=python("in excel")

Integrating Excel and Python

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Introduction

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Author of PyXLL (2010)

pyxll.com

and Jinx, the Excel Java Add-In (2018)

exceljava.com

Integrating Excel and Python

- **What is Python and who uses it?**
- Reading and Writing Excel Files
- Automating Excel
- Writing Excel Add-Ins

What is Python?

- Multi-paradigm language with dynamic semantics
- High-level built in data types
- Easy to learn syntax
- Extensive standard library

Basic Data Types

- int, float, bool, str
- dict, set, list, tuple
- function
- object
- None

Example Python Function

```
def calculate_mean(values):
    """Returns the mean of a sequence of values"""
    total = sum(values)
    num_values = len(values)
    return total / num_values

>> values = [1.0, 1.5, 2.0, 2.5, 3.0]
>> print(calculate_mean(values))
2.0
```

Example Python Class

```
class Statistics:
    def __init__(self, values):
        self.values = values

    def mean(self):
        return sum(self.values) / len(self.values)

>> stats = Statistics([1.0, 1.5, 2.0, 2.5, 3.0])
>> print(stats.mean())
2.0
```

Functional Programming in Python

```
my_list = [1, 2, 3, 4, 5, 6, 7, 8, 9, 10]
filtered_list = filter(lambda x: (x*2 > 10), my_list)
mapped_list = map(lambda x: x*2, my_list)
reduced_list = reduce(lambda x, y: x+y, my_list)

>> print(list(filtered_list))
[6, 7, 8, 9, 10]
>> print(list(mapped_list))
[2, 4, 6, 8, 10, 12, 14, 16, 18, 20]
>> print(reduced_list)
55
```

What is Python good for?

- Data Analysis and Visualization
- Machine Learning & AI
- Financial Modelling
- Scientific Computing
- Web Development
- Scripting / Automation

Examples of Python Packages

Scientific Computing

pandas

$y_{it} = \beta' x_{it} + \mu_i + \epsilon_{it}$

NumPy

SciPy

Data Access

Quandl

SQLAlchemy

AI & Machine Learning

theano

TensorFlow

K Keras

Integrating Excel and Python

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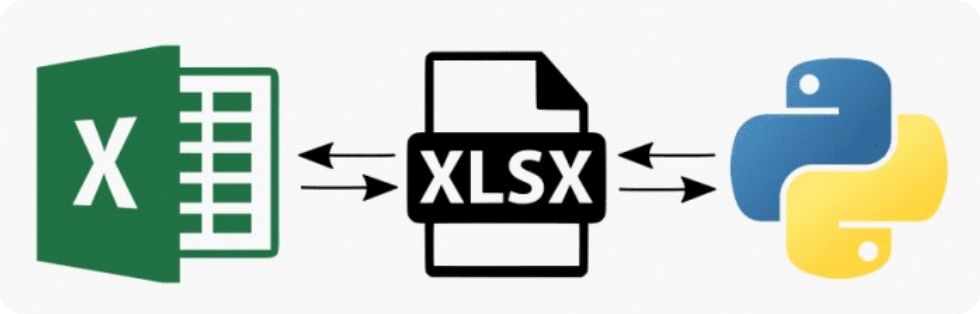
Reading and Writing Excel Files



Reading and Writing Excel Files

- openpyxl
  - Read and write xlsx files
  - Some content (e.g. charts) lost when reading and writing a file
- XlsxWriter
  - Write xlsx files
  - Faster and may use less memory than openpyxl
- xlrd / xlwt
  - Read and write old-style xls files
- ODBC
  - Read and write to existing Excel files use Microsoft Excel ODBC driver
  - Windows only, but doesn't lose any content

Example: openpyxl

```
from openpyxl import Workbook
wb = Workbook()
ws = wb.active  # Get the active worksheet
ws['A1'] = 42  # Data can be assigned directly to cells
ws.append([1, 2, 3])  # Rows can also be appended
ws['A2'] = datetime.datetime.now() # Python types converted
wb.save("sample.xlsx") # Save the file
```

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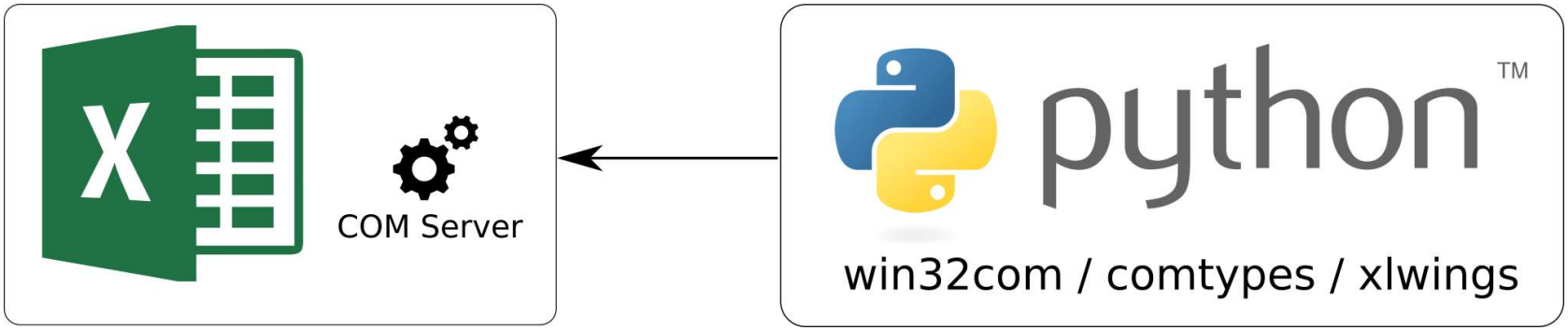
Excel Automation with Python



Excel Automation with Python

- win32com / pywin32
  - Excellent client and server side support for IDispatch based COM interfaces.
  - Requires additional C code to access non-dispatch based interfaces.
- comtypes
  - Pure python package capable of calling custom COM interfaces.
- xlwings
  - Wrapper around win32com for Excel on Windows and appscript on Mac.
  - Support for calling Python from VBA.

Example: win32com

- Connect to Excel from Python
- Modify active worksheet
- Connect to events

Integrating Excel and Python

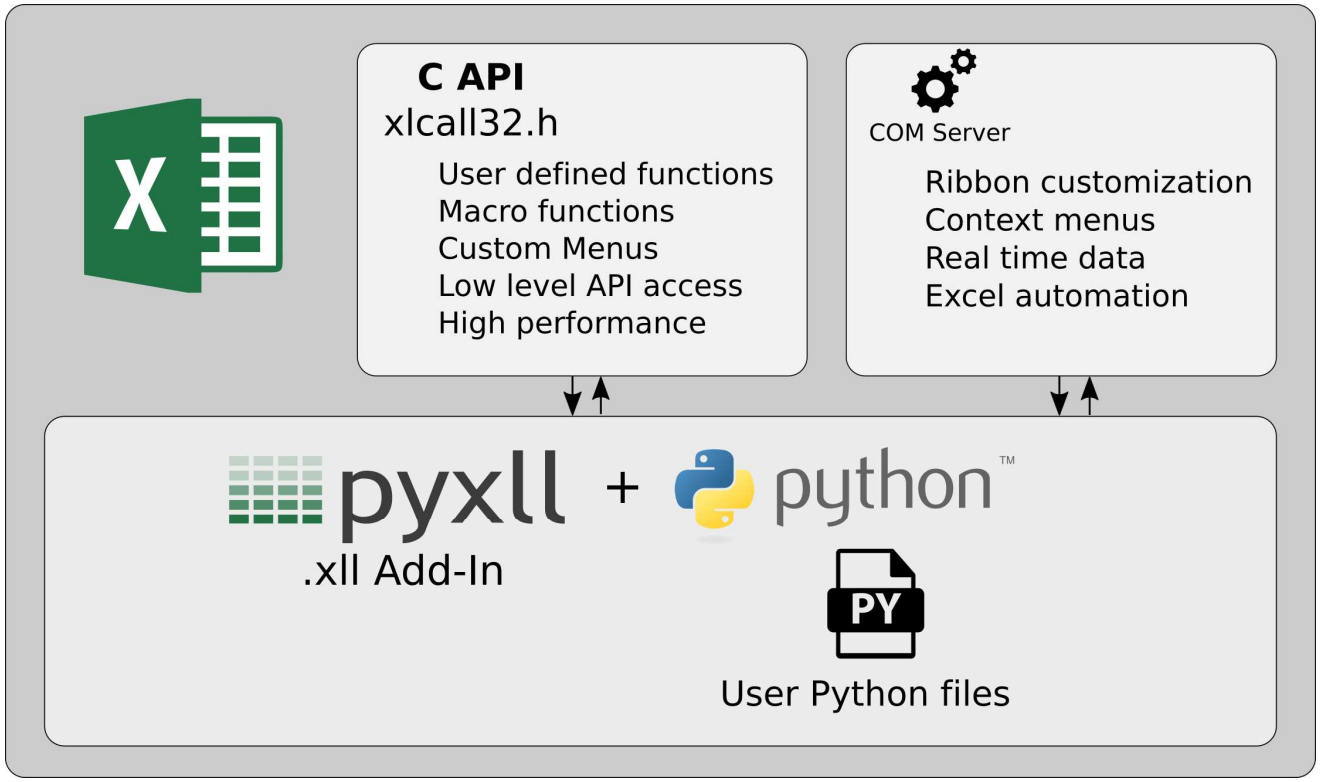
- What is Python and who uses it?
- Reading and Writing Excel Files
- Automating Excel
- **Writing Excel Add-Ins**

Writing Excel Add-Ins in Python

Expose Python functions to Excel as

- User defined functions (UDFs)
  - Volatile
  - Multi-threaded
  - Asynchronous
  - Real Time Data
  - Macro Equivalent
  - Dynamic array functions
- Macro functions
  - Call back into Excel
- Ribbon Controls
- Toolbar and Context Menu Items

Writing Excel Add-Ins in Python



Demo: Python embedded in Excel

Demo of IPython prompt running inside Excel.

Demo: Customizing the Ribbon

- Write/modify a ribbon xml file
  - Add tabs / groups / controls to <ribbon> element
  - Add controls / sub-menus to <contextMenus> element
  - Actions are bound to Python functions
- Configure pyxll.cfg
- Can be done programmatically using pyxll API

Demo: User Defined Functions

- Decorate functions using @xl_func
- Add optional function signature for type information
- Array functions can be automatically resized
- Objects returned as object handles

Standard Types

- int, float, bool, str
- 1d and 2d arrays, e.g. "float[]" and "float[][]"
- NumPy arrays, e.g. "numpy_array<float, ndim=2>"
- Pandas DataFrame and Series, e.g. "dataframe<index=False>"
- Python Objects
- "var" type that accepts any type
- "xl_cell" for cell info as well as value

Custom Types

Add your own type converters using

- @xl_arg_type
- @xl_return_type

Access all type converters using

- pyxll.get_type_converter

Demo: User Defined Functions 2

- Return small DataFrames as arrays
- Return large DataFrames objects
- Manipulate and view DataFrames

Demo: Real Time Data

- RTD functions use return type "rtd<T>"
- Values can be returned on a background thread using *RTD.value*
- Return value can be any type
- Errors returned using *RTD.set_error*

Demo: Machine Learning

- Models can be developed outside of Excel
- Trained models can be deployed to Excel for business users
- Same model used for automatic processing and user interaction

Questions

Download materials from

http://github.com/pyxll/develop-excel-london-2018

Contact me

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Also available for Java / Scala / Kotlin

https://exceljava.com

Download from

https://www.pyxll.com