
xlwings - Make Excel Fly!

Release dev

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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 :)

INSTALLATION

2.1 Prerequisites

- Traditionally, xlwings requires an **installation of Excel** and therefore only works on **Windows** and **macOS**. Note that macOS currently does not support UDFs.
- Since v0.26.0, xlwings can be installed on Linux servers in connection with Google Sheets or Excel on the web, see [Remote Interpreter](#).
- xlwings requires at least Python 3.7.

Here are previous versions of xlwings that support older versions of Python:

- Python 3.6: 0.25.3
- 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 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
```

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. Make sure to close Excel before installing/upgrading the add-in.

Note: When you are on macOS and are using the VBA standalone module instead of the add-in, you need to run `$ xlwings runpython install` once.

2.4 Dependencies

- **Windows:** pywin32
- **Mac:** psutil, applescript

The dependencies are automatically installed via conda or pip. If you would like to install xlwings without dependencies, you can run `pip install xlwings --no-deps` or set the environment variable `XLWINGS_NO_DEPS=1` before running `pip install xlwings`.

2.5 How to activate xlwings PRO

See *xlwings PRO*.

2.6 Optional Dependencies

- NumPy
- pandas
- Matplotlib
- Pillow

- cryptography (for xlwings.pro)
- Jinja2 (for xlwings.pro.reports)
- requests (for permissioning)

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.

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:

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

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

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

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

```
>>> sheet.range('A1').value = [['Foo 1', 'Foo 2', 'Foo 3'], [10.0, 20.0, 30.0]]
>>> sheet.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'])
>>> sheet.range('A1').value = df
>>> sheet.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>]
>>> sheet.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 f'Hello {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 \(UDFs\)](#).

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']
```

Note that you usually should use `App` as a context manager as this will make sure that the Excel instance is closed and cleaned up again properly:

```
with xw.App() as app:
    book = 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.

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
>>> sheet = xw.sheets.active # in active book
>>> sheet = 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))
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 App context manager

If you want to open a new Excel instance via `App()`, you usually should use `App` as a context manager as this will make sure that the Excel instance is closed and cleaned up again properly:

```
with xw.App() as app:
    book = app.books['Book1']
```

5.4 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>
```

5.5 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:

```
>>> sheet = xw.Book().sheets['Sheet1']
>>> sheet['A1']
```

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```
<Range [Book1]Sheet1!$A$1>
>>> sheet['A1:B5']
<Range [Book1]Sheet1!$A$1:$B$5>
>>> sheet[0, 1]
<Range [Book1]Sheet1!$B$1>
>>> sheet[:, 10, :10]
<Range [Book1]Sheet1!$A$1:$J$10>
```

5.6 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>
```


DATA STRUCTURES TUTORIAL

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

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

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

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

Note: To write a list in column orientation to Excel, use `transpose`: `sheet.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"):

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

```
>>> sheet.range('A10').value = [['Foo 1', 'Foo 2', 'Foo 3'], [10, 20, 30]]
>>> sheet.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 `sheet.range('A1').value = [[1,2],[3,4]]` than `sheet.range('A1').value = [1, 2]` and `sheet.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:

```
>>> sheet = xw.Book().sheets[0]
>>> sheet.range('A1').value = [[1,2], [3,4]]
>>> rng1 = sheet.range('A1').expand('table') # or just .expand()
>>> rng2 = sheet.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]]
>>> sheet.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 `sheet.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
>>> sheet = xw.Book().sheets[0]
>>> sheet.range('A1').value = np.eye(3)
>>> sheet.range('A1').options(np.array, expand='table').value
array([[ 1.,  0.,  0.],
       [ 0.,  1.,  0.],
       [ 0.,  0.,  1.]])
```

6.5 Pandas DataFrames

```
>>> sheet = xw.Book().sheets[0]
>>> df = pd.DataFrame([[1.1, 2.2], [3.3, None]], columns=['one', 'two'])
>>> df
   one  two
0  1.1  2.2
1  3.3  NaN
>>> sheet.range('A1').value = df
>>> sheet.range('A1:C3').options(pd.DataFrame).value
   one  two
0  1.1  2.2
1  3.3  NaN
# options: work for reading and writing
>>> sheet.range('A5').options(index=False).value = df
>>> sheet.range('A9').options(index=False, header=False).value = df
```

6.6 Pandas Series

```
>>> import pandas as pd
>>> import numpy as np
>>> sheet = 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
>>> sheet.range('A1').value = s
>>> sheet.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.: `sheet.range('A1').value = np.eye(10)`

6.7 Chunking: Read/Write big DataFrames etc.

When you read and write from or to big ranges, you may have to chunk them or you will hit a timeout or a memory error. The ideal chunksize will depend on your system and size of the array, so you will have to try out a few different chunksizes to find one that works well:

```
import pandas as pd
import numpy as np
sheet = xw.Book().sheets[0]
data = np.arange(75_000 * 20).reshape(75_000, 20)
df = pd.DataFrame(data=data)
sheet['A1'].options(chunksize=10_000).value = df
```

And the same for reading:

```
# As DataFrame
df = sheet['A1'].expand().options(pd.DataFrame, chunksize=10_000).value
# As list of list
df = sheet['A1'].expand().options(chunksize=10_000).value
```


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.

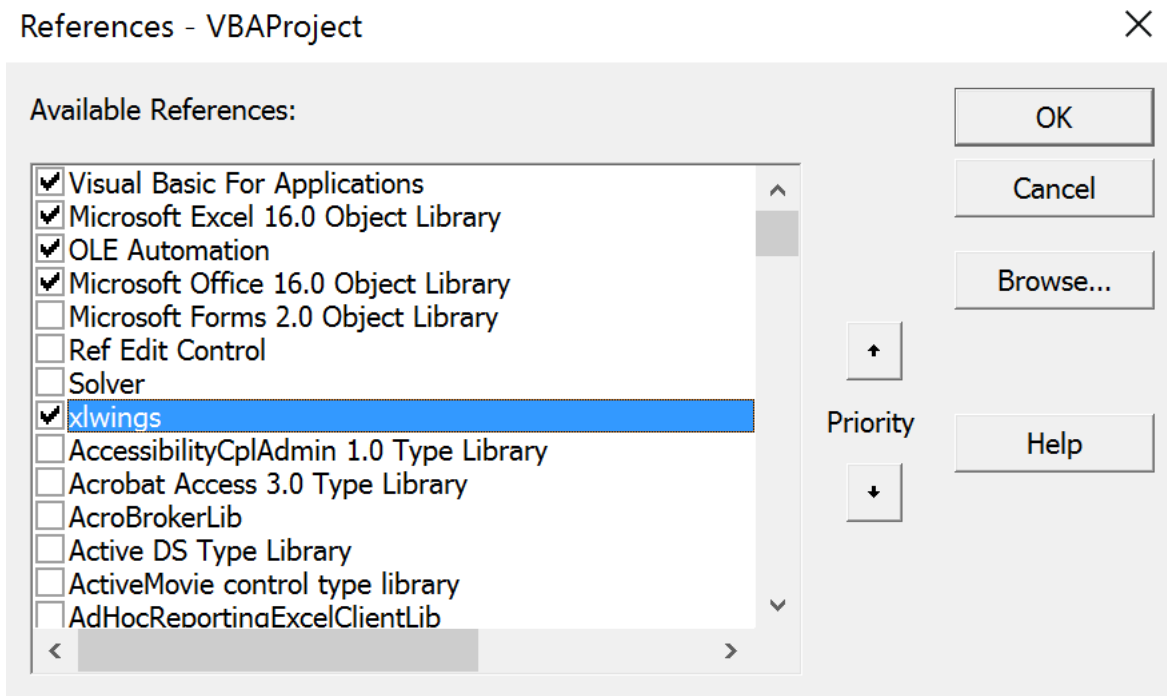
The `Run main` button is the easiest way to run your Python code: It runs a function called `main` in a Python module that has the same name as your workbook. This allows you to save your workbook as `xlsx` without enabling macros. The `xlwings quickstart` command will create a workbook that will automatically 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.
- **ADD_WORKBOOK_TO_PYTHONPATH:** Uncheck this box to not automatically add the directory of your workbook to the `PYTHONPATH`. This can be helpful if you experience issues with OneDrive/SharePoint: uncheck this box and provide the path where your source file is manually via the `PYTHONPATH` setting.

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 Making use of 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", ""
"ADD_WORKBOOK_TO_PYTHONPATH", ""
"CONDA_PATH", ""
"CONDA_ENV", ""
"UDF_MODULES", ""
"DEBUG_UDFS", ""
"USE_UDF_SERVER", ""
"SHOW_CONSOLE", ""
"ONEDRIVE_CONSUMER_WIN", ""
"ONEDRIVE_CONSUMER_MAC", ""
"ONEDRIVE_COMMERCIAL_WIN", ""
"ONEDRIVE_COMMERCIAL_MAC", ""
"SHAREPOINT_WIN", ""
"SHAREPOINT_MAC", ""
```

Note: The ONEDRIVE_WIN/_MAC 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 variables 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_WIN/_MAC 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.

Note: Workbook directory config files are not supported if your workbook is stored on SharePoint or OneDrive.

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`.

RUNPYTHON

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():  
    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. You only need to do this once. Also, this is only required for importing the functions, i.e. end users won't need to bother about this.
- 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):
```

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```
# 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))
```

Note:

- Expanding array formulas will overwrite cells without prompting
- 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 `>= 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.

File Home Insert Page Layout Formulas Data Review					
B4		✕ ✓ <i>fx</i>		=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					

File Home Insert Page Layout Formulas Data Review View xlwings							
B4		✕ ✓ <i>fx</i>		=dynamic_array(B2,C2)			
	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							

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:
    # =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
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.

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])

sheet = xw.Book().sheets[0]
sheet.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.

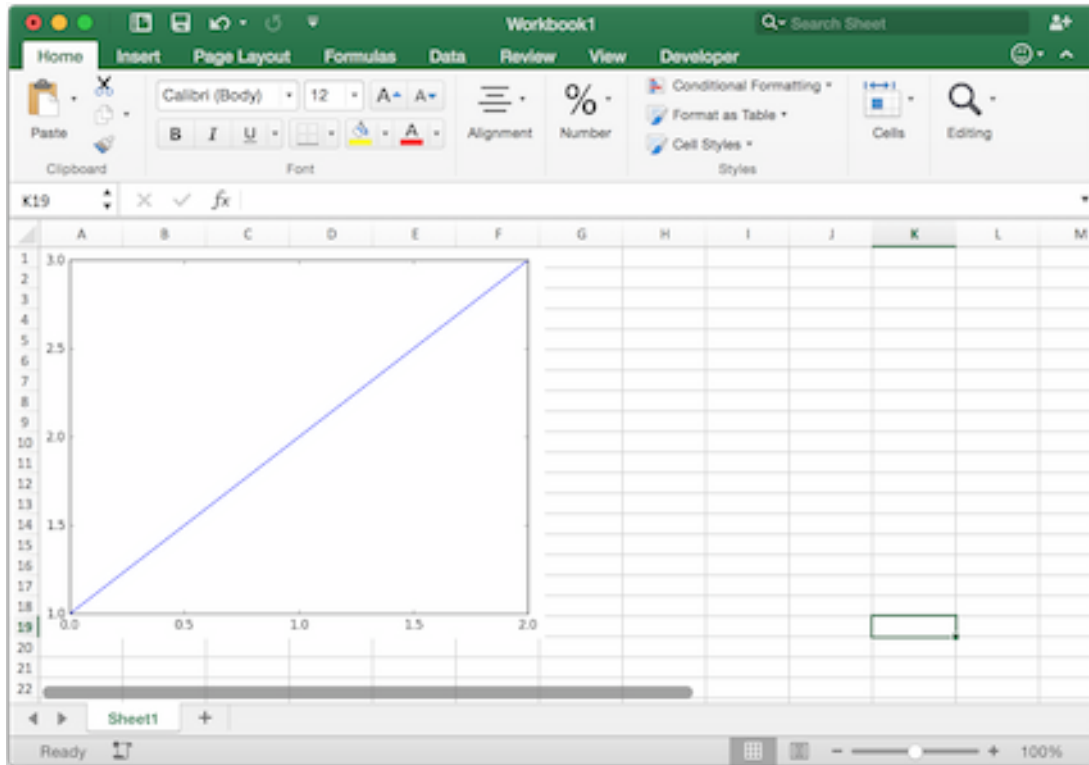
10.1.2 Full integration with Excel

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()
```

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```
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

10.2.1 Prerequisites

In addition to plotly, you will need kaleido, psutil, and requests. The easiest way to get it is via pip:

```
$ pip install kaleido psutil requests
```

or conda:

```
$ conda install -c conda-forge python-kaleido psutil requests
```

See also: <https://plotly.com/python/static-image-export/>

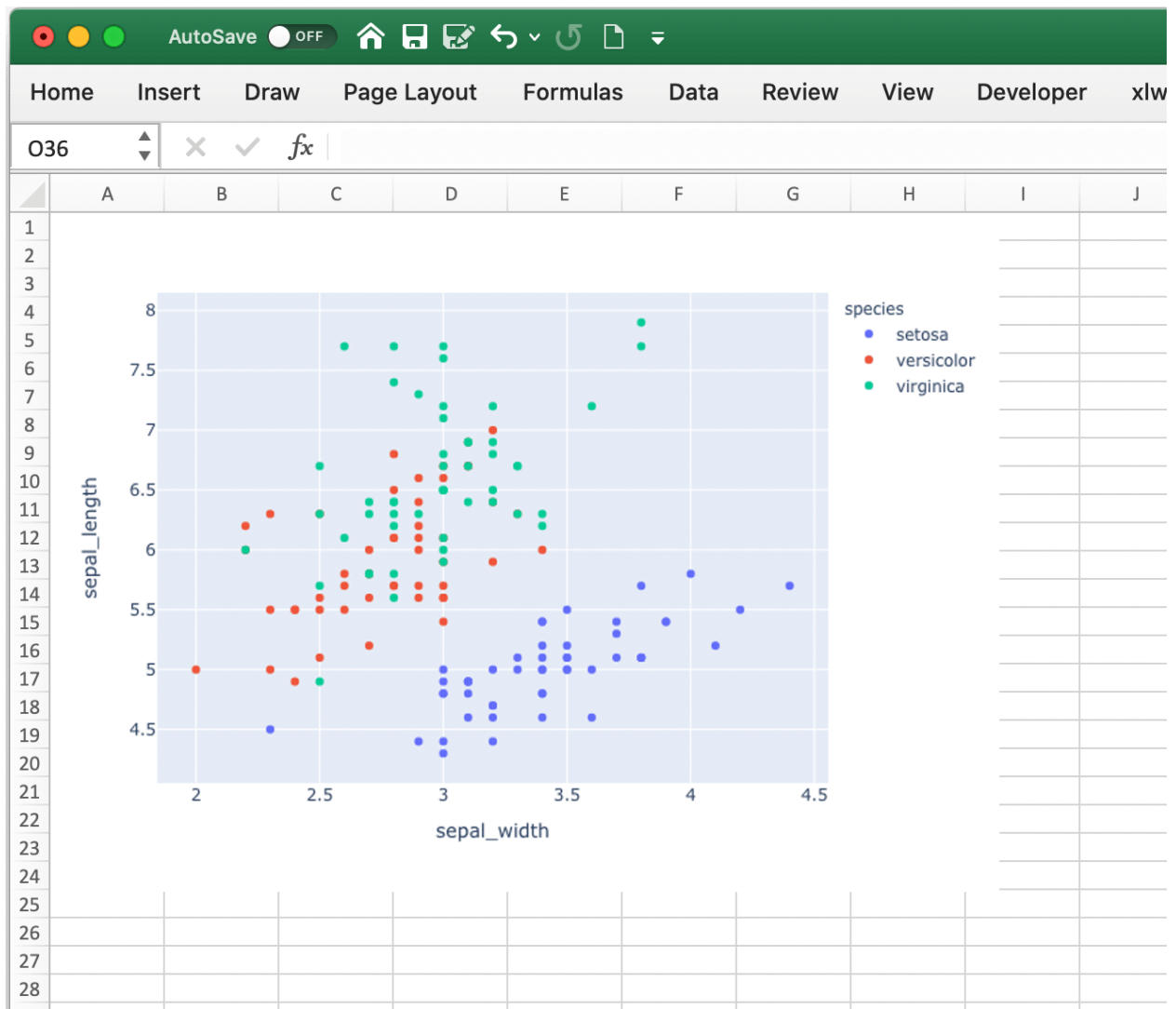
10.2.2 How to use

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`.



The screenshot shows a Jupyter Notebook titled "Untitled" with a Python 3 kernel. The left pane displays an Excel spreadsheet with the following data:

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

The right pane shows the following code and output:

```
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]:
```

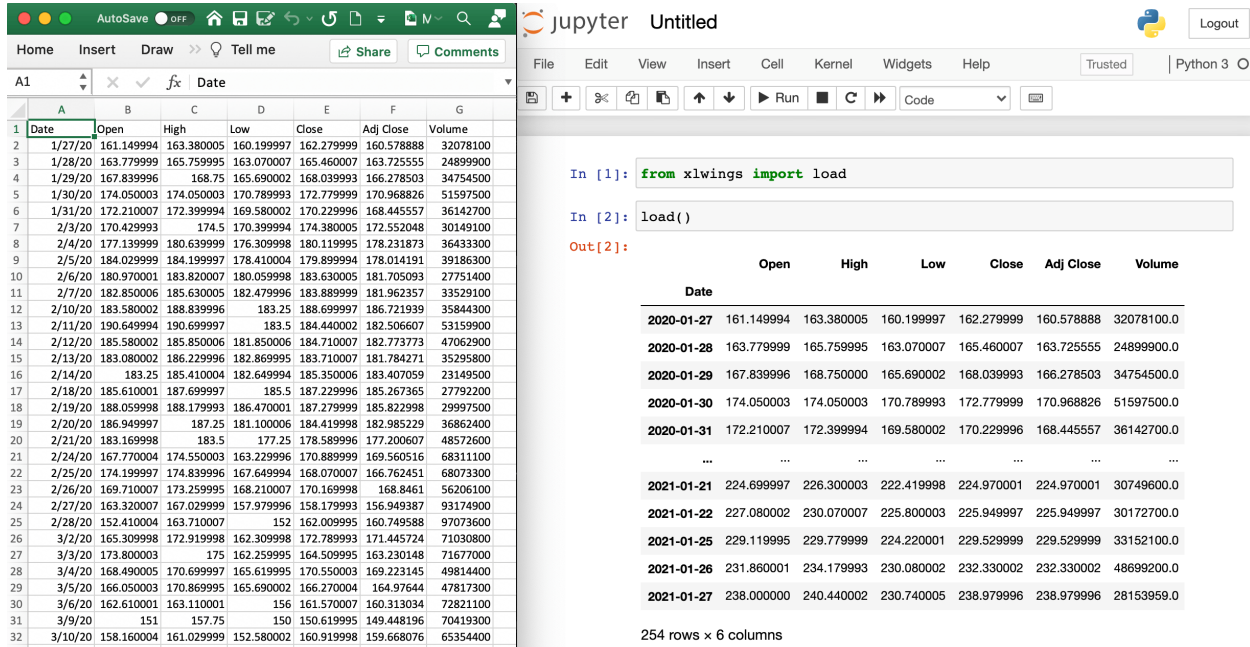
	one	two
0	0	5
1	1	6
2	2	7
3	3	8
4	4	9

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

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](#).



```
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	28153959.0

254 rows x 6 columns

New in version 0.22.0.

COMMAND LINE CLIENT (CLI)

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

addin	Run "xlwings addin install" to install the Excel add-in (will be copied to the XLSTART folder). Instead of "install" you can also use "update", "remove" or "status". Note that this command may take a while. You can install your custom add-in by providing the name or path via the <code>--file/-f</code> flag, e.g. "xlwings addin install -f custom.xlam" or copy all Excel files in a directory to the XLSTART folder by providing the path via the <code>--dir</code> flag. (New in 0.6.0, the <code>--dir</code> flag was added in 0.24.8)
quickstart	Run "xlwings quickstart myproject" 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. Use <code>--fastapi</code> for creating a project that uses a remote Python interpreter. Use <code>--addin --ribbon</code> to create a template for a custom ribbon addin. Leave away the <code>--ribbon</code> if you don't want a ribbon tab.
runpython	macOS only: run "xlwings runpython install" 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)
restapi	Use "xlwings restapi run" to run the xlwings REST API via Flask dev server. Accepts <code>--host</code> and <code>--port</code> as optional arguments.
license	xlwings PRO: Use "xlwings license update -k KEY" 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 workbook's dir in your active Excel file. Use the "--file" flag to only import a single file by providing its path. Requires xlwings PRO.</p> <p>(Changed in 0.23.4)</p>
permission	<p>"xlwings permission cwd" prints a JSON string that can be used to permission the execution of all modules in the current working directory via GET request.</p> <p>"xlwings permission book" does the same for code that is embedded in the active workbook.</p> <p>(New in 0.23.4)</p>
release	<p>Run "xlwings release" to configure your active workbook to work with a one-click installer for easy deployment. Requires xlwings PRO.</p> <p>(New in 0.23.4)</p>
copy	<p>Run "xlwings copy os" to copy the xlwings Office Scripts module. Run "xlwings copy gs" to copy the xlwings Google Apps Script module.</p> <p>(New in 0.26.0)</p>
vba	<p>This functionality allows you to easily write VBA code in an external editor: run "xlwings vba edit" to update the VBA modules of the active workbook from their local exports everytime you hit save. If you run this the first time, the modules will be exported from Excel into your current working directory. To overwrite the local version of the modules with those from Excel, run "xlwings vba export". To overwrite the VBA modules in Excel with their local versions, run "xlwings vba import". The "--file/-f" flag allows you to specify a file path instead of using the active Workbook. Requires "Trust access to the VBA project object model" enabled. NOTE: Whenever you change something in the VBA editor (such as the layout of a form or the properties of a module), you have to run "xlwings vba export".</p>

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(New in 0.26.3, changed in 0.27.0)

DEPLOYMENT

13.1 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"
```

13.2 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
```


ONEDRIVE AND SHAREPOINT

Since v0.27.4, xlwings works with locally synced files on OneDrive, OneDrive for Business, and SharePoint. Some constellations will work out-of-the-box, while others require you to edit the configuration via the `xlwings.conf` file (see *User Config*) or the workbook's `xlwings.conf` sheet (see *Workbook Config*).

Note: This documentation is for OneDrive and SharePoint files that are synced to a local folder. This means that both, the Excel and Python file, need to show the green check mark in the File Explorer/Finder as status—a cloud icon will not work. If, in turn, you are looking for the documentation to run xlwings with Excel on the web, see *Remote Python Interpreter: Google Sheets & Excel (Desktop & Web)*.

An easy workaround if you run into issues is to:

- Disable the `ADD_WORKBOOK_TO_PYTHONPATH` setting (either via the checkbox on the Ribbon or via the settings in the `xlwings.conf` sheet).
- Add the directory of your Python source file to the `PYTHONPATH`—again, either via Ribbon or `xlwings.conf` sheet.

If you are using the PRO version, you could instead also embed your code to get around these issues.

For a bit more flexibility, follow the solutions below.

14.1 OneDrive (Personal)

Default setups work out-of-the-box on Windows and macOS. If you get an error message, add the following setting with the correct path to the local root directory of your OneDrive. If possible, make use of environment variables (as shown in the examples) so the configuration will work across different users with the same setup:

- **Windows** (Example):

<code>ONEDRIVE_CONSUMER_WIN</code>	<code>%USERPROFILE%\OneDrive</code>
------------------------------------	-------------------------------------

- **macOS** (Example):

ONEDRIVE_CONSUMER_MAC	\$HOME/OneDrive
-----------------------	-----------------

14.2 OneDrive for Business

- **Windows:** Default setups work out-of-the-box. If you get an error message, add the following setting with the correct path to the local root directory of your OneDrive for Business. If possible, make use of environment variables (as shown in the examples) so the configuration will work across different users with the same setup:

ONEDRIVE_COMMERCIAL_WIN	%USERPROFILE%\OneDrive - My Company LLC
-------------------------	---

- **macOS:** macOS *always* requires the following setting with the correct path to the local root directory of your OneDrive for Business. If possible, make use of environment variables (as shown in the examples) so the configuration will work across different users with the same setup:

ONEDRIVE_COMMERCIAL_MAC	\$HOME/OneDrive - My Company LLC
-------------------------	----------------------------------

14.3 SharePoint (Online and On-Premises)

On Windows, the location of the local root folder of SharePoint can *sometimes* be derived from the OneDrive environment variables. Most of the time though, you'll have to provide the following setting (on macOS this is a must):

- **Windows:**

SHAREPOINT_WIN	%USERPROFILE%\My Company LLC
----------------	------------------------------

- **macOS:**

SHAREPOINT_MAC	\$HOME/My Company LLC
----------------	-----------------------

14.4 Implementation Details & Limitations

A lot of the xlwings functionality depends on the workbook's `FullName` property (via VBA/COM) that returns the local path of the file unless it is saved on OneDrive, OneDrive for Business or SharePoint **with AutoSave enabled**. In this case, it returns a URL instead.

URLs for OneDrive and OneDrive for Business can be translated fairly straight forward to the local equivalent. You will need to know the root directory of the local drive though: on Windows, these are usually provided via environment variables for OneDrive. On macOS they don't exist, which is the reason why you need to provide the root directory for OneDrive. On Windows, the root directory for SharePoint can sometimes be derived from the env vars, too, but this is not guaranteed. On macOS, you'll need to provide it always anyway.

SharePoint, unfortunately, allows you to map the drives locally in any way you want and there's no way to reliably get the local path for these files. On Windows, xlwings first checks the registry for the mapping. If this doesn't work, xlwings checks if the local path is mapped by using the defaults and if the file can't be found, it checks all existing local files on SharePoint. If it finds one with the same name, it'll use this. If, however, it finds more than one with the same name, you will get an error message. In this case, you can either rename the file to something unique across all the locally synced SharePoint files or you can change the `SHAREPOINT_WIN/MAC` setting to not stop at the root folder but include additional folders. As an example, assume you have the following file structure on your local SharePoint:

```
My Company LLC/
├─ sitename1/
│   └─ myfile.xlsx
├─ sitename2 - Documents/
│   └─ myfile.xlsx
```

In this case, you could either rename one of the files, or you could add a path that goes beyond the root folder (preferably under the `xlwings.conf` sheet):

SHAREPOINT_WIN	%USERPROFILE%/My Company LLC/sitename2 - Documents
----------------	--

TROUBLESHOOTING

15.1 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`

15.2 Issue: Files that are saved on OneDrive or SharePoint cause an error to pop up

Solution:

See the dedicated page about how to configure OneDrive and Sharepoint: *OneDrive and SharePoint*.

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
```

16.1 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):
    # 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.

- **chunksize**

When you read and write from or to big ranges, you may have to chunk them or you will hit a timeout or a memory error. The ideal chunksize will depend on your system and size of the array, so you will have to try out a few different chunksizes to find one that works well:

```
import pandas as pd
import numpy as np
sheet = xw.Book().sheets[0]
data = np.arange(75_000 * 20).reshape(75_000, 20)
df = pd.DataFrame(data=data)
sheet['A1'].options(chunksize=10_000).value = df
```

And the same for reading:

```
# As DataFrame
df = sheet['A1'].expand().options(pd.DataFrame, chunksize=10_000).value
# As list of list
df = sheet['A1'].expand().options(chunksize=10_000).value
```


16.2 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.

16.2.1 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`.

16.2.2 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.]])
```

16.2.3 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:

	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			

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

16.2.4 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:

	A	B	C	D
1		a	a	b
2	ix	c	d	e
3	10	1	2	3
4	20	4	5	6
5	30	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				

```
>>> sht = xw.Book().sheets[0]
>>> df = sht.range('A1:D5').options(pd.DataFrame, header=2).value
>>> df
a      b
c  d  e
```

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```

ix
10  1  2  3
20  4  5  6
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

```

16.2.5 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))

```

16.3 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):
```

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```

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
    # 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)

# 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`.

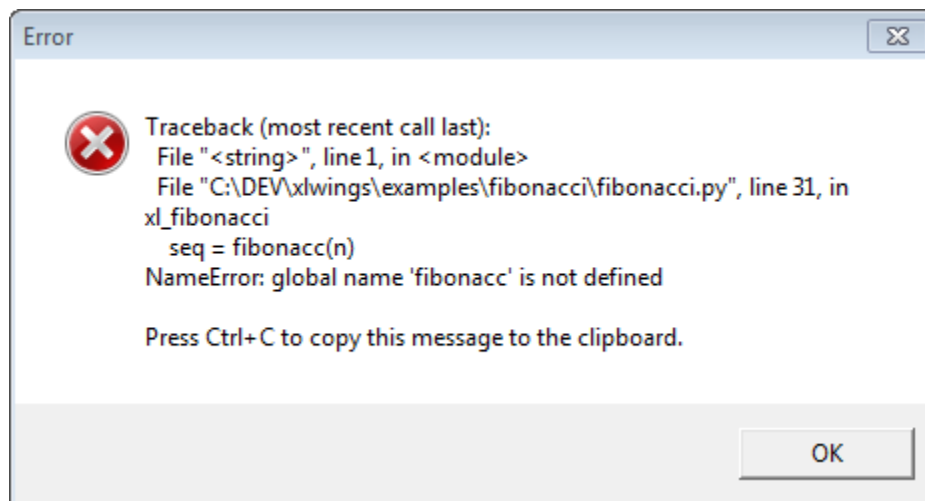
The `Converter` class provides basic scaffolding to make the task of writing a new `Converter` easier. If you need more control you can subclass `Accessor` directly, but this part requires more work and is currently undocumented.

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`).

17.1 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
```

17.2 UDF debug server

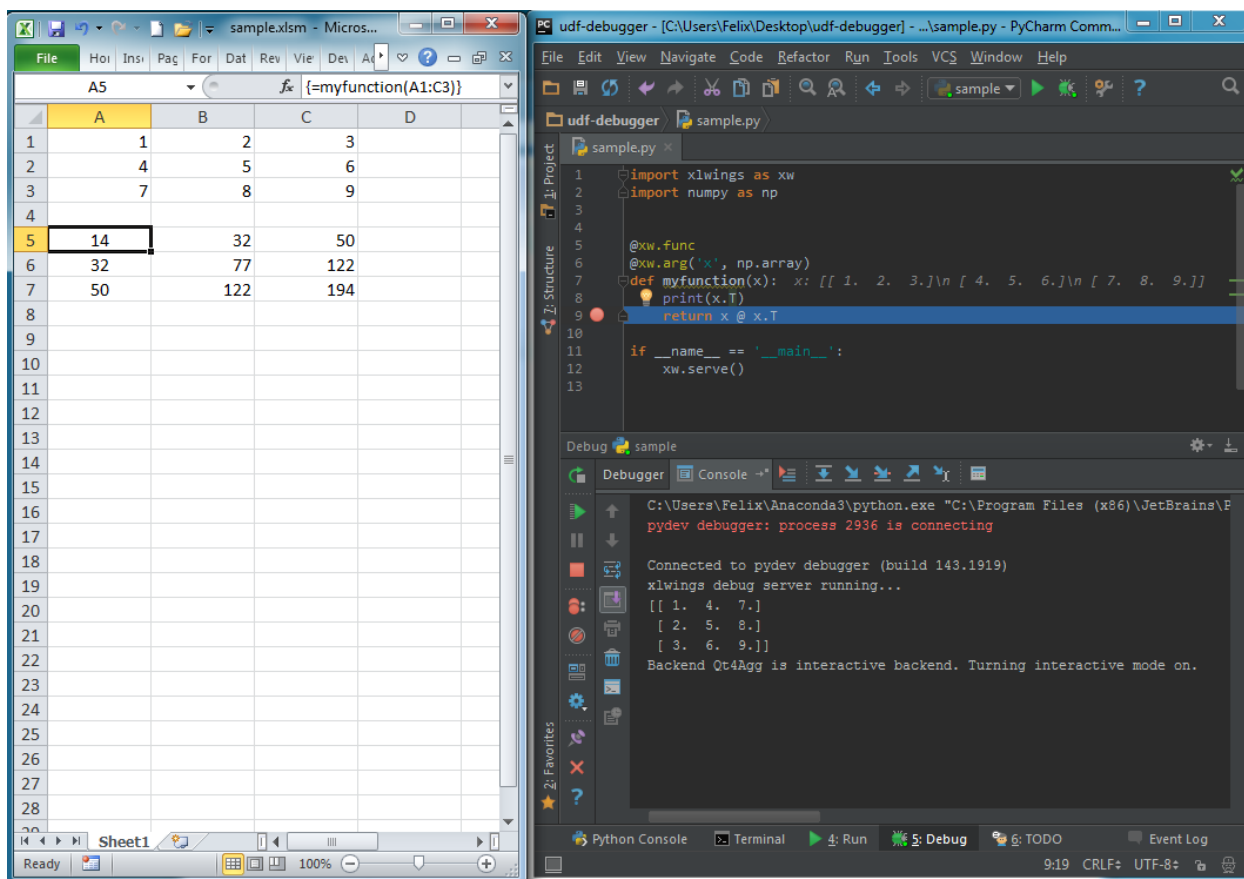
Windows only: To debug UDFs, just check the `Debug UDFs` in the *Add-in & Settings*, at the top of the xlwings VBA module. Then add the following lines at the end of your Python source file and run it. Depending on which IDE you use, you might need to run the code in “debug” mode (e.g. in case you’re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



EXTENSIONS

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.

18.1 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
✕
✓
fx
=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				

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.

19.1 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)

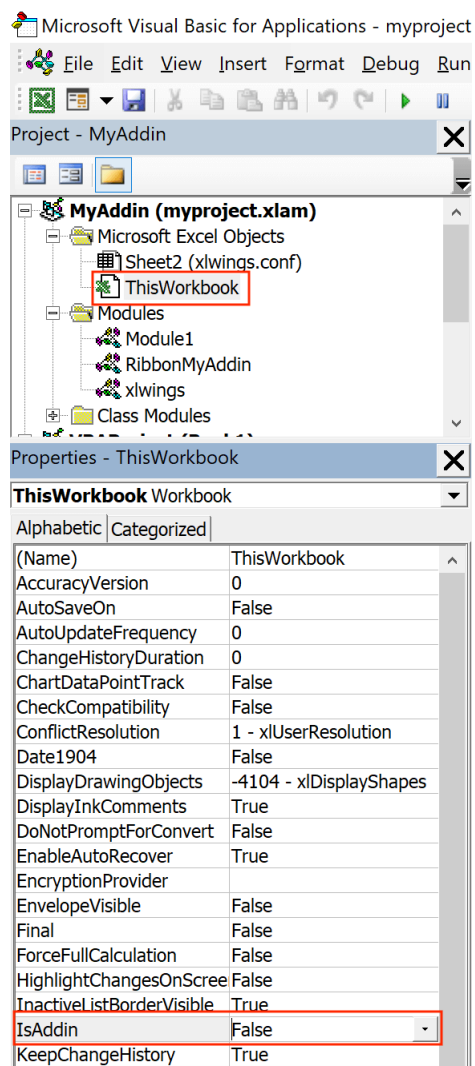
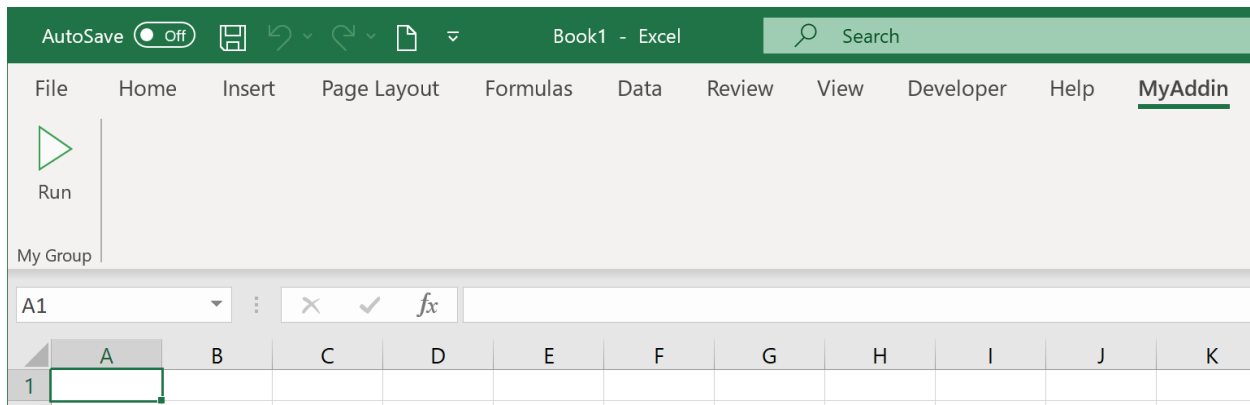
You should see a new ribbon tab called `MyAddin` like this:

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 to 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.

19.2 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.

19.3 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.

19.4 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](#).

19.5 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.

19.6 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.

19.7 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:

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

- `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.

20.1 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)
    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!
```

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```
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()
```

20.2 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
```

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```
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).

21.1 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: This is an experimental feature and may be removed in the future. Currently, this functionality is only available on Windows for UDFs. The RunPython functionality is currently not supported.

22.1 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.

22.2 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](#).

XLWINGS PRO OVERVIEW

xlwings PRO is [source-available](#) and dual-licensed under one of the following licenses:

- [PolyForm Noncommercial License 1.0.0](#) (noncommercial use is free)
- [xlwings PRO License](#) (commercial use requires a [paid plan](#))

License Key

To use xlwings PRO, you need to install a license key on a Terminal/Command Prompt like so:

```
xlwings license update -k YOUR_LICENSE_KEY
```

Make sure to replace `LICENSE_KEY` with your personal key (see below). This will store the license key in your `xlwings.conf` file (see *User Config: Ribbon/Config File* for where this is on your system). Instead of running this command, you can also store the license key as an environment variable with the name `XLWINGS_LICENSE_KEY`.

License key for noncommercial purpose:

- To use xlwings PRO for free in a noncommercial context, use the following license key: `noncommercial` (Note that you need at least xlwings 0.26.0).

License key for commercial purpose:

- To try xlwings PRO for free in a commercial context, request a trial license key: <https://www.xlwings.org/trial>
- To use xlwings PRO in a commercial context beyond the trial, you need to enroll in a paid plan (they include additional services like support and the ability to create one-click installers): <https://www.xlwings.org/pricing>

xlwings PRO licenses are developer licenses, are verified offline (i.e., no telemetry/license server involved) and allow royalty-free deployments to unlimited internal and external end-users and servers for a hassle-free management. Deployments use deploy keys that don't expire but instead are bound to a specific version of xlwings.

xlwings PRO functionality requires additionally the `cryptography` package, which comes preinstalled with Anaconda and WinPython. Otherwise, install it via `pip` or `Conda`. With `pip`, you can also run `pip install "xlwings[pro]"`: this will take care of the extra dependencies for xlwings PRO.

23.1 PRO Features

- *Remote Interpreter*: Work with Google Sheets and Excel on the web and a remote Python interpreter.
- *Embedded code*: Store your Python source code directly in Excel for easy deployment.
- *xlwings Reports*: A template-based reporting mechanism, allowing business users to change the layout of the report without having to touch the Python code.
- *Markdown Formatting*: Support for Markdown formatting of text in cells and shapes like e.g., text boxes.
- *Permissioning of Code Execution*: Control which users can run which Python modules via xlwings.

Paid plans come with additional services like:

- *One-click Installer*: Easily build your own Python installer including all dependencies—your end users don't need to know anything about Python
- On-demand video course
- Direct Support

Check out the [paid plans](#) for more details!

REMOTE PYTHON INTERPRETER: GOOGLE SHEETS & EXCEL (DESKTOP & WEB)

This feature requires `xlwings` PRO and at least v0.27.0.

Instead of installing Python on each end-user's machine, you can work with a remote Python interpreter. This works the same as a web application, but uses Excel as the frontend instead of a web page in a browser. A remote interpreter doesn't just work with the Desktop versions of Excel on Windows and macOS but additionally supports Google Sheets and Excel on the web for a full cloud experience. You can run the Python web server wherever it works best for you, whether that means using a cloud service or running a physical machine on premise.

Important: This feature is currently experimental and only covers parts of the RunPython API (UDFs are not yet supported). See also [Limitations](#) and [Roadmap](#).

24.1 Why is this useful?

Having to install a local installation of Python with the correct dependencies is the number one friction when using `xlwings`. Most excitingly though, the remote interpreter adds support for the web-based spreadsheets: Google Sheets and Excel on the web.

To automate Office on the web, you have to use Office Scripts (i.e., TypeScript, a typed superset of JavaScript) and for Google Sheets, you have to use Apps Script (i.e., JavaScript). If you don't feel like learning JavaScript, `xlwings` allows you to write Python code instead. But even if you are comfortable with JavaScript, you are very limited in what you can do, as both Office Scripts and Apps Script are primarily designed to automate simple spreadsheet tasks such as inserting a new sheet or formatting cells rather than performing data-intensive tasks. They also make it very hard/impossible to use external JavaScript libraries and run in environments with minimal resources.

Note: From here on, when I refer to the **`xlwings` JavaScript module**, I mean either the `xlwings` Apps Script module if you use Google Sheets or the `xlwings` Office Scripts module if you use Excel on the web.

On the other hand, `xlwings` with a remote Python interpreter brings you these advantages:

- **Work with the whole Python ecosystem:** including pandas, machine learning libraries, database packages, web scraping, boto (for AWS S3), etc. This makes xlwings a great alternative for Power Query, which isn't currently available for Excel on the web or Google Sheets.
- **Leverage your existing development workflow:** use your favorite IDE/editor (local or cloud-based) with full Git support, allowing you to easily track changes, collaborate and perform code reviews. You can also write unit tests using pytest.
- **Remain in control of your data and code:** except for the data you expose in Excel or Google Sheets, everything stays on your server. This can include database passwords and other sensitive info such as customer data. There's also no need to give the Python code to end-users: the whole business logic with your secret sauce is protected on your own infrastructure.
- **Choose the right machine for the job:** whether that means using a GPU, a ton of CPU cores, lots of memory, or a gigantic hard disc. As long as Python runs on it, you can go from serverless functions as offered by the big cloud vendors all the way to a self-managed Kubernetes cluster under your desk (see [Production Deployment](#)).
- **Headache-free deployment and maintenance:** there's only one location (usually a Linux server) where your Python code lives and you can automate the whole deployment process with continuous integration pipelines like GitHub actions etc.
- **Cross-platform:** xlwings with a remote interpreter works with Google Sheets, Excel on the web and the Desktop apps of Excel on Windows and macOS.

24.2 Prerequisites

Excel Desktop

- At least xlwings 0.27.0
- Either the xlwings add-in installed or a workbook that has been set up in standalone mode

Google Sheets

- At least xlwings 0.27.0
- New sheets: no special requirements.
- Older sheets: make sure that Chrome V8 runtime is enabled under **Extensions > Apps Script > Project Settings > Enable Chrome V8 runtime**.

Excel on the web

- At least xlwings 0.27.0
- You need access to Excel on the web with the Automate tab enabled, i.e., access to Office Scripts. Note that Office Scripts currently requires OneDrive for Business or SharePoint (it's not available on the free office.com), see also [Office Scripts Requirements](#).
- The fetch command in Office Scripts must **not** be disabled by your Microsoft 365 administrator.

24.3 Introduction

Working with a remote Python interpreter consists of two parts:

- Backend: the Python part
- Frontend: the xlwings JavaScript module (for Google Sheets/Excel on the web) or the VBA code in the form of the add-in or standalone modules (Desktop Excel)

The backend exposes your Python functions by using a Python web framework. In more detail, you need to handle a POST request along these lines (the sample shows an excerpt that uses [FastAPI](#) as the web framework, but it works accordingly with any other web framework like Django or Flask):

```
@app.post("/hello")
def hello(data: dict = Body(...)):
    # Instantiate a Book object with the deserialized request body
    book = xw.Book(json=data)

    # Use xlwings as usual
    book.sheets[0].value = 'Hello xlwings!'

    # Pass the following back as the response
    return book.json()
```

- For Desktop Excel, you can run the web server locally and call the respective function from VBA right away (given that you have the add-in installed).
- For the cloud-based spreadsheets, you have to run this on a web server that can be reached from Google Sheets or Excel on the web, and you have to paste the xlwings JavaScript module into the respective editor. How this all works, will be shown in detail under [Cloud-based development with Gitpod](#).

The next section shows you how you can play around with the remote interpreter on your local desktop before we'll dive into developing against the cloud-based spreadsheets.

24.4 Local Development with Desktop Excel

The easiest way to try things out is to run the web server locally against your Desktop version of Excel. We're going to use [FastAPI](#) as our web framework. While you can use any web framework you like, no quickstart command exists for these yet, so you'd have to set up the boilerplate yourself.

Start by running the following command on a Terminal/Command Prompt. Feel free to replace `demo` with another project name and make sure to run this command in the desired directory:

```
$ xlwings quickstart demo --fastapi
```

This creates a folder called `demo` in the current directory with the following files:

```
app.py
demo.xlsm
main.py
requirements.txt
```

I would recommend you to create a virtual or Conda environment where you install the dependencies via `pip install -r requirements.txt`. In `app.py`, you'll find the FastAPI boilerplate code and in `main.py`, you'll find the `hello` function that is exposed under the `/hello` endpoint.

To run this server locally, run `python main.py` in your Terminal/Command Prompt or use your code editor/IDE's run button. You should see something along these lines:

```
$ python main.py
INFO:      Will watch for changes in these directories: ['/Users/fz/Dev/demo']
INFO:      Uvicorn running on http://127.0.0.1:8000 (Press CTRL+C to quit)
INFO:      Started reloader process [36073] using watchgod
INFO:      Started server process [36075]
INFO:      Waiting for application startup.
INFO:      Application startup complete.
```

Your web server is now listening, so let's open `demo.xlsm`, press `Alt+F11` to open the VBA editor, and in `Module1`, place your cursor somewhere inside the following function:

```
Sub SampleRemoteCall()
    RunRemotePython "http://127.0.0.1:8000/hello", apiKey:="DEVELOPMENT"
End Sub
```

Then hit `F5` to run the function—you should see `Hello xlwings!` in cell `A1` of the first sheet. To move this to production, you need to deploy the backend to a server, set a unique API key and adjust the `url/apiKey` in the `RunRemotePython` function accordingly, see [Production Deployment](#).

The next sections, however, show you how you can make this work with the Google Sheets and Excel on the web.

24.5 Cloud-based development with Gitpod

Using Gitpod is the easiest solution if you'd like to develop against either Google Sheets or Excel on the web

If you want to have a development environment up and running in less than 5 minutes (even if you're new to web development), simply click the **Open in Gitpod** button to open a [sample project in Gitpod](#) (Gitpod is a cloud-based development environment with a generous free tier):

Opening the project in Gitpod will require you to sign in with your GitHub account. A few moments later, you should see an online version of VS Code. In the Terminal, it will ask you to paste the xlwings license key ([get a free trial key](#) if you want to try this out in a commercial context or use the `noncommercial` license key if your usage [qualifies as noncommercial](#)). Note that your browser will ask you for permission to paste. Once you confirm your license key by hitting **Enter**, the server will automatically start with everything properly configured. You can then open the `app` directory and look at the `main.py` file, where you'll see the `hello` function. This is the function we're going to call from Google Sheets/Excel on the web in just a moment. The other file in this directory, `app.py` contains all the FastAPI boilerplate code. Let's leave this alone for a moment and look at the `js` folder instead. Open the file according to your platform:

Google Sheets

```
xlwings_google.js
```

Excel on the web

```
xlwings_excel.ts
```

Copy all the code, then switch to Google Sheets or Excel on the web, respectively, and continue as follows:

Google Sheets

Click on **Extensions > Apps Script**. This will open a separate browser tab and open a file called `Code.gs` with a function stub. Replace this function stub with the copied code from `xlwings_google.js` and click on the **Save** icon. Then hit the **Run** button (the `hello` function should be automatically selected in the dropdown to the right of it). If you run this the very first time, Google Sheets will ask you for the permissions it needs. Once approved, the script will run the `hello` function and write **Hello xlwings!** into cell A1.

To add a button to a sheet to run this function, switch from the Apps Script editor back to Google Sheets, click on **Insert > Drawing** and draw a rounded rectangle. After hitting **Save** and **Close**, the rectangle will appear on the sheet. Select it so that you can click on the 3 dots on the top right of the shape. Select **Assign Script** and write `hello` in the text box, then hit **OK**.

Excel on the web

In the Automate tab, click on New Script. This opens a code editor pane on the right-hand side with a function stub. Replace this function stub with the copied code from `xlwings_excel.ts`. Make sure to click on Save script before clicking on Run: the script will run the `hello` function and write `Hello xlwings!` into cell A1.

To run this script from a button, click on the 3 dots in the Office Scripts pane (above the script), then select + Add button.

Any changes you make to the `hello` function in `app/main.py` in Gitpod are automatically saved and reloaded by the web server and will be reflected the next time you run the script from Google Sheets or Excel on the web.

To test out `yahoo`, the other function of the [sample project](#), replace `hello` with `yahoo` in the `runPython` function in the `xlwings` JavaScript module.

Note: While Excel on the web requires you to create a separate script with a function called `main` for each Python function, Google Sheets allows you to add multiple functions with any name.

Please note that clicking the Gitpod button gets you up and running quickly, but if you want to save your changes (i.e., commit them to Git), you should first fork the project on GitHub to your own account and open it by prepending `https://gitpod.io/#` to your GitHub URL instead of clicking the button (this works with GitLab and Bitbucket too). Or continue with the next section, which shows you how you can start a project from scratch on your local machine.

An alternative for Gitpod is [GitHub Codespaces](#), but unlike Gitpod, GitHub Codespaces only works with GitHub, has no free tier, and may not be available yet on your account.

24.6 Local Development with Google Sheets or Excel on the web

This section walks you through a local development workflow as an alternative to using Gitpod/GitHub Codespaces. What's making this a little harder than using a preconfigured online IDE like Gitpod is the fact that we need to expose our local web server to the internet for easy development.

As before, we're going to use [FastAPI](#) as our web framework. While you can use any web framework you like, no quickstart command exists for these yet, so you'd have to set up the boilerplate yourself. Let's start with the server before turning our attention to the client side (i.e, Google Sheets or Excel on the web).

24.6.1 Part I: xlwings Server

Start a new quickstart project by running the following command on a Terminal/Command Prompt. Feel free to replace `demo` with another project name and make sure to run this command in the desired directory:

```
$ xlwings quickstart demo --fastapi
```

This creates a folder called `demo` in the current directory with a few files. Since we're using an online spreadsheet instead of the Desktop Excel, you can delete `demo.xlsm`, which should leave you with the following files:

```
main.py
app.py
requirements.txt
```

I would recommend you to create a virtual or Conda environment where you install the dependencies via `pip install -r requirements.txt`. In `app.py`, you'll find the FastAPI boilerplate code and in `main.py`, you'll find the `hello` function that is exposed under the `/hello` endpoint.

The application expects you to set the environment variable `XLWINGS_API_KEY` to a unique key in order to protect your application from unauthorized access. You should choose a strong random key, for example by running the following on a Terminal/Command Prompt: `python -c "import secrets; print(secrets.token_hex(32))"`. If you don't set an environment variable, it will use `DEVELOPMENT` as the API key (only use this for quick tests and never for production!).

To run this server locally, run `python main.py` in your Terminal/Command Prompt or use your code editor/IDE's run button. You should see something along these lines:

```
$ python main.py
INFO:      Will watch for changes in these directories: ['/Users/fz/Dev/demo']
INFO:      Uvicorn running on http://127.0.0.1:8000 (Press CTRL+C to quit)
INFO:      Started reloader process [36073] using watchgod
INFO:      Started server process [36075]
INFO:      Waiting for application startup.
INFO:      Application startup complete.
```

Your web server is now listening, however, to enable it to communicate with Google Sheets or Excel on the web, you need to expose the port used by your local server (port 8000 in your example) securely to the internet. There are many free and paid services available to help you do this. One of the more popular ones is [ngrok](#) whose free version will do the trick (for a list of ngrok alternatives, see [Awesome Tunneling](#)):

- [ngrok Installation](#)
- [ngrok Tutorial](#)

For the sake of this tutorial, let's assume you've installed ngrok, in which case you would run the following on your Terminal/Command Prompt to expose your local server to the public internet:

```
$ ngrok http 8000
```

Note that the number of the port (8000) has to correspond to the port that is configured on your local development server as specified at the bottom of `main.py`. ngrok will print something along these lines:

```
ngrok by @inconshreveable
    (Ctrl+C to quit)

Session Status      online
Account             name@domain.com (Plan: Free)
Version             2.3.40
Region             United States (us)
Web Interface       http://127.0.0.1:4040
Forwarding          http://xxxx-xxxx-xx-xx-xxx-xxxx-xxxx-xxxx-xxx.
    ngrok.io -> http://localhost:8000
Forwarding          https://xxxx-xxxx-xx-xx-xxx-xxxx-xxxx-xxxx-xxx.
    ngrok.io -> http://localhost:8000
```

To configure the xlwings client in the next step, we'll need the `https` version of the Forwarding address that ngrok prints, i.e., `https://xxxx-xxxx-xx-xx-xxx-xxxx-xxxx-xxxx-xxx.ngrok.io`.

Note: When you're not actively developing, you should stop your ngrok session by hitting `Ctrl-C` in the Terminal/Command Prompt.

24.6.2 Part II: xlwings Client

Now it's time to switch to Google Sheets or Excel on the web! To paste the xlwings JavaScript module, follow these 3 steps:

1. **Copy the xlwings JavaScript module:** On a Terminal/Command Prompt on your local machine, run the following command:

Google Sheets

```
$ xlwings copy gs
```

Excel on the web

```
$ xlwings copy os
```

This will copy the correct xlwings JavaScript module to the clipboard so we can paste it in the next step.

2. **Paste the xlwings JavaScript module**

Google Sheets

Click on **Extensions > Apps Script**. This will open a separate browser tab and open a file called `Code.gs` with a function stub. Replace this function stub with the copied code from the previous step and click on the **Save** icon. Then hit the **Run** button (the `hello` function should be automatically selected in the dropdown to the right of it). If you run this the very first time, Google Sheets will ask you for the permissions it needs. Once approved, the script will run the `hello` function and write `Hello xlwings!` into cell A1.

To add a button to a sheet to run this function, switch from the Apps Script editor back to Google Sheets, click on **Insert > Drawing** and draw a rounded rectangle. After hitting **Save** and **Close**, the rectangle will appear on the sheet. Select it so that you can click on the 3 dots on the top right of the shape. Select **Assign Script** and write `hello` in the text box, then hit **OK**.

Excel on the web

In the **Automate** tab, click on **New Script**. This opens a code editor pane on the right-hand side with a function stub. Replace this function stub with the copied code from the previous step. Make sure to click on **Save script** before clicking on **Run**: the script will run the `hello` function and write `Hello xlwings!` into cell A1.

To run this script from a button, click on the 3 dots in the Office Scripts pane (above the script), then select **+ Add button**.

3. **Configuration:** The final step is to configure the xlwings JavaScript module properly, see the next section [Configuration](#).

24.7 Configuration

xlwings can be configured in two ways:

- Via arguments in the `runPython` (Google Sheets or Excel on the web) or `RunRemotePython` (Desktop Excel) function, respectively.
- Via `xlwings.conf` sheet (in this case, the keys are `UPPER_CASE` with underscore instead of camel-Case, see the screenshot below).

If you provide a value via config sheet and via function argument, the function argument wins. Let's see what the available settings are:

- **url** (required): This is the full URL of your function. In the above example under *Local Development with Google Sheets or Excel on the web*, this would be `https://xxxx-xxxx-xx-xx-xxx-xxxx-xxxx-xxxx-xxx.ngrok.io/hello`, i.e., the ngrok URL **with the /hello endpoint appended**.
- **apiKey** (optional): While this is technically optional, it is usually required by the backend. It has to correspond to whatever you set the `XLWINGS_API_KEY` environment variable on your server and will protect your functions from unauthorized access. It's good practice to keep your sensitive keys such as the `apiKey` out of your source code (the JavaScript/VBA module), but putting it in the `xlwings.conf` sheet may only be marginally better. Excel on the web, however, doesn't currently provide you with

a better way of handling this. Google Sheets, on the other hand, allows you to work with [Properties Service](#) to keep the API key out of both the JavaScript code and the `xlwings.conf` sheet.

Note: The API key is chosen by you to protect your application and has nothing to do with the xlwings license key!

- **headers** (optional): A dictionary (VBA) or object literal (JS) with name/value pairs. If you set the `Authorization` header, `apiKey` will be ignored.
- **exclude** (optional): By default, xlwings sends over the complete content of the whole workbook to the server. If you have sheets with big amounts of data, this can make the calls slow or you could even hit a timeout. If your backend doesn't need the content of certain sheets, you can exclude them from being sent over via this setting. Currently, you can only exclude entire sheets as comma-delimited string like so: `"Sheet1, Sheet2"`.

24.7.1 Configuration Examples: Function Arguments

Excel Desktop

Using only required arguments:

```
Sub Hello()  
    RunRemotePython "http://127.0.0.1:8000/hello", apiKey:="YOUR_UNIQUE_API_KEY"  
End Sub
```

Additionally providing the `exclude` parameter to exclude the content of the `xlwings.conf` and `Sheet1` sheets:

```
Sub Hello()  
    RunRemotePython "http://127.0.0.1:8000/hello", apiKey:="YOUR_UNIQUE_API_KEY",  
    ↪ exclude:="xlwings.conf, Sheet1"  
End Sub
```

Google Sheets

Using only required arguments:

```
function hello() {  
    runPython("https://xxxx-xxxx-xx-xx-xxx-xxxx-xxxx-xxxx-xxx.ngrok.io/hello", {  
        apiKey: "YOUR_UNIQUE_API_KEY",  
    });  
}
```

Additionally providing the `exclude` parameter to exclude the content of the `xlwings.conf` and `Sheet1` sheets as well as a custom header:

```
function hello() {
  runPython("https://xxxx-xxxx-xx-xx-xxx-xxxx-xxxx-xxxx-xxx.ngrok.io/hello", {
    apiKey: "YOUR_UNIQUE_API_KEY",
    exclude: "xlwings.conf, Sheet1",
    headers: { MyHeader: "my value" },
  });
}
```

Excel on the web

Using only required arguments:

```
async function main(workbook: ExcelScript.Workbook) {
  await runPython(
    workbook,
    "https://xxxx-xxxx-xx-xx-xxx-xxxx-xxxx-xxxx-xxx.ngrok.io/hello",
    { apiKey: "YOUR_UNIQUE_API_KEY" }
  );
}
```

Additionally providing the `exclude` parameter to exclude the content of the `xlwings.conf` and `Sheet1` sheets as well as a custom header:

```
async function main(workbook: ExcelScript.Workbook) {
  await runPython(
    workbook,
    "https://xxxx-xxxx-xx-xx-xxx-xxxx-xxxx-xxxx-xxx.ngrok.io/hello",
    {
      apiKey: "YOUR_UNIQUE_API_KEY",
      exclude: "xlwings.conf, Sheet1",
      headers: { MyHeader: "my value" },
    }
  );
}
```

24.7.2 Configuration Examples: xlwings.conf sheet

Create a sheet called `xlwings.conf` and fill in key/value pairs like so:

	A	B	C	D	E	F
1	API_KEY	4bd5b65497e41f7a85006fdf23a1fb0e73353ffd7b1c9				
2	EXCLUDE	Sheet1, xlwings.conf				
3						
4						
5						
6						

< > ≡ Sheet1 xlwings.conf +

24.8 Production Deployment

The xlwings web server can be built with any web framework and can therefore be deployed using any solution capable of running a Python backend or function. Here is a list for inspiration (non-exhaustive):

- **Fully-managed services:** [Heroku](#), [render](#), [Fly.io](#), etc.
- **Interactive environments:** [PythonAnywhere](#), [Anvil](#), etc.
- **Serverless functions:** [AWS Lambda](#), [Azure Functions](#), [Google Cloud Functions](#), [Vercel](#), etc.
- **Virtual Machines:** [DigitalOcean](#) (referral link), [vultr](#) (referral link), [Linode](#), [AWS EC2](#), [Microsoft Azure VM](#), [Google Cloud Compute Engine](#), etc.
- **Corporate servers:** Anything will work (including Kubernetes) as long as the respective endpoints can be accessed from your spreadsheet app.

Important: For production deployment, always make sure to set a unique and random API key, see [Configuration](#).

If you'd like to deploy the [sample project](#) to production in less than 5 minutes, you can do so by clicking the button below, which will deploy it to Heroku's free tier. Note, however, that on the free plan, the backend will "sleep" after 30 minutes of inactivity, which means that it will take a few moments the next time you call it until it is up and running again. The `XLWINGS_API_KEY` is auto-generated and you can look it up under your app's Settings > Config Vars > Reveal Config Vars once the app is deployed. To get the URL, you'll need to append `/hello` to the app's URL that you'll find in your dashboard.

24.9 Triggers

Google Sheets

For Google Sheets, you can take advantage of the integrated Triggers (accessible from the menu on the left-hand side of the Apps Script editor). You can trigger your xlwings functions on a schedule or by an event, such as opening or editing a sheet.

Excel on the web

Normally, you would use Power Automate to achieve similar things as with Google Sheets Triggers, but unfortunately, Power Automate can't run Office Scripts that contain a `fetch` command like xlwings does, so for the time being, you can only trigger xlwings calls manually on Excel on the web. Alternatively, you can open your Excel file with Google Sheets and leverage the Triggers that Google Sheets offers. This, however, requires you to store your Excel file on Google Drive.

24.10 Limitations

- Currently, only a subset of the xlwings API is covered, mainly the Range and Sheet classes with a focus on reading and writing values. This, however, includes full support for type conversion including pandas DataFrames, NumPy arrays, datetime objects, etc.
- You are moving within the web's request/response cycle, meaning that values that you write to a range will only be written back to Google Sheets/Excel once the function call returns. Put differently, you'll get the state of the sheets at the moment the call was initiated, but you can't read from a cell you've just written to until the next call.
- You will need to use the same xlwings version for the Python package and the JavaScript module, otherwise, the server will raise an error.
- Currently, custom functions (a.k.a. user-defined functions or UDFs) are not supported.
- For users with no experience in web development, this documentation may not be quite good enough just yet.

Platform-specific limitations:

Google Sheets

- Quotas for Google Services apply.

Excel on the web

- xlwings relies on the `fetch` command in Office Scripts that cannot be used via Power Automate and that can be disabled by your Microsoft 365 administrator.
- While Excel on the web feels generally slow, it seems to have an extreme lag depending on where in the world you open the browser with Excel on the web. For example, a hello world call takes ~4.5s if you open a browser in Amsterdam/Netherlands while it takes ~8.5s if you do it Buenos Aires/Argentina.
- Platform limits with Office Scripts apply.

24.11 Roadmap

- Add support for UDFs/custom functions.
- Complete the RunPython API by adding features that currently aren't supported yet, e.g., charts, shapes, named ranges, tables, etc.
- Improve efficiency.

XLWINGS REPORTS

This feature requires xlwings PRO.

xlwings Reports is a solution for template-based Excel and PDF reporting, making the generation of pixel-perfect factsheets really simple. xlwings Reports allows business users without Python knowledge to create and maintain Excel templates without having to rely on a Python developer after the initial setup has been done: xlwings Reports separates the Python code (pre- and post-processing) from the Excel template (layout/formatting).

xlwings Reports supports all commonly required components:

- **Text:** Easily format your text via Markdown syntax.
- **Tables (dynamic):** Write pandas DataFrames to Excel cells and Excel tables and format them dynamically based on the number of rows.
- **Charts:** Use your favorite charting engine: Excel charts, Matplotlib, or Plotly.
- **Images:** You can include both raster (e.g., png) or vector (e.g., svg) graphics, including dynamically generated ones, e.g., QR codes or plots.
- **Multi-column Layout:** Split your content up into e.g. a classic two column layout by using Frames.
- **Single Template:** Generate reports in various languages, for various funds etc. based on a single template.
- **PDF Report:** Generate PDF reports automatically and “print” the reports on PDFs in your corporate layout for pixel-perfect results including headers, footers, backgrounds and borderless graphics.
- **Easy Pre-processing:** Since everything is based on Python, you can connect with literally any data source and clean it with pandas or some other library.
- **Easy Post-processing:** Again, with Python you’re just a few lines of code away from sending an email with the reports as attachment or uploading the reports to your web server, S3 bucket etc.

25.1 Quickstart

You can work on the sheet, book or app level:

- `mysheet.render_template(**data)`: replaces the placeholders in `mysheet`
- `mybook.render_template(**data)`: replaces the placeholders in all sheets of `mybook`
- `myapp.render_template(template, output, **data)`: convenience wrapper that copies a template book before replacing the placeholder with the values. Since this approach allows you to work with hidden Excel instances, it is the most commonly used method for production.

Let's go through a typical example: start by creating the following Python script `report.py`:

```
# report.py
from pathlib import Path

import pandas as pd
import xlwings as xw

# We'll place this file in the same directory as the Excel template
this_dir = Path(__file__).resolve().parent

data = dict(
    title='MyTitle',
    df=pd.DataFrame(data={'one': [1, 2], 'two': [3, 4]})
)

# Change visible=False to run this in a hidden Excel instance
with xw.App(visible=True) as app:
    book = app.render_template(this_dir / 'mytemplate.xlsx',
                              this_dir / 'myreport.xlsx',
                              **data)
    book.to_pdf(this_dir / 'myreport.pdf')
```

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

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

Run the Python script (or run the code from a Jupyter notebook):

```
python report.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
1	MyTitle	
2		
3	My DataFrame	
4	one	two
5	1	3
6	2	4
7		

If you like, you could also create a classic xlwings tool to call this script or you could design a GUI app by using a framework like PySimpleGUI and turn it into an executable by using a freezer (e.g., PyInstaller). This, however, is beyond the scope of this tutorial.

Note: 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](#).

Note: Unlike xlwings, xlwings Reports never writes out the index of pandas DataFrames. If you need the index to appear in Excel, use `df.reset_index()`, see [DataFrames](#).

See also [render_templates](#) ([API reference](#)).

25.1.1 Render Books and Sheets

Sometimes, it's useful to render a single book or sheet instead of using the `myapp.render_template` method. This is a workbook stored as `Book1.xlsx`:

Running the following code:

```
import xlwings as xw

book = xw.Book('Book1.xlsx')
sheet = book.sheets['template'].copy(name='report')
```

(continues on next page)

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

template +

(continued from previous page)

```
sheet.render_template(title='A Demo!', table=[[1, 2], [3, 4]])
book.to_pdf()
```

Copies the template sheet first and then fills it in:

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

template report

See also the [mysheet.render_template \(API reference\)](#) and [mybook.render_template \(API reference\)](#).

New in version 0.22.0.

25.2 DataFrames


To write DataFrames in a consistent manner to Excel, xlwings Reports ignores the DataFrame indices. If you need to pass the index over to Excel, reset the index before passing in the DataFrame to `render_template` or `render_template`: `df.reset_index()`.

When working with pandas DataFrames, the report designer often needs to tweak the data. Thanks to filters, they can do the most common operations directly in the template without the need to write Python code. A filter is added to the placeholder in Excel by using the pipe character: `{{ myplaceholder | myfilter }}`. You can combine multiple filters by using multiple pipe characters: they are applied from left to right,

i.e. the result from the first filter will be the input for the next filter. Let's start with an example before listing each filter with its details:

```
import xlwings as xw
import pandas as pd

book = xw.Book('Book1.xlsx')
sheet = book.sheets['template'].copy(name='report')
df = pd.DataFrame({'one': [1, 2, 3], 'two': [4, 5, 6], 'three': [7, 8, 9]})
sheet.render_template(df=df)
```



	A	B	C	D
1	{{ df }}			
2				
3				
4				
5				
6				
7	{{ df noheader }}			
8				
9				
10				
11				
12				
13	{{ df sortdesc(1) columns(0, None, 1) }}			
14				
15				
16				
17				

	A	B	C	D
1	one	two	three	
2	1	4	7	
3	2	5	8	
4	3	6	9	
5				
6				
7	1	4	7	
8	2	5	8	
9	3	6	9	
10				
11				
12				
13	one		two	
14	3		6	
15	2		5	
16	1		4	
17				

Available filters for DataFrames:

- **noheader**: Hide the column headers

Example:

```
{{ df | noheader }}
```

- **header**: Only return the header

Example:

```
{{ df | header }}
```

- **sortasc**: Sort in ascending order (indices are zero-based)

Example: sort by second, then by first column:

```
{{ df | sortasc(1, 0) }}
```

- **sortdesc**: Sort in descending order (indices are zero-based)

Example: sort by first, then by second column in descending order:

```
{{ df | sortdesc(0, 1) }}
```

- **columns:** Select/reorder columns and insert empty columns (indices are zero-based)

See also: `colslice`

Example: introduce an empty column (`None`) as the second column and switch the order of the second and third column:

```
{{ df | columns(0, None, 2, 1) }}
```

Note: Merged cells: you'll also have to introduce empty columns if you are using merged cells in your Excel template.

- **mul, div, sum, sub:** Apply an arithmetic operation (multiply, divide, sum, subtract) on a column (indices are zero-based)

Syntax:

```
{{ df | operation(value, col_ix[, fill_value]) }}
```

`fill_value` is optional and determines whether empty cells are included in the operation or not. To include empty values and thus make it behave like in Excel, set it to `0`.

Example: multiply the first column by 100:

```
{{ df | mul(100, 0) }}
```

Example: multiply the first column by 100 and the second column by 2:

```
{{ df | mul(100, 0) | mul(2, 1) }}
```

Example: add 100 to the first column including empty cells:

```
{{ df | add(100, 0, 0) }}
```

- **maxrows:** Maximum number of rows (currently, only `sum` is supported as aggregation function)

If your DataFrame has 12 rows and you use `maxrows(10, "Other")` as filter, you'll get a table that shows the first 9 rows as-is and sums up the remaining 3 rows under the label `Other`. If your data is unsorted, make sure to call `sortasc/sortdesc` first to make sure the correct rows are aggregated.

See also: `aggsmall`, `head`, `tail`, `rowslice`

Syntax:

```
{{ df | maxrows(number_rows, label[, label_col_ix]) }}
```


label_col_ix is optional: if left away, it will label the first column of the DataFrame (index is zero-based)

Examples:

```
{{ df | maxrows(10, "Other") }}
{{ df | sortasc(1) | maxrows(5, "Other") }}
{{ df | maxrows(10, "Other", 1) }}
```

- **aggsmall:** Aggregate rows with values below a certain threshold (currently, only sum is supported as aggregation function)

If the values in the specified row are below the threshold values, they will be summed up in a single row.

See also: maxrows, head, tail, rowslice

Syntax:

```
{{ df | aggsmall(threshold, threshold_col_ix, label[, label_col_ix][, min_
↪rows]) }}
```

label_col_ix and min_rows are optional: if label_col_ix is left away, it will label the first column of the DataFrame (indices are zero-based). min_rows has the effect that it skips rows from aggregating if it otherwise the number of rows falls below min_rows. This prevents you from ending up with only one row called “Other” if you only have a few rows that are all below the threshold. NOTE that this parameter only makes sense if the data is sorted!

Examples:

```
{{ df | aggsmall(0.1, 2, "Other") }}
{{ df | sortasc(1) | aggsmall(0.1, 2, "Other") }}
{{ df | aggsmall(0.5, 1, "Other", 1) }}
{{ df | aggsmall(0.5, 1, "Other", 1, 10) }}
```

- **head:** Only show the top n rows

See also: maxrows, aggsmall, tail, rowslice

Example:

```
{{ df | head(3) }}
```

- **tail:** Only show the bottom n rows

See also: maxrows, aggsmall, head, rowslice

Example:

```
{{ df | tail(5) }}
```

- **rowslice:** Slice the rows

See also: maxrows, aggsmall, head, tail

Syntax:

```
{{ df | rowslice(start_index[, stop_index]) }}
```

`stop_index` is optional: if left away, it will stop at the end of the DataFrame

Example: Show rows 2 to 4 (indices are zero-based and interval is half-open, i.e. the start is including and the end is excluding):

```
{{ df | rowslice(2, 5) }}
```

Example: Show rows 2 to the end of the DataFrame:

```
{{ df | rowslice(2) }}
```

- **colslice**: Slice the columns

See also: `columns`

Syntax:

```
{{ df | colslice(start_index[, stop_index]) }}
```

`stop_index` is optional: if left away, it will stop at the end of the DataFrame

Example: Show columns 2 to 4 (indices are zero-based and interval is half-open, i.e. the start is including and the end is excluding):

```
{{ df | colslice(2, 5) }}
```

Example: Show columns 2 to the end of the DataFrame:

```
{{ df | colslice(2) }}
```

25.3 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. 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 (note that this example makes use of *Frames*):

Running the following script:

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

nrows, ncols = 3, 3
df = pd.DataFrame(data=nrows * [ncols * ['test']],
                  columns=[f'col {i}' for i in range(ncols)])
```

(continues on next page)

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

(continued from previous page)

```
render_template('template.xlsx', 'output.xlsx', df=df)
```

Will produce the following report:

	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.		
9			

Headers of Excel tables are relatively strict, e.g. you can't have multi-line headers or merged cells. To get around these limitations, uncheck the Header Row checkbox under Table Design and use the noheader filter (see DataFrame filters). This will allow you to design your own headers outside of the Excel Table.

Note:

- At the moment, you can only assign pandas DataFrames to tables
-

25.4 Excel Charts

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

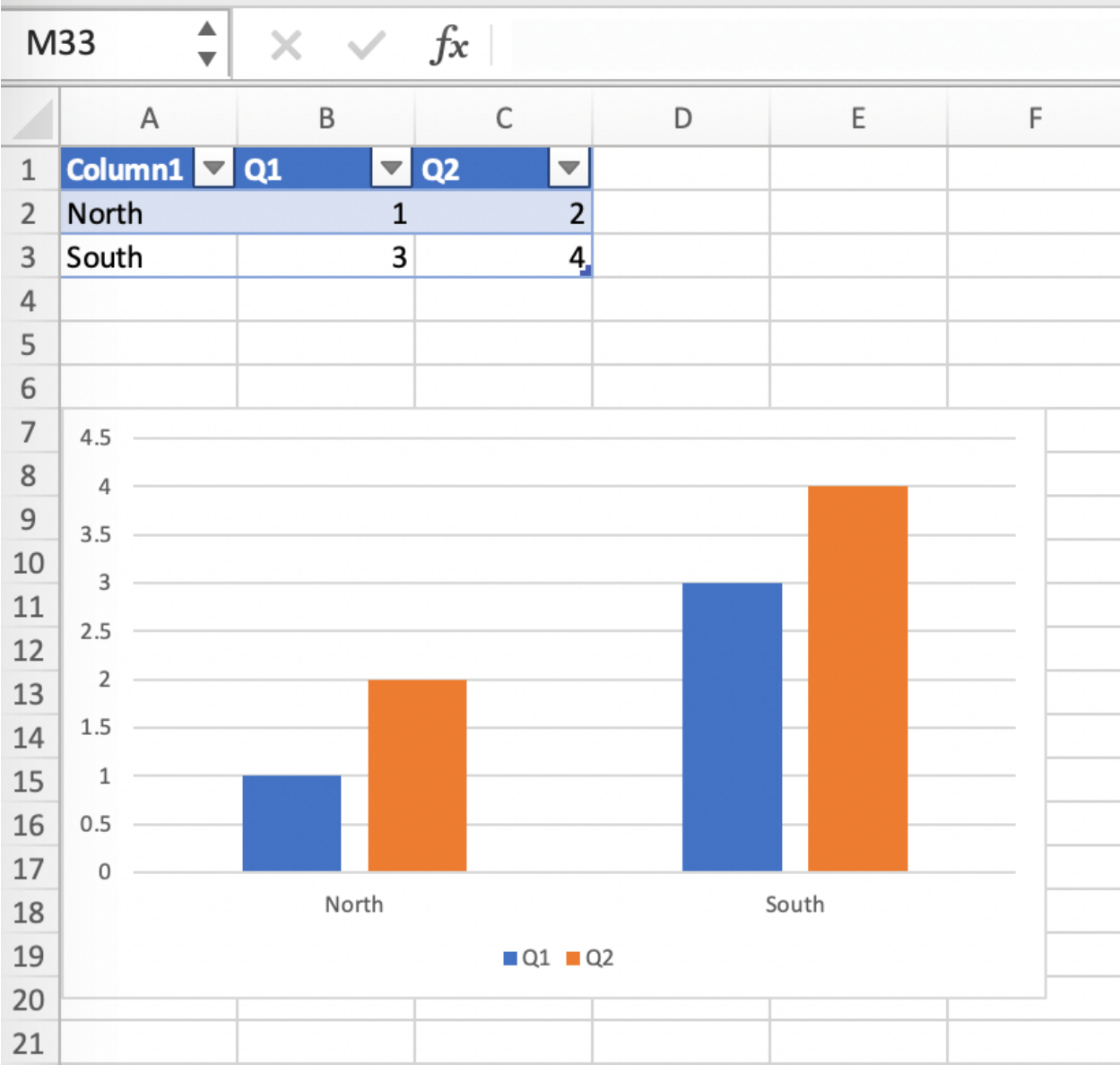
1. Add some sample/dummy data to your Excel template:

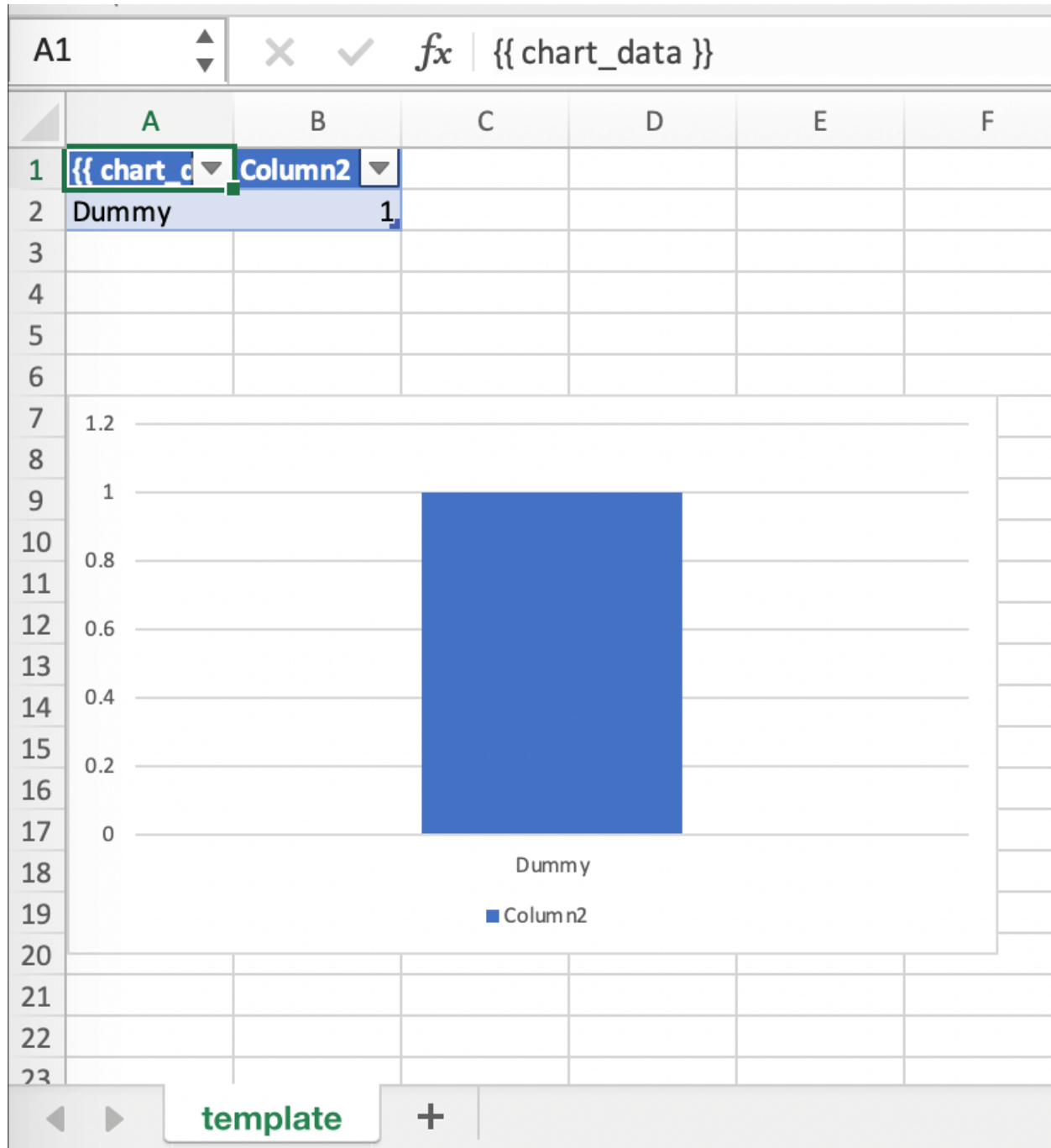
	A	B	C
1		Q1	Q2
2	North	1	2
3	South	3	4
4			
5			

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.

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

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:

```
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'])

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

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 can 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. To prevent the data sheet from being printed when calling `to_pdf`, you can give it a name that starts with `#` and it will be ignored. NOTE that if you start your sheet name with `##`, it won't be printed but also not rendered!

25.5 Images

Images are inserted so that the cell with the placeholder will become the top-left corner of the image. For example, write the following placeholder into your desired cell: `{{ logo }}`, then run the following code:

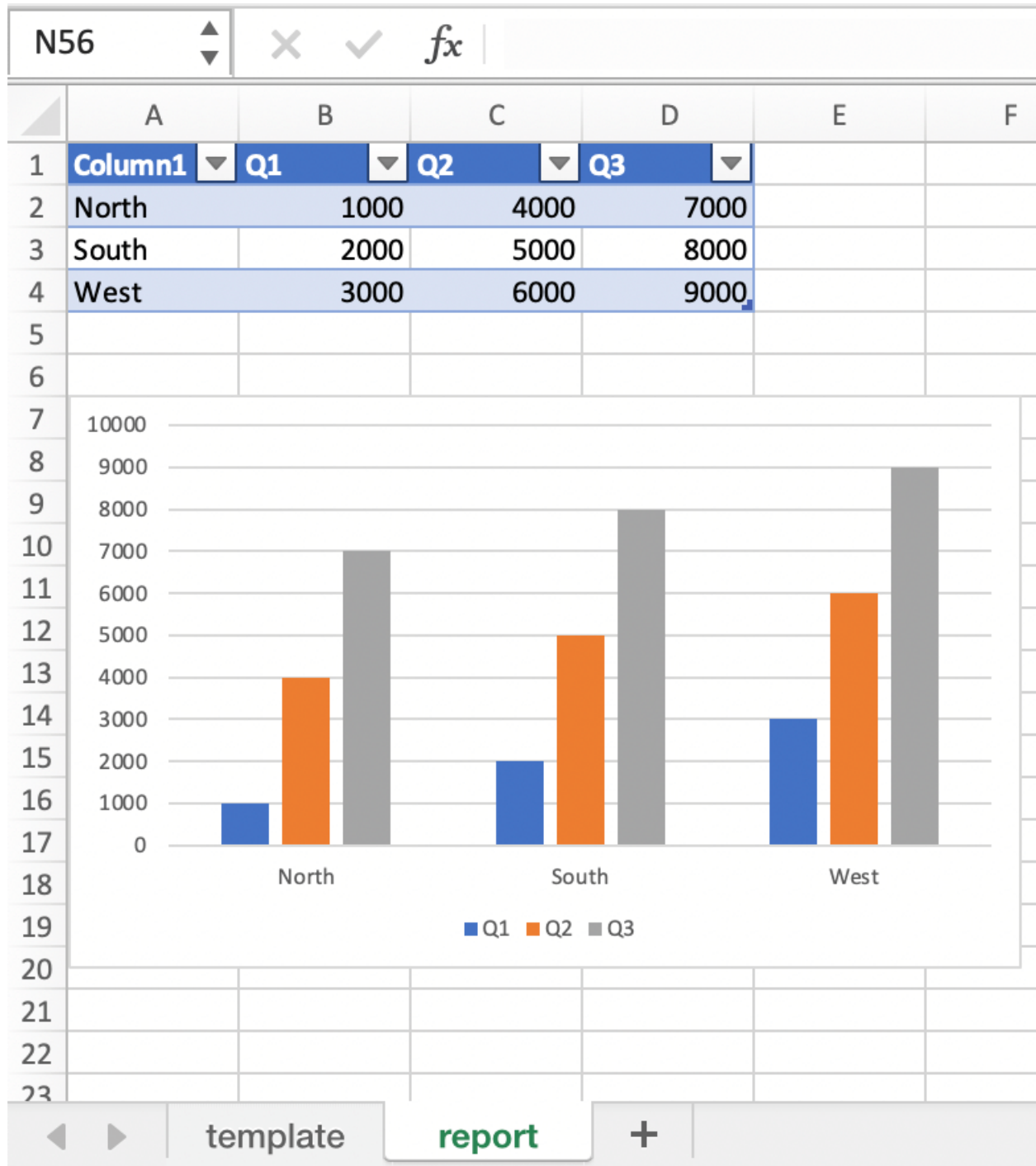
```
import xlwings as xw
from xlwings.pro.reports import Image

book = xw.Book('Book1.xlsx')
sheet = book.sheets['template'].copy(name='report')
sheet.render_template(logo=Image(r'C:\path\to\logo.png'))
```

Note: Image also accepts a `pathlib.Path` object instead of a string.

If you want to use vector-based graphics, you can use `svg` on Windows and `pdf` on macOS. You can control the appearance of your image by applying filters on your placeholder.

Available filters for Images:



- **width:** Set the width in pixels (height will be scaled proportionally).

Example:

```
{{ logo | width(200) }}
```

- **height:** Set the height in pixels (width will be scaled proportionally).

Example:

```
{{ logo | height(200) }}
```

- **width and height:** Setting both width and height will distort the proportions of the image!

Example:

```
{{ logo | height(200) | width(200) }}
```

- **scale:** Scale your image using a factor (height and width will be scaled proportionally).

Example:

```
{{ logo | scale(1.2) }}
```

- **top:** Top margin. Has the effect of moving the image down (positive pixel number) or up (negative pixel number), relative to the top border of the cell. This is very handy to fine-tune the position of graphics object.

See also: `left`

Example:

```
{{ logo | top(5) }}
```

- **left:** Left margin. Has the effect of moving the image right (positive pixel number) or left (negative pixel number), relative to the left border of the cell. This is very handy to fine-tune the position of graphics object.

See also: `top`

Example:

```
{{ logo | left(5) }}
```

25.6 Matplotlib and Plotly Plots

For a general introduction on how to handle Matplotlib and Plotly, see also: [Matplotlib](#). There, you'll also find the prerequisites to be able to export Plotly charts as pictures.

25.6.1 Matplotlib

Write the following placeholder in the cell where you want to paste the Matplotlib plot: `{{ lineplot }}`. Then run the following code to get your Matplotlib Figure object:

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

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

book = xw.Book('Book1.xlsx')
sheet = book.sheets['template'].copy(name='report')
sheet.render_template(lineplot=fig)
```

25.6.2 Plotly

Plotly works practically the same:

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

fig = px.line(x=["a","b","c"], y=[1,3,2], title="A line plot")
book = xw.Book('Book1.xlsx')
sheet = book.sheets['template'].copy(name='report')
sheet.render_template(lineplot=fig)
```

To change the appearance of the Matplotlib or Plotly plot, you can use the same filters as with images. Additionally, you can use the following filter:

- **format**: allows to change the default image format from `png` to e.g., `vector`, which will export the plot as vector graphics (svg on Windows and pdf on macOS). As an example, to make the chart smaller and use the vector format, you would write the following placeholder:

```
{{ lineplot | scale(0.8) | format("vector") }}
```

25.7 Text

You can work with placeholders in text that lives in cells or shapes like text boxes. If you have more than just a few words, text boxes usually make more sense as they won't impact the row height no matter how you style them. Using the same grid formatting across worksheets is key to getting a consistent multi-page report.

25.7.1 Simple Text without Formatting

New in version 0.21.4.

You can use any shapes like rectangles or circles, not just text boxes:

```
from xlwings.pro.reports import render_template

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

This code turns this template:

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

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

into this report:

	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, as explained in the next section.

If you will be printing on a *PDF Layout* with a dark background, you may need to change the font color to white. This has the nasty side effect that you won't see anything on the screen anymore. To solve that issue, use the `fontcolor` filter:

- **fontcolor:** Change the color of the whole (!) cell or shape. The primary purpose of this filter is to make white fonts visible in Excel. For most other colors, you can just change the color in Excel itself.

Note that this filter changes the font of the whole cell or shape and only has an effect if there is just a single placeholder—if you need to manipulate single words, use Markdown instead, see below. Black and white can be used as word, otherwise use a hex notation of your desired color.

Example:

```
{{ mytitle | fontcolor("white") }}  
{{ mytitle | fontcolor("#efefef") }}
```

25.7.2 Markdown Formatting

New in version 0.23.0.

You can format text in cells or shapes via Markdown syntax. Note that you can also use placeholders in the Markdown text that will take the values from the variables you supply via the `render_template` method:

```
import xlwings as xw  
from xlwings.pro import Markdown  
  
mytext = """\n  
# Title  
  
Text bold and italic  
  
* A first bullet  
* A second bullet  
  
# {{ second_title }}  
  
This paragraph has a line break.  
Another line.  
"""  
  
# The first sheet requires a shape as shown on the screenshot  
sheet = xw.sheets.active  
sheet.render_template(myplaceholder=Markdown(mytext),  
                      second_title='Another Title')
```

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

Like this (this uses the default formatting):

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

	A	B	C	D	E	F
	1 2 3	{{ myplaceholder }}				

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

25.8 Date and Time

If a placeholder corresponds to a Python `datetime` object, by default, Excel will format that cell as a date-formatted cell. This isn't always desired as the formatting depends on the user's regional settings. To prevent that, format the cell in the `Text` format or use a `TextBox` and use the `datetime` filter to format the date in the desired format. The `datetime` filter accepts the `strftime` syntax—for a good reference, see e.g., strftime.org.

To control the language of month and weekday names, you'll need to set the `locale` in your Python code. For example, for German, you would use the following:

```
import locale
locale.setlocale(locale.LC_ALL, 'de_DE')
```

Example: The default formatting is December 1, 2020:

```
{{ mydate | datetime }}
```

Example: To apply a specific formatting, provide the desired format as filter argument. For example, to get it in the 12/31/20 format:

```
{{ mydate | datetime("%m/%d/%y") }}
```

25.9 Number Format

The `format` filter allows you to format numbers by using the same mechanism as offered by Python's f-strings. For example, to format the placeholder `performance=0.13` as `13.0%`, you would do the following:

```
{{ performance | format(".1%") }}
```

This corresponds to the following f-string in Python: `f"{performance:0.1%}"`. To get an introduction to the formatting string syntax, have a look at the [Python String Format Cookbook](#).

25.10 Frames: Multi-column Layout

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 a Note with the text `<frame>` into **row 1** of your Excel template wherever you want a new dynamic column to start. 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.

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

You can define and format DataFrames by formatting

- one header and
- one data row

If you use the `noheader` filter for DataFrames, you can leave the header away and format a single data row. Alternatively, you could also use Excel Tables, as they can make formatting easier.

Running the following code:

```
from xlwings.pro.reports import render_template
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.reset_index(), df2=df2.reset_index())

render_template('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

25.11 PDF Layout

Using the `layout` parameter in the `to_pdf()` command, you can “print” your Excel workbook on professionally designed PDFs for pixel-perfect reports in your corporate layout including headers, footers, backgrounds and borderless graphics:

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

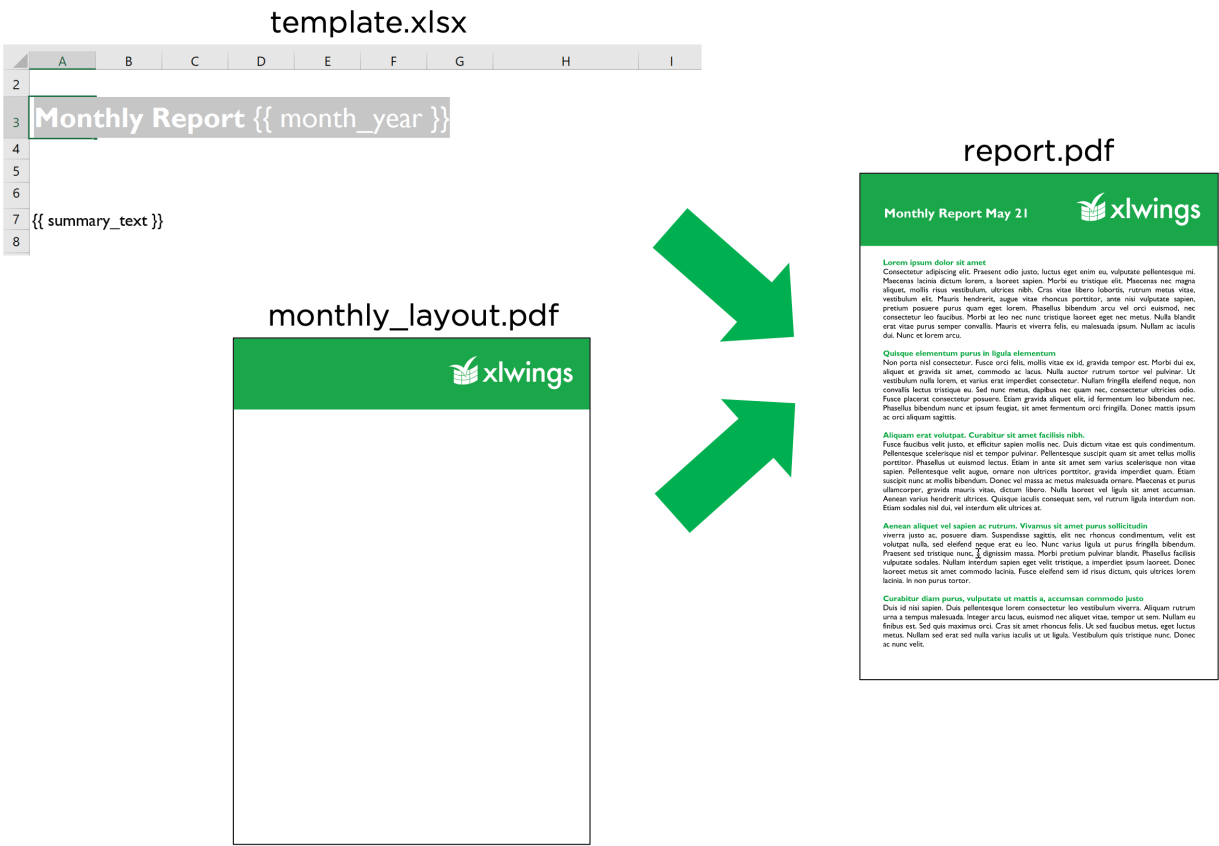
df = pd.DataFrame([[1, 2, 3], [4, 5, 6], [7, 8, 9]])

book = render_template('template.xlsx',
                      'report.xlsx',
                      month_year = 'May 21',
                      summary_text = '...')

book.to_pdf('report.pdf', layout='monthly_layout.pdf')
```

Note that the layout PDF either needs to consist of a single page (will be used for each reporting page) or will need to have the same number of pages as the report (each report page will be printed on the corresponding layout page).

To create your layout PDF, you can use any program capable of exporting a file in PDF format such as PowerPoint or Word, but for the best results consider using a professional desktop publishing software such as Adobe InDesign.



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

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

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

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```
# 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 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. 1 Another line. 2	<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>				

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.
""

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

# Styling
```

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```

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!
↪ 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:

```

>>> style.strong.bold = False
>>> style.strong.color = (255, 0, 0)
>>> style.strong
strong.color: (255, 0, 0)

```

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*

RELEASING XLWINGS TOOLS

This feature requires xlwings PRO.

xlwings PRO offers a simple way to deploy your xlwings tools to your end users without the usual hassle that's involved when installing and configuring Python and xlwings. End users don't need to know anything about Python as they only need to:

- Run an installer (one installer can power many different Excel workbooks)
- Use the Excel workbook as if it was a normal macro-enabled workbook

Advantages:

- **Zero-config:** The end user doesn't have to configure anything throughout the whole process.
- **No add-in required:** No installation of the xlwings add-in required.
- **Easy to update:** If you want to deploy an update of your Python code, it's often good enough to distribute a new version of your workbook.
- **No conflicts:** The installer doesn't touch any environment variables or registry keys and will therefore not conflict with any existing Python installations.
- **Deploy key:** The release command will add a deploy key as your LICENSE_KEY. A deploy key won't expire and end users won't need a paid subscription.

You as a developer need to create the one-click installer and run the `xlwings release` command on the workbook. Let's go through these two steps in detail!

There is a video walkthrough at: https://www.youtube.com/watch?v=yw36VT_n1qg

27.1 Step 1: One-Click Installer

As a subscriber of one of our [paid plans](#), you will get access to a private GitHub repository, where you can build your one-click installer:

- 1) Update your `requirements.txt` file with your dependencies: in your repository, start by clicking on the `requirements.txt` file. This will open the following screen where you can click on the pencil icon to edit the file (if you know your way around Git, you can also clone the repository and use your local commit/push workflow instead):

```
2 lines (1 sloc) | 22 Bytes
1 xlwings[pro]==0.20.8
2
```

After you're done with your edits, click on the green **Commit changes** button.

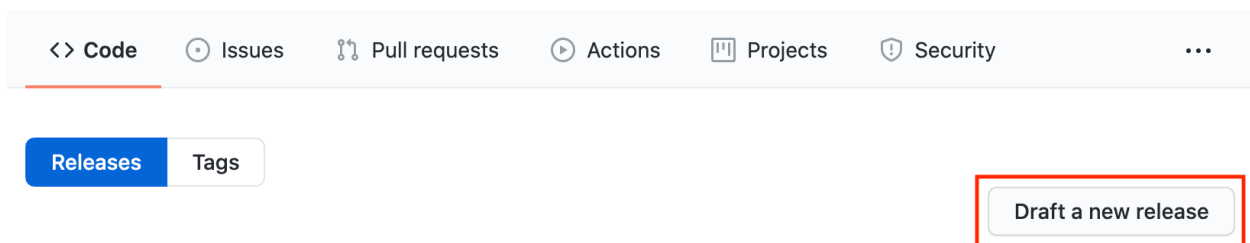
Note: If you are unsure about your dependencies, it's best to work locally with a virtual or Conda environment. In the virtual/Conda environment, only install packages that you need, then run: `pip list --format=freeze`.

2) On the right-hand side of the landing page, click on **Releases**:



No releases published
[Create a new release](#)

On the next screen, click on **Draft a new release** (note, the very first time, you will see a green button called **Create a new release** instead):



This will bring up the following screen, where you'll only have to fill in a **Tag version** (e.g., `1.0.0`), then click on the green button **Publish release**:

After 3-5 minutes (you can follow the progress under the **Actions** tab), you'll find the installer ready for download under **Releases** (ignore the `zip` and `tar.gz` files):


Note: The one-click installer is a normal Python installation that you can use with multiple Excel workbooks. Hence, you don't need to create a separate installer for each workbook as long as they all work with the same set of dependencies as defined by the `requirements.txt` file.

Releases

Tags

1.0.0

@

 Target: main ▼


Choose an existing tag, or create a new tag on publish


Release title

Write

Preview

Describe this release

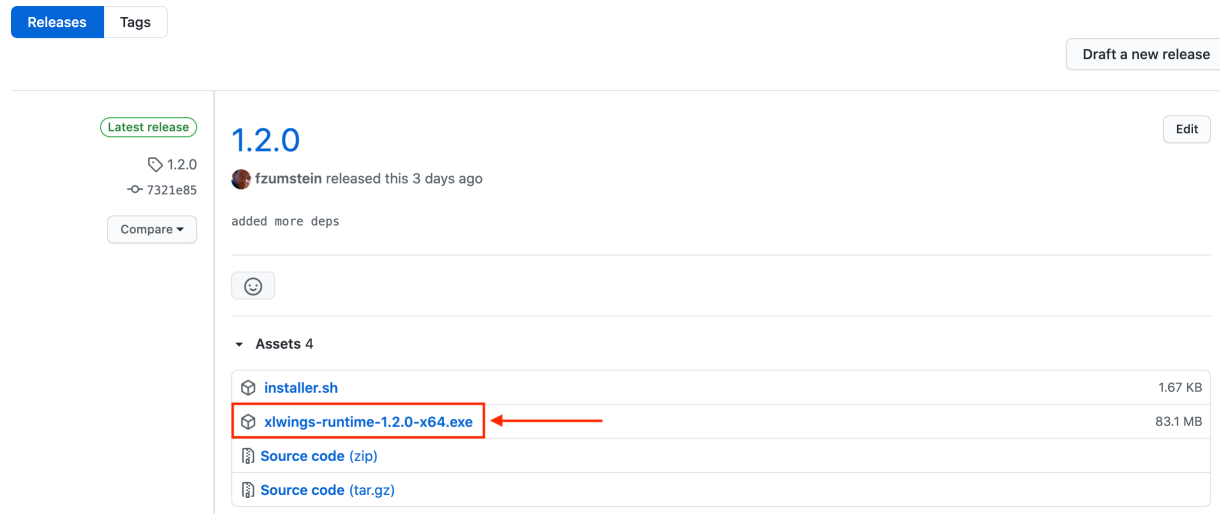
Attach files by dragging & dropping, selecting or pasting them. 

 Attach binaries by dropping them here or selecting them.

☐ **This is a pre-release**
We'll point out that this release is identified as non-production ready.

Publish release

Save draft



27.2 Step 2: Release Command (CLI)

The release command is part of the xlwings CLI (command-line client) and will prepare your Excel file to work with the one-click installer generated in the previous step. Before anything else:

- Make sure that you have enabled Trust access to the VBA project object model under File > Options > Trust Center > Trust Center Settings > Macro Settings. You only need to do this once and since this is a developer setting, your end users won't need to bother about this. This setting is needed so that xlwings can update the Excel file with the correct version of the VBA code.
- Run the installer from the previous step. This will not interfere with your existing Python installation as it won't touch your environment variables or registry. Instead, it will only write to the following folder: %LOCALAPPDATA%\<installer-name>.
- Make sure that your local version of xlwings corresponds to the version of xlwings in the requirements.txt from the installer. The easiest way to double-check this is to run `pip freeze` on a Command Prompt or Anaconda Prompt. If your local version of xlwings differs, install the same version as the installer uses via: `pip install xlwings==<version from installer>`.

To work with the release command, you should have your workbook in the xlsx format and all the Python modules in the same folder:

```
myworkbook.xlsx
mymodule_one.py
mymodule_two.py
...
```

You currently can't organize your code in directories, but you can easily import `mymodule_two` from `mymodule_one`.

Make sure that your Excel workbook is the active workbook, then run the following command on a Command/Anaconda Prompt:

xlwings release

If this is the first time you are running this command, you will be asked a few questions. If you are shown a [Y/n], you can hit Enter to accept the default as expressed by the capitalized letter:

- **Name of your one-click installer?** *Type in the name of your one-click installer. If you want to use a different Python distribution (e.g., Anaconda), you can leave this empty (but you will need to update the xlwings.conf sheet with the Conda settings once the release command has been run).*
- **Embed your Python code?** [Y/n] *This will copy the Python code into the sheets of the Excel file. It will respect all Python files that are in the same folder as the Excel workbook.*
- **Hide the config sheet?** [Y/n] *This will hide the xlwings.conf sheet.*
- **Hide the sheets with the embedded Python code?** [Y/n] *If you embed your Python code, this will hide all sheets with a .py ending.*
- **Allow your tool to run without the xlwings add-in?** [Y/n] *This will remove the VBA reference to xlwings and copy in the xlwings VBA modules so that the end users don't need to have the xlwings add-in installed. Note that in this case, you will need to have your RunPython calls bound to a button as you can't use the Ribbon's Run main button anymore.*

Whatever answers you pick, you can always change them later by editing the xlwings.conf sheet or by deleting the xlwings.conf sheet and re-running the xlwings release command. If you go with the defaults, you only need to provide your end users with the one-click installer and the Excel workbook, no external Python files are required.

27.3 Updating a Release

To edit your Python code, it's easiest to work with external Python files and not with embedded code. To stop xlwings from using the embedded code, simply delete all sheets with a .py ending and the workbook will again use the external Python modules. Once you are done editing the files, simply run the xlwings release command again, which will embed the updated code. If you haven't done any changes to your dependencies (i.e., you haven't upgraded a package or introduced a new one), you only need to redeploy your Excel workbook to have the end users get the update.

If you did make changes to the requirements.txt and release a new one-click installer, you will need to have the users install the new version of the installer first.

Note: Every time you change the xlwings version in requirements.txt of your one-click installer, make sure to upgrade your local xlwings installatino to the same version and run xlwings release again!

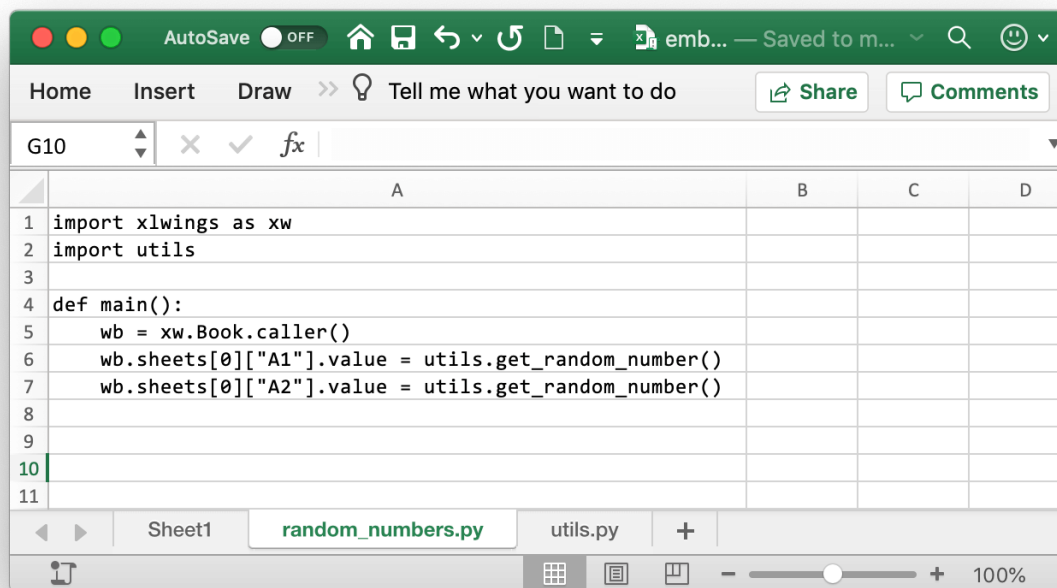
27.4 Embedded Code Explained

When you run the `xlwings release` command, your code will be embedded automatically (except if you switch this behavior off). You can, however, also embed code directly: on a command line, run the following command:

```
xlwings code embed
```

This will import all Python files from the current directory and paste them into Excel sheets of the currently active workbook. Now, you can use `RunPython` as usual: `RunPython "import mymodule;mymodule.myfunction()"`.

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

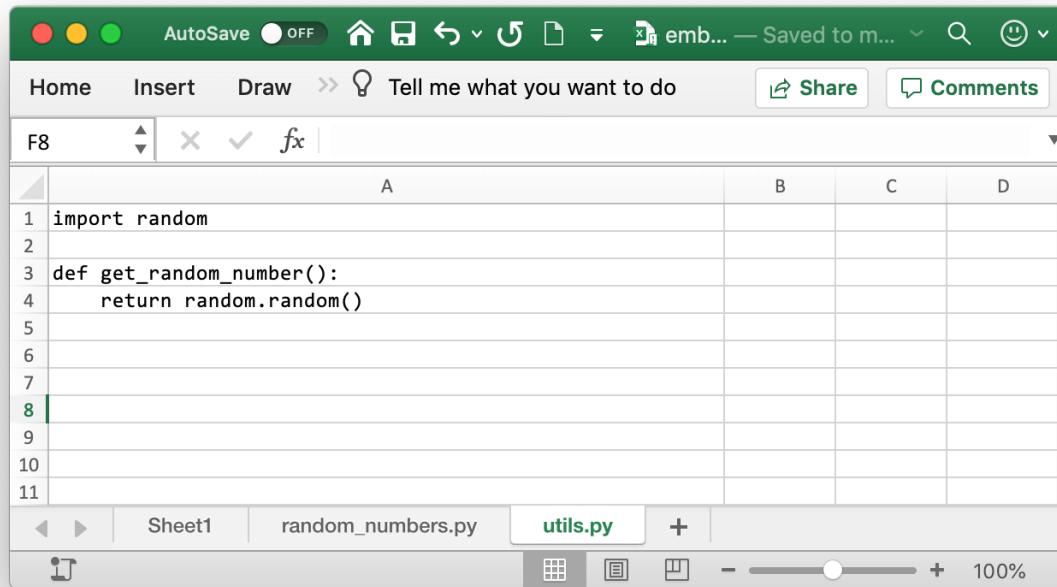


You can call the `main` function from VBA like so:

```
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.



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

PERMISSIONING OF CODE EXECUTION

This feature requires xlwings PRO.

xlwings allows you to control which Python modules are allowed to run from Excel. In order to use this functionality, you need to run your own web server. You can choose between an HTTP POST and a GET request for the permissioning:

- **GET:** This is the simpler option as you only need to host a static JSON file that you can generate via the xlwings CLI. You can use any web server that is capable of serving static files (e.g., nginx) or use a free external service like GitHub pages. However, every permission change requires you to update the JSON file on the server.
- **POST:** This option relies on the web server to validate the incoming payload of the POST request. While this requires custom logic on your end, you are able to connect it with any internal system (such as a database or LDAP server) to dynamically decide whether a user should be able to run a specific Python module through xlwings.

Before looking at both of these options in more detail, let's go through the prerequisites and configuration.

Note: This feature does not stop users from running arbitrary Python code through Python directly. Rather, think of it as a mechanism to prevent accidental execution of Python code from Excel via xlwings.

28.1 Prerequisites

- This functionality requires every end user to have the `requests` and `cryptography` libraries installed. You can install them via pip:

```
pip install requests cryptography
```

or via Conda:

```
conda install requests cryptography
```

- You need to have a `LICENSE_KEY` in the form of a [trial key](#), a paid license key or a deploy key.

28.2 Configuration

While xlwings offers various ways to configure your workbook (see [Configuration](#)), it will only respect the permissioning settings in the config file in the user's home folder (on Windows, this is %USERPROFILE%\xlwings\xlwings.conf):

- To prevent end users from overwriting xlwings.conf, you'll need to make sure that the file is owned by the Administrator while giving end users read-only permissions.
- Add the following settings while replacing the PERMISSION_CHECK_URL and PERMISSION_CHECK_METHOD (POST or GET) with the appropriate value for your case. PERMISSION_CHECK_AUTHORIZATION is an optional setting that allows you to send a token with POST requests via the Authorization header:

```
"LICENSE_KEY", "YOUR_LICENSE_OR_DEPLOY_KEY"
"PERMISSION_CHECK_ENABLED", "True"
"PERMISSION_CHECK_URL", "https://myurl.com"
"PERMISSION_CHECK_METHOD", "POST"
"PERMISSION_CHECK_AUTHORIZATION", "your_token"
```

28.3 GET request

You can generate the static JSON file by using the xlwings CLI:

- Print the JSON string for all Python modules in a certain folder:

```
cd myfolder
xlwings permission cwd
```

- Print the JSON string for all embedded modules of the active workbook:

```
xlwings permission book
```

Both commands will print a JSON string similar to this one:

```
{
  "modules": [
    {
      "file_name": "myfile.py",
      "sha256": "cea259922207049a734c88930b5c09109deb6b55f692fd0832f4e57052d85896
→",
      "machine_names": [
        "DESKTOP-QQ27RP3"
      ]
    },
    {
      "file_name": "myfile2.py",
```

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```

    "sha256": "355200bb9ae00fcec1d7b660e7dd95fb3dbf246a9db397a6daa2471458a8e6cb",
    "machine_names": [
        "DESKTOP-QQ27RP3"
    ]
}
]
}

```

All you need to do at this point is:

- Add additional machines names e.g., "machine_names": ["DESKTOP-QQ27RP3", "DESKTOP-XY12AS2"]. Alternatively, you can use the "*" wildcard if you want to allow the module to be used on all end user's computers. In case of the wildcard, it will still make sure that the file's content hasn't been changed by looking at its sha256 hash. xlwings uses `import socket; socket.gethostname()` as the machine name.
- Make this JSON file accessible via your web server and update the settings in the `xlwings.conf` file accordingly (see above).

28.4 POST request

If you work with POST requests, xlwings will post a payload similar to the following:

```

{
  "machine_name": "DESKTOP-QQ27RP3",
  "modules": [
    {
      "file_name": "myfile.py",
      "sha256":
        ↪ "cea259922207049a734c88930b5c09109deb6b55f692fd0832f4e57052d85896"
    },
    {
      "file_name": "myfile2.py",
      "sha256":
        ↪ "355200bb9ae00fcec1d7b660e7dd95fb3dbf246a9db397a6daa2471458a8e6cb"
    }
  ]
}

```

It is now up to you to validate this request and:

- Return the HTTP status code 200 ("success") if the user is allowed to run the code of these modules
- Return the HTTP status code 403 ("forbidden") if the user is not allowed to run the code of these modules

Note that xlwings only checks for HTTP status code 200, so any other status code will fail.

28.5 Implementation Details & Limitations

- Currently, RunPython and user-defined functions (UDFs) are supported. RunFrozenPython is not supported.
- Permissions checks are only done when the Python module is run via Excel/xlwings, it has no effect on Python code that is run from Python directly.
- RunPython won't allow you to run code that uses the `from x import y` syntax. Use `import x;x.y` instead.
- The answer of the permissioning server is cached for the duration of the Python session. For UDFs, this means until the functions are re-imported or the **Restart UDF Server** button is clicked or until Excel is restarted. The same is true if you run RunPython with the **Use UDF Server** option. By default, however, RunPython starts a new Python session every time, so it will contact the server whenever you call RunPython.
- Only top-level modules are checked, i.e. modules that are imported as UDFs or run via RunPython call. Any modules that are imported as dependencies of these modules are not checked.
- RunPython with external Python source files depends on logic in the VBA part of xlwings. UDFs and RunPython calls that use embedded code will only rely on Python to perform the permissioning check.

29.1 Top-level functions

`xlwings.load(index=1, header=1, chunksize=5000)`

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 (via current region) and turned into a pandas DataFrame. If you don't have pandas installed, it returns the values as nested lists.

Note: Only use this in an interactive context like e.g. a Jupyter notebook! Don't use this in a script as it depends on the active book.

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
- **chunksize** (*int, default 5000*) – Chunks the loading of big arrays.

Examples

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

See also: `view`

Changed in version 0.23.1.

`xlwings.view(obj, sheet=None, table=True, chunksize=5000)`

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.

Note: Only use this in an interactive context like e.g., a Jupyter notebook! Don't use this in a script as it depends on the active book.

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
- **chunksize** (*int, default 5000*) – Chunks the loading of big arrays.

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.

29.2 Object model

29.2.1 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>])
```

property `active`

Returns the active app.

New in version 0.9.0.

add (***kwargs*)

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

property 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.

29.2.2 App

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

An app corresponds to an Excel instance and should normally be used as context manager to make sure that everything is properly cleaned up again and to prevent zombie processes. New Excel instances can be fired up like so:

```
import xlwings as xw

with xw.App() as app:
    print(app.books)
```

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 frontmost application and hand over focus from Python to Excel.

New in version 0.9.0.

property api

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

New in version 0.9.0.

property 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.

property 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.

property cut_copy_mode

Gets or sets the status of the cut or copy mode. Accepts False for setting and returns None, copy or cut when getting the status.

New in version 0.24.0.

property 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.

property enable_events

True if events are enabled. Read/write boolean.

New in version 0.24.4.

property hwnd

Returns the Window handle (Windows-only).

New in version 0.9.0.

property interactive

True if Excel is in interactive mode. If you set this property to False, Excel blocks all input from the keyboard and mouse (except input to dialog boxes that are displayed by your code). Read/write Boolean. NOTE: Not supported on macOS.

New in version 0.24.4.

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
```

Types are supported too:

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

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```
>>> my_sum(1, 2)
3
```

However typed arrays are not supported. So the following won't work

```
Function MySum(arr() as integer)
    ' code here
End Function
```

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

New in version 0.9.0.

property pid

Returns the PID of the app.

New in version 0.9.0.

properties(kwargs)**

Context manager that allows you to easily change the app's properties temporarily. Once the code leaves the with block, the properties are changed back to their previous state. Note: Must be used as context manager or else will have no effect. Also, you can only use app properties that you can both read and write.

Examples

```
import xlwings as xw
app = App()

# Sets app.display_alerts = False
with app.properties(display_alerts=False):
    # do stuff

# Sets app.calculation = 'manual' and app.enable_events = True
with app.properties(calculation='manual', enable_events=True):
    # do stuff

# Makes sure the status bar is reset even if an error happens in the
↳with block
with app.properties(status_bar='Calculating...'):
    # do stuff
```

New in version 0.24.4.

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.

render_template(*template=None*, *output=None*, *book_settings=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, pictures and Matplotlib/Plotly figures.

Parameters

- **template** (*str or path-like object*) – Path to your Excel template, e.g. `r'C:\Path\to\my_template.xlsx'`
- **output** (*str or path-like object*) – 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}`.
- **data** (*kwargs*) – All key/value pairs that are used in the template.

Returns wb

Return type xlwings Book

New in version 0.24.4.

property 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.

property selection

Returns the selected cells as `Range`.

New in version 0.9.0.

property 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.

property 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.

property 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.

property visible

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

New in version 0.3.3.

29.2.3 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.

property active

Returns the active Book.

add()

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

open(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, json=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 file-name, 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.

29.2.4 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, json=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 xw.apps[10559] (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 (full)name	<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 Platform 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.
- **json** (*dict*) – A JSON object as delivered by the MS Office Scripts or Google Apps Script xlwings module but in a deserialized form, i.e., as dictionary.

New in version 0.26.0.

activate(*steal_focus=False*)

Activates the book.

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

property api

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

New in version 0.9.0.

property 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.

property fullname

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

json()

Returns a JSON serializable object as expected by the MS Office Scripts or Google Apps Script xlwings module. Only available with book objects that have been instantiated via `xw.Book(json=...)`.

New in version 0.26.0.

macro(name)

Runs a Sub or Function in Excel VBA.

Parameters

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

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.

property name

Returns the name of the book as str.

property 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.

render_template(**data)

This method requires xlwings *PRO*.

Replaces all Jinja variables (e.g. `{{ myvar }}`) in the book with the keyword argument of the same name.

New in version 0.25.0.

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

Examples

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

save(path=None, password=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
- **password** (*str, default None*) – Protection password with max. 15 characters

New in version 0.25.1.

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.

property 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.

property 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, layout=None, exclude_start_string='#', show=False, quality='standard')

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.
- **layout** (*str or path-like object, default None*) – This argument requires xlwings *PRO*.

Path to a PDF file on which the report will be printed. This is ideal for headers and footers as well as borderless printing of graphics/artwork. The PDF file either needs to have only 1 page (every report page uses the same layout) or otherwise needs the same amount of pages as the report (each report page is printed on the respective page in the layout PDF).

New in version 0.24.3.

- **exclude_start_string** (*str, default '#'*) – Sheet names that start with this character/string will not be printed.

New in version 0.24.4.

- **show** (*bool, default False*) – Once created, open the PDF file with the default application.

New in version 0.24.6.

- **quality** (*str, default 'standard'*) – Quality of the PDF file. Can either be 'standard' or 'minimum'.

New in version 0.26.2.

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.

29.2.5 PageSetup

class xlwings.main.**PageSetup**(*impl*)

property **api**

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

New in version 0.24.2.

property **print_area**

Gets or sets the range address that defines the print area.

Examples

```
>>> mysheet.page_setup.print_area = '$A$1:$B$3'
>>> mysheet.page_setup.print_area
'$A$1:$B$3'
>>> mysheet.page_setup.print_area = None # clear the print_area
```

New in version 0.24.2.

29.2.6 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.

property **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.

29.2.7 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>
>>> wb.sheets.add()
<Sheet [Book1]Sheet2>
```

Changed in version 0.9.0.

activate()

Activates the Sheet and returns it.

property 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.

property book

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

property 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.

property 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.

clear_formats()

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

New in version 0.26.2.

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()
```

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```
# 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.

property index

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

property name

Gets or sets the name of the Sheet.

property names

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

New in version 0.9.0.

property page_setup

Returns a PageSetup object.

New in version 0.24.2.

property 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.

Examples

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

select()

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

New in version 0.9.0.

property shapes

See [Shapes](#)

New in version 0.9.0.

property tables

See [Tables](#)

New in version 0.21.0.

to_pdf(path=None, layout=None, show=False, quality='standard')

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.
- **layout** (*str or path-like object, default None*) – This argument requires xlwings *PRO*.

Path to a PDF file on which the report will be printed. This is ideal for headers and footers as well as borderless printing of graphics/artwork. The PDF file either needs to have only 1 page (every report page uses the same layout) or otherwise needs the same amount of pages as the report (each report page is printed on the respective page in the layout PDF).

New in version 0.24.3.

- **show** (*bool, default False*) – Once created, open the PDF file with the default application.

New in version 0.24.6.

- **quality** (*str, default 'standard'*) – Quality of the PDF file. Can either be 'standard' or 'minimum'.

New in version 0.26.2.

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.

property `used_range`

Used Range of Sheet.

Returns

Return type `xw.Range`

New in version 0.13.0.

property `visible`

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

New in version 0.21.1.

29.2.8 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))
```

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```
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.

property address

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

New in version 0.9.0.

property 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.

clear_formats()

Clears the format of a Range but leaves the content.

New in version 0.26.2.

property 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 hex string like #efefef or an Excel 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) # or '#ffffff'
>>> 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.

property 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.

property 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 <= column_width <= 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.

property 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

copy_picture(*appearance='screen', format='picture'*)

Copies the range to the clipboard as picture.

Parameters

- **appearance** (*str*, *default 'screen'*) – Either ‘screen’ or ‘printer’.
- **format** (*str*, *default 'picture'*) – Either ‘picture’ or ‘bitmap’.

New in version 0.24.8.

property count

Returns the number of cells.

property 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.

property formula

Gets or sets the formula for the given Range.

property formula2

Gets or sets the formula2 for the given Range.

property 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)
'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.

property has_array

True if the range is part of a legacy CSE Array formula and False otherwise.

property height

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

Returns**Return type** float

New in version 0.4.0.

property 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

property 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.

property 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.

property 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.

property merge_cells

Returns True if the Range contains merged cells, otherwise False

property name

Sets or gets the name of a Range.

New in version 0.4.0.

property note

Returns a Note object. Before the introduction of threaded comments, a Note was called a Comment.

New in version 0.24.2.

property 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%'
>>> 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'
- **chunksize** (*int*) –

Use a **chunksize**, e.g. **10000** to prevent timeout or memory issues when reading or writing large amounts of data. Works with all formats, including DataFrames, NumPy arrays, and list of lists.

=> 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, all_except_borders, all_using_source_theme, column_widths, comments, formats, 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

property 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.

property row

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

Returns

Return type Integer

New in version 0.3.5.

property 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.

property 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.

property shape

Tuple of Range dimensions.

New in version 0.3.0.

property sheet

Returns the Sheet object to which the Range belongs.

New in version 0.9.0.

property size

Number of elements in the Range.

New in version 0.3.0.

property table

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

New in version 0.21.0.

to_pdf(*path=None, layout=None, show=None, quality='standard'*)

Exports the range as PDF.

Parameters

- **path** (*str or path-like, default None*) – Path where you want to store the pdf. Defaults to the address of the range in the same directory as the Excel file if the Excel file is stored and to the current working directory otherwise.
- **layout** (*str or path-like object, default None*) – This argument requires xlwings *PRO*.

Path to a PDF file on which the report will be printed. This is ideal for headers and footers as well as borderless printing of graphics/artwork. The PDF file either needs to have only 1 page (every report page uses the same layout) or otherwise needs the same amount of pages as the report (each report page is printed on the respective page in the layout PDF).

- **show** (*bool, default False*) – Once created, open the PDF file with the default application.
- **quality** (*str, default 'standard'*) – Quality of the PDF file. Can either be 'standard' or 'minimum'.

New in version 0.26.2.

to_png(*path=None*)

Exports the range as PNG picture.

Parameters path (*str or path-like, default None*) – Path where you want to store the picture. Defaults to the name of the range in the same directory as the Excel file if the Excel file is stored and to the current working directory otherwise.

New in version 0.24.8.

property 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.

property value

Gets and sets the values for the given Range. See [xlwings.Range.options\(\)](#) about how to set options, e.g., to transform it into a DataFrame or how to set a chunksize.

Returns object – see [xlwings.Range.options\(\)](#)

Return type returned object depends on the converter being used,

property width

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

Returns

Return type float

New in version 0.4.0.

property wrap_text

Returns True if the wrap_text property is enabled and False if it's disabled. If not all cells have the same value in a range, on Windows it returns None and on macOS False.

New in version 0.23.2.

29.2.9 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'
```

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```
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.

property count

Returns the number of rows.

New in version 0.9.0.

29.2.10 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')

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

autofit()

Autofits the width of the columns.

property count

Returns the number of columns.

New in version 0.9.0.

29.2.11 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.

property api

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

property count

Returns the number of objects in the collection.

29.2.12 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.

property 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.

property height

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

New in version 0.5.0.

property left

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

New in version 0.5.0.

property name

Returns or sets the name of the shape.

New in version 0.5.0.

property 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.

property text

Returns or sets the text of a shape.

New in version 0.21.4.

property top

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

New in version 0.5.0.

property type

Returns the type of the shape.

New in version 0.9.0.

property width

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

New in version 0.5.0.

29.2.13 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'
```

property api

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

property count

Returns the number of objects in the collection.

29.2.14 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>>
```

property `api`

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

New in version 0.9.0.

property `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.

property `height`

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

property `left`

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

property name

Returns or sets the name of the chart.

property 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')`

to_pdf(*path=None, show=None, quality='standard'*)

Exports the chart as PDF.

Parameters

- **path** (*str or path-like, default None*) – Path where you want to store the pdf. Defaults to the name of the chart in the same directory as the Excel file if the Excel file is stored and to the current working directory otherwise.
- **show** (*bool, default False*) – Once created, open the PDF file with the default application.
- **quality** (*str, default 'standard'*) – Quality of the PDF file. Can either be 'standard' or 'minimum'.

New in version 0.26.2.

to_png(*path=None*)

Exports the chart as PNG picture.

Parameters **path** (*str or path-like, default None*) – Path where you want to store the picture. Defaults to the name of the chart in the same directory as the Excel file if the Excel file is stored and to the current working directory otherwise.

New in version 0.24.8.

property top

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

property width

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

29.2.15 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=None*, *top=None*, *width=None*, *height=None*, *name=None*, *update=False*, *scale=None*, *format=None*, *anchor=None*)

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 None*) – Left position in points, defaults to 0. If you use top/left, you must not provide a value for anchor.
- **top** (*float*, *default None*) – Top position in points, defaults to 0. If you use top/left, you must not provide a value for anchor.
- **width** (*float*, *default None*) – Width in points. Defaults to original width.
- **height** (*float*, *default None*) – Height in points. Defaults to original height.
- **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.
- **scale** (*float*, *default None*) – Scales your picture by the provided factor.
- **format** (*str*, *default None*) – Only used if image is a Matplotlib or Plotly plot. By default, the plot is inserted in the “png” format, but you may want to change this to a vector-based format like “svg” on Windows (may require Microsoft 365) or “eps” on macOS for better print quality. If you use 'vector', it will be using 'svg' on Windows and 'eps' on macOS. To find out which formats your version of Excel supports, see: <https://support.microsoft.com/en-us/topic/support-for-eps-images-has-been-turned-off-in-office-a069d664-4bcf-415e-a1b5-cbb0c334a840>
- **anchor** (*xw.Range*, *default None*) – The xlwings Range object of where you want to insert the picture. If you use anchor, you must not provide values for top/left.

New in version 0.24.3.

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

1. Picture

```
>>> import xlwings as xw
>>> sht = xw.Book().sheets[0]
>>> sht.pictures.add(r'C:\path\to\file.png')
<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>>
```

property api

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

property count

Returns the number of objects in the collection.

29.2.16 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.

property 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.

property height

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

New in version 0.5.0.

property left

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

New in version 0.5.0.

property lock_aspect_ratio

True will keep the original proportion, False will allow you to change height and width independently of each other (read/write).

New in version 0.24.0.

property name

Returns or sets the name of the picture.

New in version 0.5.0.

property parent

Returns the parent of the picture.

New in version 0.9.0.

property top

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

New in version 0.5.0.

update(*image*, *format=None*)

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.

property width

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

New in version 0.5.0.

29.2.17 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.

property api

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

New in version 0.9.0.

property count

Returns the number of objects in the collection.

29.2.18 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.

property 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.

property name

Returns or sets the name of the name object.

New in version 0.9.0.

property 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.

property refers_to_range

Returns the Range object referred to by a Name object.

New in version 0.9.0.

29.2.19 Note

class xlwings.main.**Note**(*impl*)

property api

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

New in version 0.24.2.

delete()

Delete the note.

New in version 0.24.2.

property text

Gets or sets the text of a note. Keep in mind that the note must already exist!

Examples

```
>>> sheet = xw.Book(...).sheets[0]
>>> sheet['A1'].note.text = 'mynote'
>>> sheet['A1'].note.text
>>> 'mynote'
```

New in version 0.24.2.

29.2.20 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>>
```

29.2.21 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.

property api

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

property data_body_range

Returns an xlwings range object that represents the range of values, excluding the header row

property display_name

Returns or sets the display name for the specified Table object

property header_row_range

Returns an xlwings range object that represents the range of the header row

property 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

property name

Returns or sets the name of the Table.

property parent

Returns the parent of the table.

property range

Returns an xlwings range object of the table.

resize(range)

Resize a Table by providing an xlwings range object

New in version 0.24.4.

property show_autofilter

Turn the autofilter on or off by setting it to True or False (read/write boolean)

property show_headers

Show or hide the header (read/write)

property show_table_style_column_stripes

Returns or sets if the Column Stripes table style is used for (read/write boolean)

property show_table_style_first_column

Returns or sets if the first column is formatted (read/write boolean)

property show_table_style_last_column

Returns or sets if the last column is displayed (read/write boolean)

property show_table_style_row_stripes

Returns or sets if the Row Stripes table style is used (read/write boolean)

property show_totals

Gets or sets a boolean to show/hide the Total row.

property table_style

Gets or sets the table style. See [Tables.add](#) for possible values.

property totals_row_range

Returns an xlwings range object representing the Total row

update(data, index=True)

Updates the Excel table with the provided data. Currently restricted to DataFrames.

Changed in version 0.24.0.

Parameters

- **data** (*pandas DataFrame*) – Currently restricted to pandas DataFrames.
- **index** (*bool, default True*) – Whether or not the index of a pandas DataFrame should be written to the Excel table.

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')
```

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```
if table_name in [table.name for table in sheet.tables]:
    sheet.tables[table_name].update(df)
else:
    mytable = sheet.tables.add(source=sheet['A1'],
                               name=table_name).update(df)
```

29.2.22 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.

property `api`

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

New in version 0.23.0.

property `bold`

Returns or sets the bold property (boolean).

```
>>> sheet['A1'].font.bold = True
>>> sheet['A1'].font.bold
True
```

New in version 0.23.0.

property `color`

Returns or sets the color property (tuple).

```
>>> sheet['A1'].font.color = (255, 0, 0) # or '#ff0000'
>>> sheet['A1'].font.color
(255, 0, 0)
```

New in version 0.23.0.

property `italic`

Returns or sets the italic property (boolean).

```
>>> sheet['A1'].font.italic = True
>>> sheet['A1'].font.italic
True
```

New in version 0.23.0.

property 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.

property size

Returns or sets the size (float).

```
>>> sheet['A1'].font.size = 13
>>> sheet['A1'].font.size
13
```

New in version 0.23.0.

29.2.23 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.

property api

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

New in version 0.23.0.

property 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.

property 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.

29.2.24 Markdown

```
class xlwings.pro.Markdown(text, style=<MarkdownStyle> h1.font: .bold: True
                           paragraph.blank_lines_after: 1 unordered_list.bullet_character: •
                           unordered_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.

29.2.25 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
```

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```

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.

29.3 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.

29.4 Reports

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- PolyForm Noncommercial License 1.0.0 (for noncommercial use): <https://polyformproject.org/licenses/noncommercial/1.0.0>
- xlwings PRO License (for commercial use): https://github.com/xlwings/xlwings/blob/main/LICENSE_PRO.txt

Commercial licenses can be purchased at <https://www.xlwings.org>

class xlwings.pro.reports.**Image**(filename)

Use this class to provide images to either `render_template()`.

Parameters `filename` (*str* or *pathlib.Path* object) – The file name or path

class xlwings.pro.reports.**Markdown**(text, style=<MarkdownStyle> *h1*.font: .bold: True
paragraph.blank_lines_after: 1
unordered_list.bullet_character: •
unordered_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.

class xlwings.pro.reports.**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.

`xlwings.pro.reports.render_template(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, pictures and Matplotlib/Plotly 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 dict 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

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 render_template
>>> import pandas as pd
>>> df = pd.DataFrame(data=[[1,2],[3,4]])
>>> mybook = render_template('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)
>>> mybook = render_template('my_template.xlsx', 'my_report.xlsx', **data)
```

If you need to handle external links or a password, use it like so:

```
>>> mybook = render_template('my_template.xlsx', 'my_report.xlsx',
                             book_settings={'update_links': True,
                             'password': 'mypassword'}, **data)
```


REST API

Note: This is an experimental feature and may be removed in the future.

New in version 0.13.0.

30.1 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": [
    [
      "1",
      "2"
    ]
  ]
}
```

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```
    ],
    [
        "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.

30.2 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)
```

30.3 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`.

30.4 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.

30.5 Endpoint overview

End-point	Corresponds to	Short Description
/book	Book	Finds your workbook across all open instances of Excel and will open it if it can't find it
/books	Books	Books collection of the active Excel instance
/apps	Apps	This allows you to specify the Excel instance you want to work with

30.6 Endpoint details

30.6.1 /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": [
```

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```

        "Chart 1",
        "Picture 3"
    ],
    "used_range": "$A$1:$B$2"
},
{
    "charts": [],
    "name": "Sheet2",
    "names": [],
    "pictures": [],
    "shapes": [],
    "used_range": "$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,

```

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```
    "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",  
  "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$2",
  "formula": [
    [
      "",
      ""
    ],
    [
      "",
      ""
    ]
  ],
  "formula_array": "",
  "height": 28.5,
  "last_cell": "$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,
}
```

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```

"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$2",
  "color": null,
  "column": 1,
  "column_width": 8.47,
  "count": 4,
  "current_region": "$A$1:$B$2",
  "formula": [
    [
      "=1+1.1",
      "a string"
    ],
    [
      "43395.0064583333",
      ""
    ]
  ]
}

```

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```

],
"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",
      "top": 0.0,
      "type": "chart",
      "width": 355.0
    },
    {
      "height": 100.0,
      "left": 0.0,
      "name": "Picture 3",

```

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```
    "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
}
```

30.6.2 /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",
      "names": [
        "Sheet1!myname1",
        "myname2"
      ]
    }
  ]
}
```

(continues on next page)

(continued from previous page)

```

    ],
    "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",

```

(continues on next page)

(continued from previous page)

```
    "refers_to": "=Sheet1!$B$2:$C$3"
  },
  {
    "name": "myname2",
    "refers_to": "=Sheet1!$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": [
    {
      "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"
  ]
}
```

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```
],
"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"
    }
  ]
}
```

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```

    }
  ]
}

```

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
  ],
}

```

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```
"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,
      "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
  ],
  "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": [
    [
      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
}
```

30.6.3 /apps

GET /apps

Example response:

```
{
  "apps": [
    {
      "books": [
        "Book1",
        "C:\\Users\\felix\\DEV\\xlwings\\scripts\\Book1.xlsx",

```

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```
        "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",
  "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:

```
{
  "app": 1104,
  "fullname": "C:\\Users\\felix\\DEV\\xlwings\\scripts\\Book1.xlsx",
```

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```
"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,
```

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(continued from previous page)

```

"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 /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": [],

```

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```
    "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_name>

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_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",

```

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```

"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 /apps/<pid>/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 /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$2",
  "formula": [
    [
      "=1+1.1",
      "a string"
    ],
    [
      "43395.0064583333",
      ""
    ]
  ],
  "formula_array": null,
  "height": 28.5,
  "last_cell": "$B$2",
  "left": 0.0,
  "name": null,
  "number_format": null,

```

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```

"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$2",
  "formula": [
    [
      "=1+1.1",
      "a string"
    ],
    [
      "43395.0064583333",
      ""
    ]
  ],
  "formula_array": null,
  "height": 28.5,
  "last_cell": "$B$2",
  "left": 0.0,

```

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```

"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,
      "type": "picture",
      "width": 100.0
    }
  ]
}

```

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```
}
```

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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