET /book/<fullname_or_name>/names/<name>

Example response:

```
{
  "name": "myname2",
  "refers_to": "=Sheet1!$A$1"
}
```

GET /book/<fullname_or_name>/names/<name>/range

Example response:

```
{
  "address": "$A$1",
  "color": null,
  "column": 1,
  "column_width": 8.47,
  "count": 1,
  "current_region": "$A$1:$B$2",
  "formula": "=1+1.1",
  "formula_array": "=1+1,1",
  "height": 14.25,
  "last_cell": "$A$1",
  "left": 0.0,
  "name": "myname2",
  "number_format": "General",
  "row": 1,
  "row_height": 14.3,
  "shape": [
    1,
    1
  ],
  "size": 1,
  "top": 0.0,
  "value": 2.1,
  "width": 51.0
}
```

GET /book/<fullname_or_name>/sheets

Example response:

```
{
  "sheets": [
    {
      "charts": [
        "Chart 1"
      ],
      "name": "Sheet1",
      "names": [
        "Sheet1!myname1"
      ],
      "pictures": [
        "Picture 3"
      ],
      "shapes": [
        "Chart 1",
        "Picture 3"
      ],
      "used_range": "$A$1:$B$2"
    },
    {
      "charts": [],
      "name": "Sheet2",
      "names": [],

```

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```
    "pictures": [],
    "shapes": [],
    "used_range": "$A$1"
  }
]
```

GET /book/<fullname_or_name>/sheets/<sheet_name_or_ix>**Example response:**

```
{
  "charts": [
    "Chart 1"
  ],
  "name": "Sheet1",
  "names": [
    "Sheet1!myname1"
  ],
  "pictures": [
    "Picture 3"
  ],
  "shapes": [
    "Chart 1",
    "Picture 3"
  ],
  "used_range": "$A$1:$B$2"
}
```

GET /book/<fullname_or_name>/sheets/<sheet_name_or_ix>/charts**Example response:**

```
{
  "charts": [
    {
      "chart_type": "line",
      "height": 211.0,
      "left": 0.0,
      "name": "Chart 1",
      "top": 0.0,
      "width": 355.0
    }
  ]
}
```

GET /book/<fullname_or_name>/sheets/<sheet_name_or_ix>/charts/<chart_name_or_ix>**Example response:**

```
{
  "chart_type": "line",
```

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```

    "height": 211.0,
    "left": 0.0,
    "name": "Chart 1",
    "top": 0.0,
    "width": 355.0
  }

```

GET /book/<fullname_or_name>/sheets/<sheet_name_or_ix>/names

Example response:

```

{
  "names": [
    {
      "name": "Sheet1!myname1",
      "refers_to": "=Sheet1!$B$2:$C$3"
    }
  ]
}

```

GET /book/<fullname_or_name>/sheets/<sheet_name_or_ix>/names/<sheet_scope_name>

Example response:

```

{
  "name": "Sheet1!myname1",
  "refers_to": "=Sheet1!$B$2:$C$3"
}

```

GET /book/<fullname_or_name>/sheets/<sheet_name_or_ix>/names/<sheet_scope_name>/range

Example response:

```

{
  "address": "$B$2:$C$3",
  "color": null,
  "column": 2,
  "column_width": 8.47,
  "count": 4,
  "current_region": "$A$1:$B$2",
  "formula": [
    [
      "",
      ""
    ],
    [
      "",
      ""
    ]
  ],
  "formula_array": "",
  "height": 28.5,

```

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```
"last_cell": "$C$3",
"left": 51.0,
"name": "Sheet1!myname1",
"number_format": "General",
"row": 2,
"row_height": 14.3,
"shape": [
  2,
  2
],
"size": 4,
"top": 14.25,
"value": [
  [
    null,
    null
  ],
  [
    null,
    null
  ]
],
"width": 102.0
}
```

GET /book/<fullname_or_name>/sheets/<sheet_name_or_ix>/pictures

Example response:

```
{
  "pictures": [
    {
      "height": 100.0,
      "left": 0.0,
      "name": "Picture 3",
      "top": 0.0,
      "width": 100.0
    }
  ]
}
```

GET /book/<fullname_or_name>/sheets/<sheet_name_or_ix>/pictures/<picture_name_or_ix>

Example response:

```
{
  "height": 100.0,
  "left": 0.0,
  "name": "Picture 3",
  "top": 0.0,
  "width": 100.0
}
```

GET /book/<fullname_or_name>/sheets/<sheet_name_or_ix>/range

Example response:

```
{
  "address": "$A$1:$B$2",
  "color": null,
  "column": 1,
  "column_width": 8.47,
  "count": 4,
  "current_region": "$A$1:$B$2",
  "formula": [
    [
      "=1+1.1",
      "a string"
    ],
    [
      "43395.0064583333",
      ""
    ]
  ],
  "formula_array": null,
  "height": 28.5,
  "last_cell": "$B$2",
  "left": 0.0,
  "name": null,
  "number_format": null,
  "row": 1,
  "row_height": 14.3,
  "shape": [
    2,
    2
  ],
  "size": 4,
  "top": 0.0,
  "value": [
    [
      2.1,
      "a string"
    ],
    [
      "Mon, 22 Oct 2018 00:09:18 GMT",
      null
    ]
  ],
  "width": 102.0
}
```

GET /book/<fullname_or_name>/sheets/<sheet_name_or_ix>/range/<address>

Example response:

```
{
  "address": "$A$1:$B$2",
```

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```

"color": null,
"column": 1,
"column_width": 8.47,
"count": 4,
"current_region": "$A$1:$B$2",
"formula": [
  [
    "=1+1.1",
    "a string"
  ],
  [
    "43395.0064583333",
    ""
  ]
],
"formula_array": null,
"height": 28.5,
"last_cell": "$B$2",
"left": 0.0,
"name": null,
"number_format": null,
"row": 1,
"row_height": 14.3,
"shape": [
  2,
  2
],
"size": 4,
"top": 0.0,
"value": [
  [
    2.1,
    "a string"
  ],
  [
    "Mon, 22 Oct 2018 00:09:18 GMT",
    null
  ]
],
"width": 102.0
}

```

GET /book/<fullname_or_name>/sheets/<sheet_name_or_ix>/shapes

Example response:

```

{
  "shapes": [
    {
      "height": 211.0,
      "left": 0.0,
      "name": "Chart 1",

```

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```

    "top": 0.0,
    "type": "chart",
    "width": 355.0
  },
  {
    "height": 100.0,
    "left": 0.0,
    "name": "Picture 3",
    "top": 0.0,
    "type": "picture",
    "width": 100.0
  }
]
}

```

GET /book/<fullname_or_name>/sheets/<sheet_name_or_ix>/shapes/<shape_name_or_ix>

Example response:

```

{
  "height": 211.0,
  "left": 0.0,
  "name": "Chart 1",
  "top": 0.0,
  "type": "chart",
  "width": 355.0
}

```

27.6.2 /books

GET /books

Example response:

```

{
  "books": [
    {
      "app": 1104,
      "fullname": "Book1",
      "name": "Book1",
      "names": [],
      "selection": "Sheet2!$A$1",
      "sheets": [
        "Sheet1"
      ]
    },
    {
      "app": 1104,
      "fullname": "C:\\Users\\felix\\DEV\\xlwings\\scripts\\Book1.xlsx",
      "name": "Book1.xlsx",

```

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```

    "names": [
      "Sheet1!myname1",
      "myname2"
    ],
    "selection": "Sheet2!$A$1",
    "sheets": [
      "Sheet1",
      "Sheet2"
    ]
  },
  {
    "app": 1104,
    "fullname": "Book4",
    "name": "Book4",
    "names": [],
    "selection": "Sheet2!$A$1",
    "sheets": [
      "Sheet1"
    ]
  }
]
}

```

GET /books/<book_name_or_ix>

Example response:

```

{
  "app": 1104,
  "fullname": "C:\\Users\\felix\\DEV\\xlwings\\scripts\\Book1.xlsx",
  "name": "Book1.xlsx",
  "names": [
    "Sheet1!myname1",
    "myname2"
  ],
  "selection": "Sheet2!$A$1",
  "sheets": [
    "Sheet1",
    "Sheet2"
  ]
}

```

GET /books/<book_name_or_ix>/names

Example response:

```

{
  "names": [
    {
      "name": "Sheet1!myname1",
      "refers_to": "=Sheet1!$B$2:$C$3"
    },
  ],
}

```

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```
{
  "name": "myname2",
  "refers_to": "=Sheet1!$A$1"
}
```

GET /books/<book_name_or_ix>/names/<name>

Example response:

```
{
  "name": "myname2",
  "refers_to": "=Sheet1!$A$1"
}
```

GET /books/<book_name_or_ix>/names/<name>/range

Example response:

```
{
  "address": "$A$1",
  "color": null,
  "column": 1,
  "column_width": 8.47,
  "count": 1,
  "current_region": "$A$1:$B$2",
  "formula": "=1+1.1",
  "formula_array": "=1+1,1",
  "height": 14.25,
  "last_cell": "$A$1",
  "left": 0.0,
  "name": "myname2",
  "number_format": "General",
  "row": 1,
  "row_height": 14.3,
  "shape": [
    1,
    1
  ],
  "size": 1,
  "top": 0.0,
  "value": 2.1,
  "width": 51.0
}
```

GET /books/<book_name_or_ix>/sheets

Example response:

```
{
  "sheets": [
```

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```

{
  "charts": [
    "Chart 1"
  ],
  "name": "Sheet1",
  "names": [
    "Sheet1!myname1"
  ],
  "pictures": [
    "Picture 3"
  ],
  "shapes": [
    "Chart 1",
    "Picture 3"
  ],
  "used_range": "$A$1:$B$2"
},
{
  "charts": [],
  "name": "Sheet2",
  "names": [],
  "pictures": [],
  "shapes": [],
  "used_range": "$A$1"
}
]
}

```

GET /books/<book_name_or_ix>/sheets/<sheet_name_or_ix>

Example response:

```

{
  "charts": [
    "Chart 1"
  ],
  "name": "Sheet1",
  "names": [
    "Sheet1!myname1"
  ],
  "pictures": [
    "Picture 3"
  ],
  "shapes": [
    "Chart 1",
    "Picture 3"
  ],
  "used_range": "$A$1:$B$2"
}

```

GET /books/<book_name_or_ix>/sheets/<sheet_name_or_ix>/charts

Example response:

```
{
  "charts": [
    {
      "chart_type": "line",
      "height": 211.0,
      "left": 0.0,
      "name": "Chart 1",
      "top": 0.0,
      "width": 355.0
    }
  ]
}
```

GET /books/<book_name_or_ix>/sheets/<sheet_name_or_ix>/charts/<chart_name_or_ix>

Example response:

```
{
  "chart_type": "line",
  "height": 211.0,
  "left": 0.0,
  "name": "Chart 1",
  "top": 0.0,
  "width": 355.0
}
```

GET /books/<book_name_or_ix>/sheets/<sheet_name_or_ix>/names

Example response:

```
{
  "names": [
    {
      "name": "Sheet1!myname1",
      "refers_to": "=Sheet1!$B$2:$C$3"
    }
  ]
}
```

GET /books/<book_name_or_ix>/sheets/<sheet_name_or_ix>/names/<sheet_scope_name>

Example response:

```
{
  "name": "Sheet1!myname1",
  "refers_to": "=Sheet1!$B$2:$C$3"
}
```

GET /books/<book_name_or_ix>/sheets/<sheet_name_or_ix>/names/<sheet_scope_name>/range

Example response:

```
{
  "address": "$B$2:$C$3",
  "color": null,
  "column": 2,
  "column_width": 8.47,
  "count": 4,
  "current_region": "$A$1:$B$2",
  "formula": [
    [
      "",
      ""
    ],
    [
      "",
      ""
    ]
  ],
  "formula_array": "",
  "height": 28.5,
  "last_cell": "$C$3",
  "left": 51.0,
  "name": "Sheet1!myname1",
  "number_format": "General",
  "row": 2,
  "row_height": 14.3,
  "shape": [
    2,
    2
  ],
  "size": 4,
  "top": 14.25,
  "value": [
    [
      null,
      null
    ],
    [
      null,
      null
    ]
  ],
  "width": 102.0
}
```

GET /books/<book_name_or_ix>/sheets/<sheet_name_or_ix>/pictures

Example response:

```
{
  "pictures": [
    {
      "height": 100.0,
      "left": 0.0,
```

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```

    "name": "Picture 3",
    "top": 0.0,
    "width": 100.0
  }
]
}

```

GET /books/<book_name_or_ix>/sheets/<sheet_name_or_ix>/pictures/<picture_name_or_ix>

Example response:

```

{
  "height": 100.0,
  "left": 0.0,
  "name": "Picture 3",
  "top": 0.0,
  "width": 100.0
}

```

GET /books/<book_name_or_ix>/sheets/<sheet_name_or_ix>/range

Example response:

```

{
  "address": "$A$1:$B$2",
  "color": null,
  "column": 1,
  "column_width": 8.47,
  "count": 4,
  "current_region": "$A$1:$B$2",
  "formula": [
    [
      "=1+1.1",
      "a string"
    ],
    [
      "43395.0064583333",
      ""
    ]
  ],
  "formula_array": null,
  "height": 28.5,
  "last_cell": "$B$2",
  "left": 0.0,
  "name": null,
  "number_format": null,
  "row": 1,
  "row_height": 14.3,
  "shape": [
    2,
    2
  ],
}

```

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```

"size": 4,
"top": 0.0,
"value": [
  [
    2.1,
    "a string"
  ],
  [
    "Mon, 22 Oct 2018 00:09:18 GMT",
    null
  ]
],
"width": 102.0
}

```

GET /books/<book_name_or_ix>/sheets/<sheet_name_or_ix>/range/<address>

Example response:

```

{
  "address": "$A$1:$B$2",
  "color": null,
  "column": 1,
  "column_width": 8.47,
  "count": 4,
  "current_region": "$A$1:$B$2",
  "formula": [
    [
      "=1+1.1",
      "a string"
    ],
    [
      "43395.0064583333",
      ""
    ]
  ],
  "formula_array": null,
  "height": 28.5,
  "last_cell": "$B$2",
  "left": 0.0,
  "name": null,
  "number_format": null,
  "row": 1,
  "row_height": 14.3,
  "shape": [
    2,
    2
  ],
  "size": 4,
  "top": 0.0,
  "value": [
    [

```

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```

    2.1,
    "a string"
  ],
  [
    "Mon, 22 Oct 2018 00:09:18 GMT",
    null
  ]
],
"width": 102.0
}

```

GET /books/<book_name_or_ix>/sheets/<sheet_name_or_ix>/shapes

Example response:

```

{
  "shapes": [
    {
      "height": 211.0,
      "left": 0.0,
      "name": "Chart 1",
      "top": 0.0,
      "type": "chart",
      "width": 355.0
    },
    {
      "height": 100.0,
      "left": 0.0,
      "name": "Picture 3",
      "top": 0.0,
      "type": "picture",
      "width": 100.0
    }
  ]
}

```

GET /books/<book_name_or_ix>/sheets/<sheet_name_or_ix>/shapes/<shape_name_or_ix>

Example response:

```

{
  "height": 211.0,
  "left": 0.0,
  "name": "Chart 1",
  "top": 0.0,
  "type": "chart",
  "width": 355.0
}

```

27.6.3 /apps

GET /apps

Example response:

```
{
  "apps": [
    {
      "books": [
        "Book1",
        "C:\\Users\\felix\\DEV\\xlwings\\scripts\\Book1.xlsx",
        "Book4"
      ],
      "calculation": "automatic",
      "display_alerts": true,
      "pid": 1104,
      "screen_updating": true,
      "selection": "[Book1.xlsx]Sheet2!$A$1",
      "version": "16.0",
      "visible": true
    },
    {
      "books": [
        "Book2",
        "Book5"
      ],
      "calculation": "automatic",
      "display_alerts": true,
      "pid": 7920,
      "screen_updating": true,
      "selection": "[Book5]Sheet2!$A$1",
      "version": "16.0",
      "visible": true
    }
  ]
}
```

GET /apps/<pid>

Example response:

```
{
  "books": [
    "Book1",
    "C:\\Users\\felix\\DEV\\xlwings\\scripts\\Book1.xlsx",
    "Book4"
  ],
  "calculation": "automatic",
  "display_alerts": true,
  "pid": 1104,
  "screen_updating": true,
  "selection": "[Book1.xlsx]Sheet2!$A$1",
```

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```

"version": "16.0",
"visible": true
}

```

GET /apps/<pid>/books

Example response:

```

{
  "books": [
    {
      "app": 1104,
      "fullname": "Book1",
      "name": "Book1",
      "names": [],
      "selection": "Sheet2!$A$1",
      "sheets": [
        "Sheet1"
      ]
    },
    {
      "app": 1104,
      "fullname": "C:\\Users\\felix\\DEV\\xlwings\\scripts\\Book1.xlsx",
      "name": "Book1.xlsx",
      "names": [
        "Sheet1!myname1",
        "myname2"
      ],
      "selection": "Sheet2!$A$1",
      "sheets": [
        "Sheet1",
        "Sheet2"
      ]
    },
    {
      "app": 1104,
      "fullname": "Book4",
      "name": "Book4",
      "names": [],
      "selection": "Sheet2!$A$1",
      "sheets": [
        "Sheet1"
      ]
    }
  ]
}

```

GET /apps/<pid>/books/<book_name_or_ix>

Example response:

```

{

```

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```
"app": 1104,
"fullname": "C:\\Users\\felix\\DEV\\xlwings\\scripts\\Book1.xlsx",
"name": "Book1.xlsx",
"names": [
  "Sheet1!myname1",
  "myname2"
],
"selection": "Sheet2!$A$1",
"sheets": [
  "Sheet1",
  "Sheet2"
]
}
```

GET /apps/<pid>/books/<book_name_or_ix>/names**Example response:**

```
{
  "names": [
    {
      "name": "Sheet1!myname1",
      "refers_to": "=Sheet1!$B$2:$C$3"
    },
    {
      "name": "myname2",
      "refers_to": "=Sheet1!$A$1"
    }
  ]
}
```

GET /apps/<pid>/books/<book_name_or_ix>/names/<name>**Example response:**

```
{
  "name": "myname2",
  "refers_to": "=Sheet1!$A$1"
}
```

GET /apps/<pid>/books/<book_name_or_ix>/names/<name>/range**Example response:**

```
{
  "address": "$A$1",
  "color": null,
  "column": 1,
  "column_width": 8.47,
  "count": 1,
  "current_region": "$A$1:$B$2",
  "formula": "=1+1.1",

```

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```

"formula_array": "=1+1,1",
"height": 14.25,
"last_cell": "$A$1",
"left": 0.0,
"name": "myname2",
"number_format": "General",
"row": 1,
"row_height": 14.3,
"shape": [
    1,
    1
],
"size": 1,
"top": 0.0,
"value": 2.1,
"width": 51.0
}

```

GET /apps/<pid>/books/<book_name_or_ix>/sheets

Example response:

```

{
  "sheets": [
    {
      "charts": [
        "Chart 1"
      ],
      "name": "Sheet1",
      "names": [
        "Sheet1!myname1"
      ],
      "pictures": [
        "Picture 3"
      ],
      "shapes": [
        "Chart 1",
        "Picture 3"
      ],
      "used_range": "$A$1:$B$2"
    },
    {
      "charts": [],
      "name": "Sheet2",
      "names": [],
      "pictures": [],
      "shapes": [],
      "used_range": "$A$1"
    }
  ]
}

```

GET /apps/<pid>/books/<book_name_or_ix>/sheets/<sheet_name_or_ix>

Example response:

```
{
  "charts": [
    "Chart 1"
  ],
  "name": "Sheet1",
  "names": [
    "Sheet1!myname1"
  ],
  "pictures": [
    "Picture 3"
  ],
  "shapes": [
    "Chart 1",
    "Picture 3"
  ],
  "used_range": "$A$1:$B$2"
}
```

GET /apps/<pid>/books/<book_name_or_ix>/sheets/<sheet_name_or_ix>/charts

Example response:

```
{
  "charts": [
    {
      "chart_type": "line",
      "height": 211.0,
      "left": 0.0,
      "name": "Chart 1",
      "top": 0.0,
      "width": 355.0
    }
  ]
}
```

GET /apps/<pid>/books/<book_name_or_ix>/sheets/<sheet_name_or_ix>/charts/<chart_name_or_ix>

Example response:

```
{
  "chart_type": "line",
  "height": 211.0,
  "left": 0.0,
  "name": "Chart 1",
  "top": 0.0,
  "width": 355.0
}
```

GET /apps/<pid>/books/<book_name_or_ix>/sheets/<sheet_name_or_ix>/names

Example response:

```
{
  "names": [
    {
      "name": "Sheet1!myname1",
      "refers_to": "=Sheet1!$B$2:$C$3"
    }
  ]
}
```

GET /apps/<pid>/books/<book_name_or_ix>/sheets/<sheet_name_or_ix>/names/<sheet_scope>

Example response:

```
{
  "name": "Sheet1!myname1",
  "refers_to": "=Sheet1!$B$2:$C$3"
}
```

GET /apps/<pid>/books/<book_name_or_ix>/sheets/<sheet_name_or_ix>/names/<sheet_scope>

Example response:

```
{
  "address": "$B$2:$C$3",
  "color": null,
  "column": 2,
  "column_width": 8.47,
  "count": 4,
  "current_region": "$A$1:$B$2",
  "formula": [
    [
      "",
      ""
    ],
    [
      "",
      ""
    ]
  ],
  "formula_array": "",
  "height": 28.5,
  "last_cell": "$C$3",
  "left": 51.0,
  "name": "Sheet1!myname1",
  "number_format": "General",
  "row": 2,
  "row_height": 14.3,
  "shape": [
    2,
    2
  ],
  "size": 4,
  "top": 14.25,
}
```

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```
"value": [
  [
    null,
    null
  ],
  [
    null,
    null
  ]
],
"width": 102.0
}
```

GET /apps/<pid>/books/<book_name_or_ix>/sheets/<sheet_name_or_ix>/pictures

Example response:

```
{
  "pictures": [
    {
      "height": 100.0,
      "left": 0.0,
      "name": "Picture 3",
      "top": 0.0,
      "width": 100.0
    }
  ]
}
```

GET /apps/<pid>/books/<book_name_or_ix>/sheets/<sheet_name_or_ix>/pictures/<picture_name_or_ix>

Example response:

```
{
  "height": 100.0,
  "left": 0.0,
  "name": "Picture 3",
  "top": 0.0,
  "width": 100.0
}
```

GET /apps/<pid>/books/<book_name_or_ix>/sheets/<sheet_name_or_ix>/range

Example response:

```
{
  "address": "$A$1:$B$2",
  "color": null,
  "column": 1,
  "column_width": 8.47,
  "count": 4,
  "current_region": "$A$1:$B$2",

```

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```

"formula": [
  [
    "=1+1.1",
    "a string"
  ],
  [
    "43395.0064583333",
    ""
  ]
],
"formula_array": null,
"height": 28.5,
"last_cell": "$B$2",
"left": 0.0,
"name": null,
"number_format": null,
"row": 1,
"row_height": 14.3,
"shape": [
  2,
  2
],
"size": 4,
"top": 0.0,
"value": [
  [
    2.1,
    "a string"
  ],
  [
    "Mon, 22 Oct 2018 00:09:18 GMT",
    null
  ]
],
"width": 102.0
}

```

GET /apps/<pid>/books/<book_name_or_ix>/sheets/<sheet_name_or_ix>/range/<address>

Example response:

```

{
  "address": "$A$1:$B$2",
  "color": null,
  "column": 1,
  "column_width": 8.47,
  "count": 4,
  "current_region": "$A$1:$B$2",
  "formula": [
    [
      "=1+1.1",
      "a string"
    ]
  ]
}

```

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```

    ],
    [
        "43395.0064583333",
        ""
    ]
],
"formula_array": null,
"height": 28.5,
"last_cell": "$B$2",
"left": 0.0,
"name": null,
"number_format": null,
"row": 1,
"row_height": 14.3,
"shape": [
    2,
    2
],
"size": 4,
"top": 0.0,
"value": [
    [
        2.1,
        "a string"
    ],
    [
        "Mon, 22 Oct 2018 00:09:18 GMT",
        null
    ]
],
"width": 102.0
}

```

GET /apps/<pid>/books/<book_name_or_ix>/sheets/<sheet_name_or_ix>/shapes

Example response:

```

{
  "shapes": [
    {
      "height": 211.0,
      "left": 0.0,
      "name": "Chart 1",
      "top": 0.0,
      "type": "chart",
      "width": 355.0
    },
    {
      "height": 100.0,
      "left": 0.0,
      "name": "Picture 3",
      "top": 0.0,

```

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```
    "type": "picture",
    "width": 100.0
  }
]
```

GET /apps/<pid>/books/<book_name_or_ix>/sheets/<sheet_name_or_ix>/shapes/<shape_name_or_ix>

Example response:

```
{
  "height": 211.0,
  "left": 0.0,
  "name": "Chart 1",
  "top": 0.0,
  "type": "chart",
  "width": 355.0
}
```


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