

# Introductory Programming Using Python

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**Day 2**

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# Admin Information

1. Download course material at <https://bit.ly/py-jul21>
  
2. Set microphone to muted when you are not speaking



# Trainer

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# Programme Day Two

Morning	Afternoon
<ul style="list-style-type: none"><li>• Read and writing files</li><li>• Copying, moving and deleting files and folders</li><li>• Working with Excel</li><li>• Image Processing</li></ul>	<ul style="list-style-type: none"><li>• Connecting to the Web</li><li>• Sending emails</li><li>• Creating Chart</li><li>• Generating PDF</li></ul>



# Outline for the day

Time	Agenda
9.00am	Welcome and admin matters
9.15am – 10.30am	
10.30am – 10.45am	Break
10.45am – 12.30pm	
12.30pm – 1.30pm	Lunch
1.30pm – 3.15pm	
3.15pm – 3.30pm	Break
3.30pm – 4.30pm	
4.45pm – 5.00pm	Wrap up, Q&A



# File Paths

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**Absolute** file paths are notated by a **leading forward slash or drive label**.

For example,

/home/example\_user/example\_directory

or

C:/system32/cmd.exe

An absolute file path describes how to access a given file or directory, starting from the root of the file system.

**Relative** file paths are notated by a **lack of a leading forward slash**.

For example,

example\_directory.

A relative file path is interpreted from the perspective your current working directory. If you use a relative file path from the wrong directory, then the path will refer to a different file than you intend, or it will refer to no file at all..



# Read files

```
1 # make sure you have a hello.txt in your current working director
2 # same directory as your python script
3 helloFile = open("hello.txt")
4 content = helloFile.read()
5 print(content)
6 helloFile.close()
7
8 # make sure you have a hello.txt in the specified director
9 # same directory as your python script
10 helloFile = open("hello.txt")
11
12 content = helloFile.readlines()
13 print(content)
14
```

Open() will return a file object which has reading and writing related methods

Pass 'r' (or nothing) to open() to open the file in read mode.

Call read() to read the contents of a file

Call close() when you are done with the file.

- Call readLines() to read the contents of a file

The screenshot shows the Python IDLE interface. On the left is the code editor with the above Python code. On the right is the Python Shell tab, which displays the output of the code execution. The shell shows:

```
3.7.4 (tags/v3.7.4:e09359112e, Jul 8 2018, 04:14:37)
Python Type "help", "copyright", "credits" or "license" for more information.
>>> [evaluate file_read_01.py]
THis is also another line
Hello world again
['THis is also another line\n', 'Hello world again\n']
```



# Write files

```
1 # make sure you have a hello.txt in your current working director
2 # same directory as your python script
3 helloFile = open("hello.txt", "w")
4 helloFile.write("This is also another line\n")
5 helloFile.close()
6
7 # reopen to display content
8 helloFile = open("hello.txt")
9 print(helloFile.read())
10 helloFile.close()
11
12 # open the file for adding next text
13 helloFile = open("hello.txt", "a")
14 helloFile.write("Hello world again\n")
15 helloFile.close()
16
17 # reopen to display content
18 helloFile = open("hello.txt")
19 print(helloFile.read())
20 helloFile.close()
```

Pass 'w' to open() to open the file in write mode or 'a' for append mode.



Opening a non-existent file in write or append mode will create that file

Call write() to write a string to a file.

Search Stack Data

Search:  Replace:   
 Case sensitive  Whole words  In Selection

Previ Ne: eplac plac Option:

Debug I/O Python Shell

Commands execute without debug. Use arrow keys for history.

```
3.7.4 (tags/v3.7.4:e09359112e, Jul 8 2019, 19:29:22) [MSC ^  
Python Type "help", "copyright", "credits" or "license" for  
[evaluate file_write..py]  
TThis is also another line  
  
TThis is also another line  
Hello world again
```



# Copy and moving files

```
1 import shutil
2
3 # copy file
4 shutil.copy("folder1/hello.txt", "folder2")
5
6 # recursively copy an entire directory
7 shutil.copytree("folder2", "folder2_backup")
8
9 # move file
10 shutil.move("folder2/hello.txt", "folder2/anotherfolder")
11
12 # move and rename file
13 shutil.move("folder2/anotherfolder/hello.txt", "folder2/anotherfolder/newhello.txt")
14
```

Search Stack Data Debug I/O Python Shell

Search: Commands execute without debug. Use arrow keys for history.

Replace: Options

Case sensitive Whole In Selection

>>> [evaluate file\_copy\_01.py]

3.5.6 |Anaconda, Inc.| (default, Aug 26 2018, 16:30:03)  
[GCC 4.2.1 Compatible Clang 4.0.1 (tags/RELEASE\_401/final)]  
Python Type "help", "copyright", "credits" or "license" for more information

- `shutil.copy(src, dst)` – Copy the file *src* to the file or directory *dst*
- `shutil.copytree(src, dst)` - Recursively copy an entire directory tree rooted at *src*.
- `shutil.move(src, dst)` - Recursively move a file or directory (*src*) to another location (*dst*).

<https://docs.python.org/3/library/shutil.html>



# Deleting files

```
import os

# error if file do not exist
os.unlink("hello.txt")

# get current working directory
print(os.getcwd())

# delete directory (can only delete empty folder)
os.rmdir("folder3")

import shutil
# delete directory (with content)
# error if folder is not found
shutil.rmtree("folder3")
```

e.g. To delete all .docx file in the current folder

```
import os

for filename in os.listdir():
    if filename.endswith(".docx"):
        print(filename)
        os.unlink(filename)
```

- `os.unlink()` will delete a file
- `os.rmdir()` will delete a folder (but folder must be empty)
- `shutil.rmtree()` will delete a folder and all its contents



Deleting can be dangerous, so do a dry run first



# Use Case Sharing

- Organizing students' submissions into separate folder
  - Class of 25 students

25 folders,  
one for each  
student

- Student 120101
- Student 120897
- Student 120904
- Student 121104
- Student 121243
- Student 121550
- Student 121804
- Student 121938
- Student 122061
- Student 122084
- Student 122152
- Student 122263
- Student 122431
- Student 122868
- Student 123295
- Student 123525
- Student 123534
- Student 123673
- Student 123864
- Student 123900
- Student 124059
- Student 124133
- Student 124990
- Student 128079



- Team 1
- Team 2
- Team 3
- Team 4
- Team 5

Student  
submission  
sorted by  
teams



# Other Use Cases

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- System administrators can use these commands to
  - Copy and backup files to other hard-disks
  - Delete folders/ files at fixed schedules
    - End of financial year?
    - End of semester?
- Others use
  - Check timestamp of files, and delete all files created before a certain date



# Exercise

---

- **Write code to achieve the following:**

1. Create a file named: “myfile.txt”.
2. Write the following line of text into the file:
  - Programming is fun!
3. Close the file
4. Create a folder called “myfolder”
  - Use os.mkdir() command
5. Copy myfile.txt to myfolder



# Python Package Index

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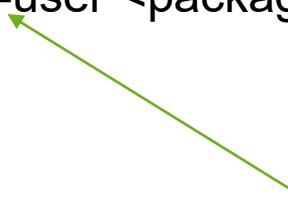
- <https://pypi.org/>
- A repository of software for the Python Programming Language
- Python Installation provides the core libraries needed for the common tasks
  - Additional packages can be found at the website and installed as extension
    - E.g. send2trash, openpyxl, pillow etc
- Installation is easy done with the following command
  - **pip install <software\_package>**
- Installed packages can be found at:
  - C:\python38\Lib\site-packages



# Using pip install

---

- **For all windows users by default**
  - Open command prompt
  - pip install <package\_name>
- **For Mac User**
  - Open terminal
  - **pip3** install <package\_name>
- **For RP staff using RP issued laptop**
  - Open command prompt
  - pip install --user <package\_name>



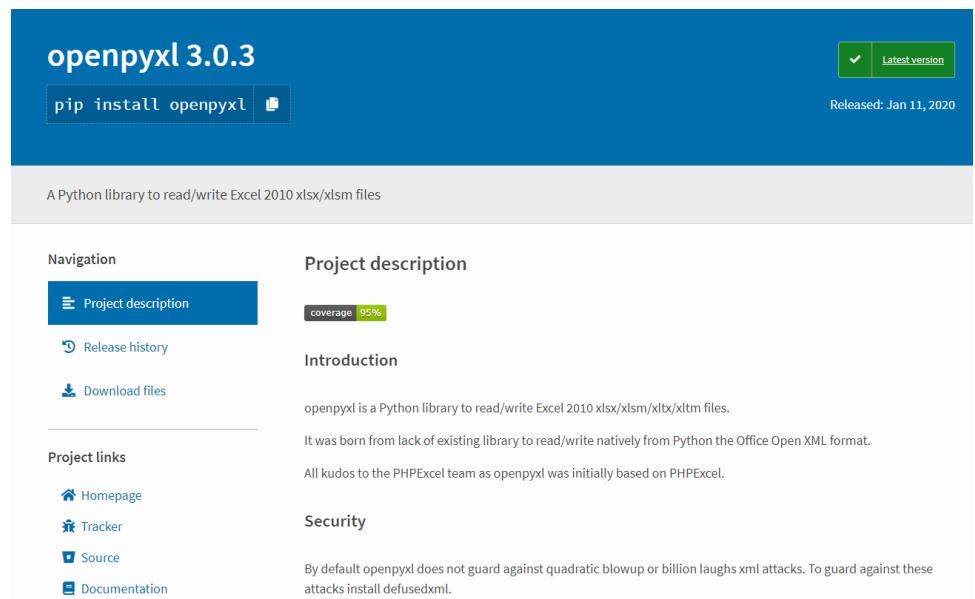
Double-Dash

# Excel Spreadsheet Manipulation with Python



# Working with Excel

- Install openpyxl module using  
“`pip install openpyxl`”
- Full openpyxl documentation:  
<https://openpyxl.readthedocs.io/en/stable/index.html>



The screenshot shows the PyPI project page for openpyxl 3.0.3. The header features the version number "openpyxl 3.0.3" and a "Latest version" button. Below the header, there's a button for "pip install openpyxl". A note states "A Python library to read/write Excel 2010 xlsx/xlsm files". The page is divided into sections: "Navigation" (Project description, Release history, Download files), "Project description" (coverage 95%), "Introduction" (a brief description of the library), and "Security" (a note about XML attacks).

openpyxl 3.0.3

`pip install openpyxl`

A Python library to read/write Excel 2010 xlsx/xlsm files

Navigation

- Project description
- Release history
- Download files

Project description

coverage 95%

Introduction

openpyxl is a Python library to read/write Excel 2010 xlsx/xlsm/xltb/xltm files.

It was born from lack of existing library to read/write natively from Python the Office Open XML format.

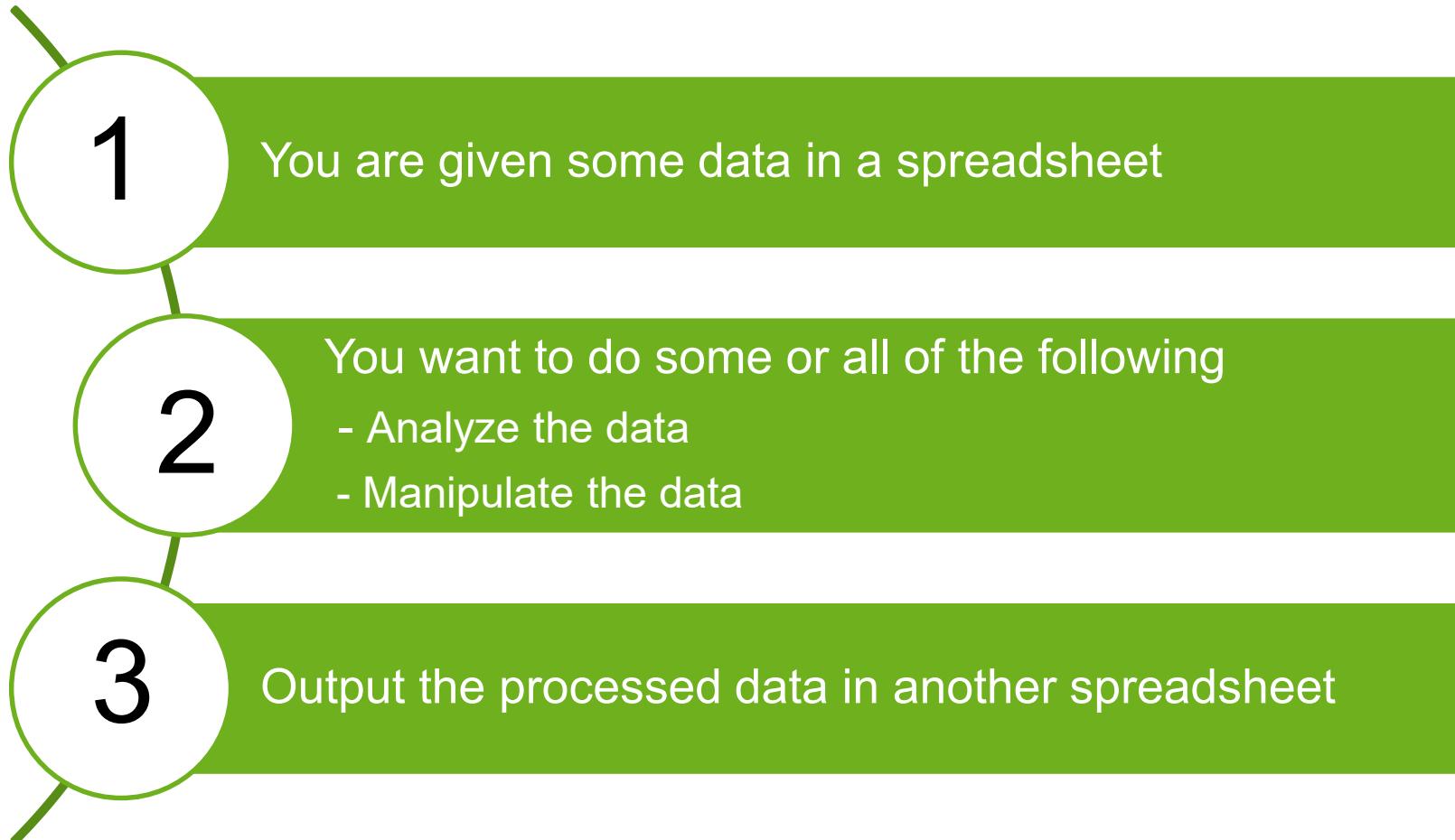
All kudos to the PHPExcel team as openpyxl was initially based on PHPExcel.

Security

By default openpyxl does not guard against quadratic blowup or billion laughs xml attacks. To guard against these attacks install defusedxml.



# Typical Workflow for Excel Automation





# Reading Excel file

1) Import openpyxl

```
import openpyxl
```

```
workbook = openpyxl.load_workbook("bmi.xlsx")  
sheet=workbook["Sheet1"]
```

2) Load Excel content into "workbook" object by specifying the file name

3) Get the worksheet named "Sheet1"

```
name = sheet.cell(row=2, column=1).value  
weight = sheet.cell(row=2, column=2).value  
height = sheet.cell(row=2, column=3).value
```

4) Get the value of each cell by specifying the row and column

```
print("name:%s \tweight: %d \theight: %f " % (name, weight, height))
```

5) Get the value of each cell by specifying the row and column



# Reading Excel file

The typical workflow for reading excel file is to use a **for** loop to go through each row to read the data

```
import openpyxl  
  
workbook = openpyxl.load_workbook("bmi.xlsx")  
sheet=workbook["Sheet1"]  
  
max_row = sheet.max_row # get number of rows  
  
#loop through every row  
for i in range(2, max_row + 1):  
  
    #read cell  
    name = sheet.cell(row=i, column=1).value  
    weight = sheet.cell(row=i, column=2).value  
    height = sheet.cell(row=i, column=3).value  
  
    print("name:%s \tweight: %d \theight: %f " % (name, weight, height))
```

1) Get the number of rows and columns

2) Use For loop to go through every row

3) Extract the status at Column C to check for attendance



# Update Excel file

```
import openpyxl

workbook = openpyxl.load_workbook("bmi.xlsx")
sheet=workbook["Sheet1"]

max_row = sheet.max_row # get number of rows

# add a column header for bmi
sheet.cell(row=1, column=4).value = "bmi"

#loop through every row
for i in range(2, max_row + 1):

    #read cell
    name = sheet.cell(row=i, column=1).value
    weight = sheet.cell(row=i, column=2).value
    height = sheet.cell(row=i, column=3).value

    bmi = weight / (height * height)

    sheet.cell(row=i, column=4).value = bmi

    print("name:%s \tBMI: %f" % (name, bmi))

#save the file
workbook.save("bmi_update.xlsx")
```

2) Load file into memory & get the sheet

1) Perform calculation with values taken from the excel files

2) Add comments to cell

5) Save the spreadsheet



# Create Excel file

If you have data in nested python list, you can write the data into an excel file.

```
import openpyxl

workbook = openpyxl.Workbook()

#get the default sheet
sheet=workbook["Sheet"]

#create a list of tuples as data source
data = [
    [225.7, 'Gone with the Wind', 'Victor Fleming'],
    [194.4, 'Star Wars', 'George Lucas'],
    [161.0, 'ET: The Extraterrestrial', 'Steven Spielberg']
]

for row in data:
    sheet.append(row)

#save the spreadsheet
workbook.save("movies.xlsx")
```

1) Some data in nested list

2) Using for loop to add each row of data into the excel sheet

3) Save the spreadsheet



# Format Excel

```
import openpyxl  
from openpyxl.styles import Font, PatternFill, Border, Side  
  
workbook = openpyxl.load_workbook("bmi.xlsx")  
sheet=workbook["Sheet1"]
```

```
#define the colors to use for styling  
BLUE = "0033CC"  
LIGHT_BLUE = "E6ECFF"  
WHITE = "FFFFFF"  
  
#define styling  
header_font = Font(name="Tahoma", size=14, color=WHITE)  
header_fill = PatternFill("solid", fgColor=BLUE)
```

```
# format header  
for row in sheet["A1:c1"]:  
    for cell in row:  
        cell.font = header_font  
        cell.fill = header_fill
```

```
#define styling  
white_side = Side(border_style="thin", color=WHITE)  
blue_side = Side(border_style="thin", color=BLUE)  
alternate_fill = PatternFill("solid", fgColor=LIGHT_BLUE)  
border = Border(bottom=blue_side, left=white_side, right=white_side)
```

```
# format rows  
for row_index, row in enumerate(sheet["A2:C3"]):  
    for cell in row:  
        cell.border = border  
        if row_index %2 :  
            cell.fill = alternate_fill
```

```
workbook.save("bmi_format.xlsx")
```

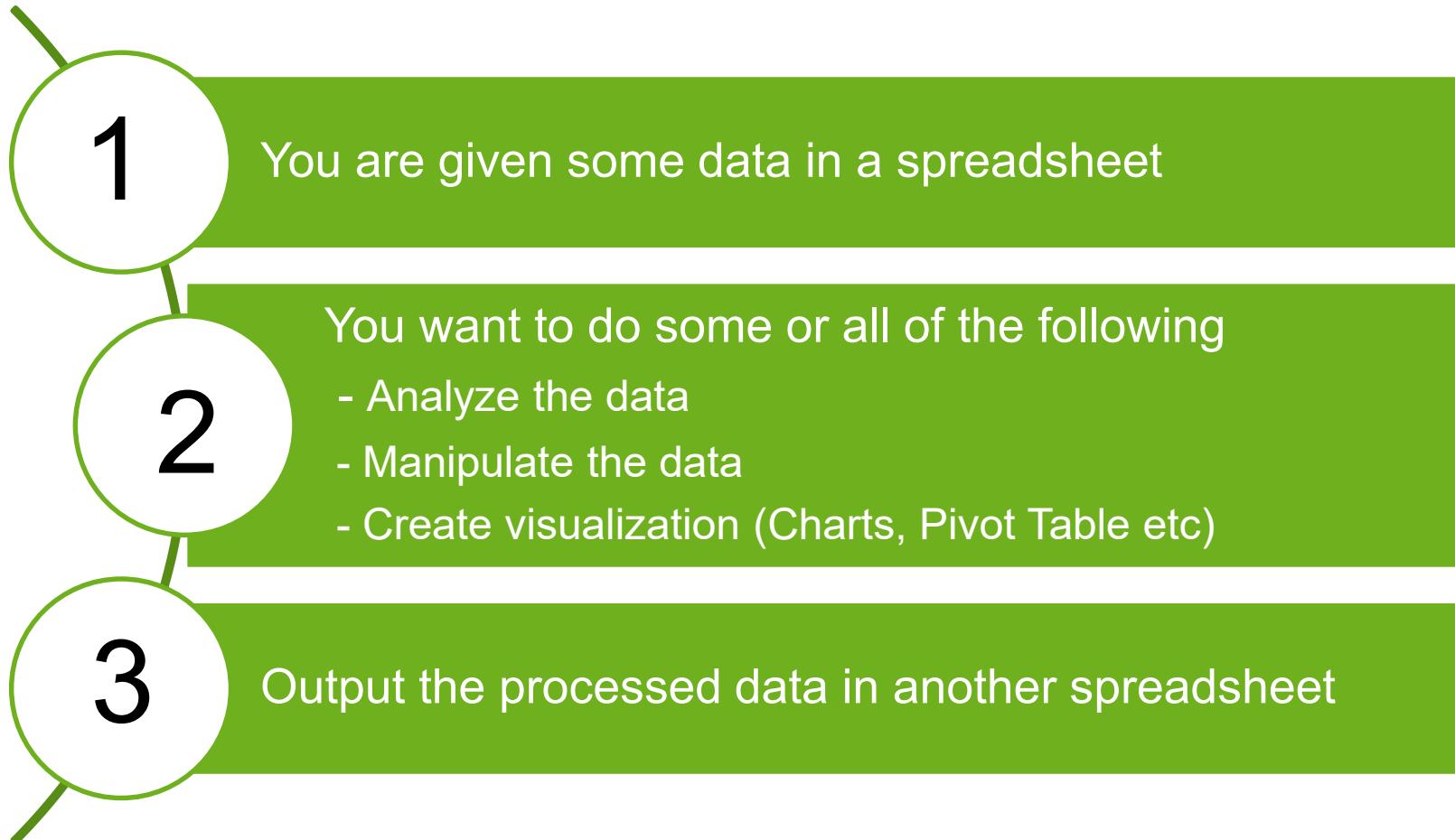
1) Import necessary functions

2) Setup colors and styles

3) Loop through cell and set properties



# Typical Workflow for Excel Automation





# Use Case Sharing

- I use RPA (Robotic Process Automation) to send WhatsApp messages to students individually
- Write script to split my contact list for students based on intake year
  - Added country code: 65 to all the numbers as well

	A	B	C	D
1	ReqTerm	StudentID	Name	Handphone
2	1610	16011054	MAX TAN	87733828
3	1710	16041191	PETER	87226030
4	1710	17011180	MARY	92266192
5	1810	18034448	ALAN	92336601
6	1910	19043330	JOSEPH	92468837
7	1910	19045104	ERIC	86511160
8	1910	19045784	JAVIER	97937779
9	1910	19047541	JUNE	97277250
10	1910	19011433	APRIL	97661277
11	2010	20041418	MAY	91766557

2 students  
in 2017  
intake

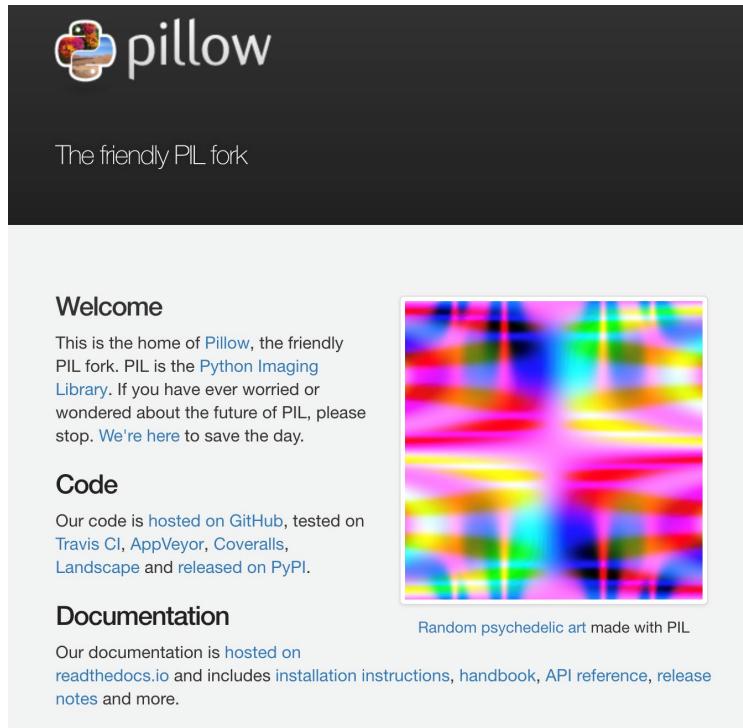
	A	B	C	D	E	F
1	ReqTerm	StudentID	Name	Handphone		ReqTerm
2	1710	16041191	PETER	6587226030		
3	1710	17011180	MARY	6592266192		
4						
5						
6						
7						

Create worksheets for  
students of different intake

# Image Processing with Python



# Image Processing



The screenshot shows the official website for Pillow, a Python Imaging Library fork. The header features the Pillow logo (a stylized icon followed by the word "pillow") and the tagline "The friendly PIL fork". Below the header, there are four main sections: "Welcome", "Code", "Documentation", and a central image example.

- Welcome:** This section explains that Pillow is the friendly PIL fork. It links to the Python Imaging Library and provides a link to save the day if you're worried about PIL's future.
- Code:** This section links to the code on GitHub, Travis CI, AppVeyor, Coveralls, Landscape, and PyPI.
- Documentation:** This section links to documentation on readthedocs.io, which includes installation instructions, handbook, API reference, release notes, and more.
- Central Image Example:** A colorful, abstract image titled "Random psychedelic art made with PIL".

For the next section we are going to use the Python Image Library, or in short Pillow.

Install using the following command:  
**pip install pillow**

The documentation is at:

<https://pillow.readthedocs.io/en/stable/handbook/overview.html>



# Image Processing

```
import os
from PIL import Image

filename = "img/clungup.jpg"

im = Image.open(filename)
print ("%s - %s" % (im.size, im.mode))

# show the image
im.show()

# close the file
im.close()
```

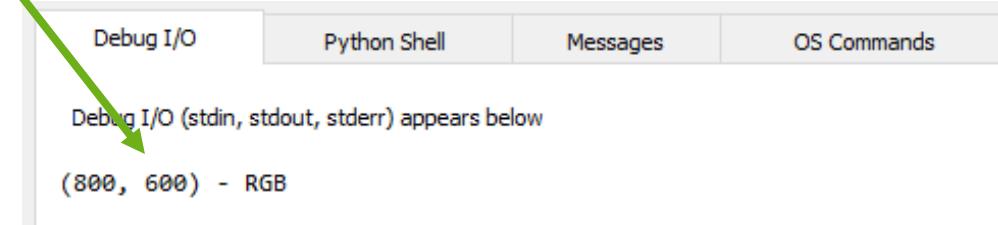


As a start we need to import it:  
`import Image`

We can open images with  
`im = Image.open(fullname)`

Then we can display the image using  
`im.show()`

Print some info about the image using  
`im.size` and `im.mode`



```
Debug I/O (stdin, stdout, stderr) appears below
(800, 600) - RGB
```

Size: 800 x 600, Mode: RGB



# Image Processing

```
import os
from PIL import Image, ImageFilter

filename = "img/clungup.jpg"

im = Image.open(filename)

out = im.filter(ImageFilter.BLUR)

im.show()
out.show()
```



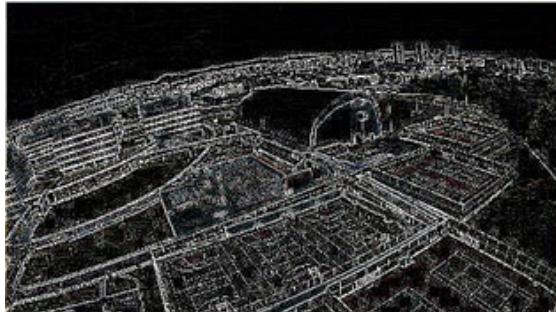
Pillow has many conversion and filters, to use filters we need to extend our import:  
`from PIL import Image, ImageFilter`

The way you can apply filters is :  
`out = im.filter(ImageFilter.BLUR)`

Try other different filters!



# Image processing - filters



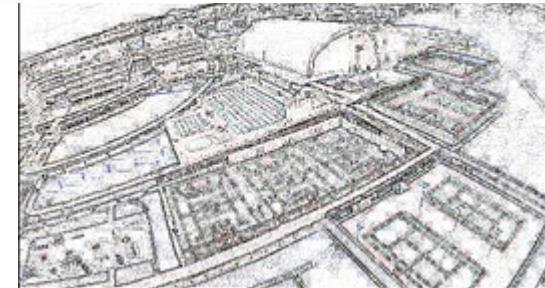
```
image = image.filter(ImageFilter.FIND_EDGES)
```

```
image = ImageOps.grayscale(image)
```



```
image = ImageOps.solarize(image)
```

```
image = image.filter(ImageFilter.CONTOUR)
```



\* Remember to include  
**ImageOps** in your import statement



# Image processing - filters

```
import os
from PIL import Image, ImageFilter, ImageOps

filename = "img/clungup.jpg"

im = Image.open(filename)

# Filter
#out = im.filter(ImageFilter.BLUR)
#out = im.filter(ImageFilter.FIND_EDGES)
#out = im.filter(ImageFilter.CONTOUR)

# ImageOps
out = ImageOps.grayscale(im)
#out = ImageOps.solarize(im)

im.show()
out.show()
```



\* Remember to include  
**ImageOps** in your import statement



# Image Processing - Rotating

Flipping the image horizontally or vertically

```
out = im.transpose(Image.FLIP_LEFT_RIGHT)  
out = im.transpose(Image.FLIP_TOP_BOTTOM)
```

} Flip images

Rotating the image

```
out = im.transpose(Image.ROTATE_90)  
out = im.transpose(Image.ROTATE_180)  
out = im.transpose(Image.ROTATE_270)
```

} Rotate images

Contrast

First add ImageEnhance to our imports:

```
from PIL import Image, ImageFilter,  
ImageEnhance
```

Then:

```
enh = ImageEnhance.Contrast(im)  
out = enh.enhance(1.3)
```

make image brighter by  
changing the contrast



# Image Processing - Writing

```
import os
from PIL import Image, ImageFilter, ImageOps

filename = "clungup.jpg"

src_folder = "img/"
out_folder = "out/"

im = Image.open(src_folder + filename) # img/clungup.jpg
out = im.filter(ImageFilter.BLUR)

outFilename = out_folder + filename # out/clungup.jpg

out.save(outFilename)
```

You can see the image, but it's not being saved !

All you need to do to save the images in the "out" folder is:  
**out.save(the name of the output file)**



# Image processing – Converting

```
import os
from PIL import Image, ImageFilter, ImageOps

filename = "clungup.jpg"

src_folder = "img/"
out_folder = "out/"

im = Image.open(src_folder + filename) # img/clungup.jpg
out = im.filter(ImageFilter.BLUR)

# split the filename and the extension
f, e = os.path.splitext(filename)

# add the gif extension to the filename
fname2 = f + ".gif"

outFilename = out_folder + fname2 # out/clungup.gif

out.save(outFilename)
```

`os.path.splitext(file)` returns a list.  
We are only interested in `f` which is  
the first item in the list.



# Image processing – Watermark

Create the mark image

You can reduce the size to 100,100

```
mark = Image.open("img\\watermark.png")
mark = mark.resize((100,100))
```

Create a new function called

```
def watermark(im, mark, position):
```

....

It takes the original image, the watermark image and the desired position that we want the watermark to appear. The function will return the result.

We can use this function like:

```
watermark(im, mark, (0, 50)).show()
```

or

```
imOut = watermark(im, mark, (0,50))
imOut.save(fileOut)
```

Maybe you want to leave a small footprint on your images, called watermark.

In this case we can use the \\img\\watermark.png and place it in each image on the bottom right.

Copyright  
@RP



# Image processing – Watermark

```
from PIL import Image

def watermark(im, mark, position):
    layer = Image.new("RGBA", im.size, (0,0,0,0))
    layer.paste(mark, position)
    return Image.composite(layer, im, layer)

im = Image.open("img\\clungup.jpg")
mark = Image.open("img\\watermark.png")
mark = mark.resize((100,100))
mark.putalpha(128)

out = watermark(im, mark, (0,0))
out.show()
```



First we need to create a new layer with the size of the original image.

Then we paste the watermark image at the desired position and we return the composite.

Finally we merge the image and the layer together and return the result.

Then you can use it like this:



# Use Case I: Batch Resize

---

1. Find all the files in “img” folder with “.jpg” extension
1. Resize all the file to 60 x 90.
1. Save all the files to the resized folder

```
import os
from PIL import Image, ImageFilter, ImageOps

files = os.listdir('img')
size = 60, 90

for file in files:
    if file.lower().endswith('.jpg'):
        im = Image.open("img/" + file)
        im.thumbnail(size, Image.ANTIALIAS)
        im.save("resized/" + file, "JPEG")
```

# Web Automation with Python



# Connecting to the Web

- requests – download files and web pages from the Web

pip install requests

```
import requests
```

```
url="https://api.data.gov.sg/v1/environment/24-hour-weather-forecast"
req=requests.get(url)
print(req.text)
```

Get the required information from  
the given URL



Economy



Education



Environment



Finance



Health



Infrastructure



Society



Technology



Transport

web\_request.py



# Connecting to the Web

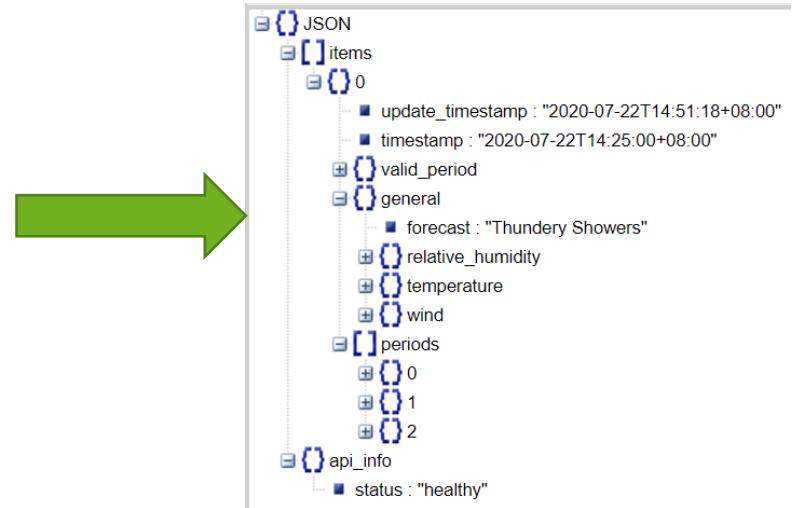
- Data is in JSON format
- Use a JSON formatter tool to present the data in a nicer form

<http://jsonviewer.stack.hu/>

```
import requests

url="https://api.data.gov.sg/v1/environment/24-hour-weather-forecast"
req=requests.get(url)
print(req.text)

{
  "items": [
    {
      "update_timestamp": "2020-07-22T14:51:18+08:00",
      "timestamp": "2020-07-22T14:25:00+08:00",
      "valid_period": {
        "start": "2020-07-22T12:00:00+08:00",
        "end": "2020-07-23T12:00:00+08:00"
      },
      "general": {
        "forecast": "Thunder Showers",
        "relative_humidity": {
          "low": 70,
          "high": 95
        },
        "temperature": {
          "low": 22,
          "high": 28
        },
        "wind": {
          "speed": {
            "low": 10,
            "high": 20
          },
          "direction": "ESE"
        }
      },
      "periods": [
        {
          "start": "2020-07-22T12:00:00+08:00",
          "end": "2020-07-22T18:00:00+08:00",
          "regions": [
            {
              "west": "Moderate Rain",
              "east": "Moderate Rain",
              "central": "Light Rain"
            },
            {
              "north": "Light Rain"
            }
          ],
          "time": {
            "start": "2020-07-22T12:00:00+08:00",
            "end": "2020-07-23T06:00:00+08:00"
          }
        },
        {
          "start": "2020-07-22T18:00:00+08:00",
          "end": "2020-07-23T12:00:00+08:00",
          "regions": [
            {
              "west": "Partly Cloudy (Night)",
              "east": "Partly Cloudy (Night)",
              "central": "Partly Cloudy (Night)"
            },
            {
              "north": "Partly Cloudy (Night)"
            }
          ],
          "time": {
            "start": "2020-07-22T18:00:00+08:00",
            "end": "2020-07-23T06:00:00+08:00"
          }
        }
      ]
    }
  ]
}
```





# Connecting to the Web

- To work with JSON data, import json first
- Use json.loads() to load the data in JSON format
- Extract and retrieve the required data

```
import json
import requests

url="https://api.data.gov.sg/v1/environment/24-hour-weather-forecast"
req=requests.get(url)

data = json.loads(req.text)

# print update timestamp
update_time = data["items"][0]["update_timestamp"]
print("Update time: " + update_time)

# print forecast
forecast = data["items"][0]["general"]["forecast"]
print("Forecast: " + forecast)
```

Update time: 2020-07-22T14:51:18+08:00  
Forecast: Thundery Showers



# Data Types - Dictionary

---

- A dictionary stores multiple **key-value pairs**
- E.g. In the first row of output, the dictionary contains 3 key-value pairs (which are the keys?)
- Every **key is unique**; no duplicate key within a dictionary
- A dictionary uses a set of curly brackets to store its key-value pairs {...}  
=> Contrast with a list that uses square brackets to store its objects [...]
- **To access a value in the dictionary, we use the key as an index**

```
{'year': '1995', 'type_of_public_transport': 'MRT', 'average_ridership': '740000'}  
{'year': '1995', 'type_of_public_transport': 'LRT', 'average_ridership': '0'}  
{'year': '1995', 'type_of_public_transport': 'Bus', 'average_ridership': '3009000'}  
{'year': '1995', 'type_of_public_transport': 'Taxi', 'average_ridership': '0'}  
{'year': '1996', 'type_of_public_transport': 'MRT', 'average_ridership': '850000'}  
{'year': '1996', 'type_of_public_transport': 'LRT', 'average_ridership': '0'}  
  
>>> words={'apple':'red','lemon':'yellow'}  
>>> words  
{'lemon': 'yellow', 'apple': 'red'}  
>>> words['apple']  
'red'  
>>> words['lemon']  
'yellow'  
>>> words.keys()  
['lemon', 'apple']  
>>> words.values()  
['yellow', 'red']  
  
>>> spam = {'color': 'red', 'age': 42}  
>>>  
>>> for k, v in spam.items():  
>>>     print('Key: {} Value: {}'.format(k, str(v)))  
Key: age Value: 42  
Key: color Value: red
```



# Connecting to the Web

- requests – download files and web pages from the Web

```
pip install requests
```

```
1 import requests  
2  
3 url = "https://api.data.gov.sg/v1/environment/2-hour-weather-forecast"  
4 req = requests.get(url)  
5 print(req.text)
```

Get the required information from the given URL



Economy



Education



Environment



Finance



Health



Infrastructure



Society



Technology



Transport

web\_request.py



# Connecting to the Web

- Data is in JSON format
- Use a JSON formatter tool to present the data in a nicer form

<http://jsonviewer.stack.hu/>

```
1 import requests
2
3 url = "https://api.data.gov.sg/v1/environment/2-hour-weather-forecast"
4 req = requests.get(url)
5 print(req.text)

{"area_metadata": [{"name": "Ang Mo Kio",
"label_location": {"latitude": 1.375, "longitude": 103.839}], {"name": "Bedok", "label_location": {"latitude": 1.321, "longitude": 103.924}], {"name": "Bishan", "label_location": {"latitude": 1.350772, "longitude": 103.839}], {"name": "Boon Lay", "label_location": {"latitude": 1.304, "longitude": 103.701}], {"name": "Bukit Batok",
```

The screenshot shows a JSON viewer interface with the following data structure:

```
Viewer Text
JSON
area_metadata
items
0
update_timestamp : "2019-03-08T18:58:53+08:00"
timestamp : "2019-03-08T18:50:00+08:00"
valid_period
start : "2019-03-08T18:30:00+08:00"
end : "2019-03-08T20:30:00+08:00"
forecasts
0
area : "Ang Mo Kio"
forecast : "Partly Cloudy (Night)"
1
```



# Connecting to the Web

- To work with JSON data, import json first
- Use json.loads() to load the data in JSON format
- Extract and retrieve the required data

```
import json
import requests

url="https://api.data.gov.sg/v1/environment/2-hour-weather-forecast"
req=requests.get(url)

data = json.loads(req.text)

forecasts = data["items"][0]["forecasts"]

# print the first item's area
print(forecasts[0]["area"]) # Ang Mo Kio

# print the first item's forecast
print(forecasts[0]["forecast"]) # Partly Cloudy (Day) <- this is just a snapshot

# printing all values
print("----- All Area and Weather Forecast -----")
for forecast in forecasts:
    area = forecast["area"]
    weather = forecast["forecast"]
    print(area + ": " + weather)
```

```
Ang Mo Kio
Partly Cloudy (Day)
----- All Area and Weather Forecast --
Ang Mo Kio: Partly Cloudy (Day)
Bedok: Partly Cloudy (Day)
Bishan: Partly Cloudy (Day)
Boon Lay: Partly Cloudy (Day)
Bukit Batok: Partly Cloudy (Day)
Bukit Merah: Partly Cloudy (Day)
Bukit Panjang: Partly Cloudy (Day)
Bukit Timah: Partly Cloudy (Day)
Central Water Catchment: Partly Cloudy (Day)
```

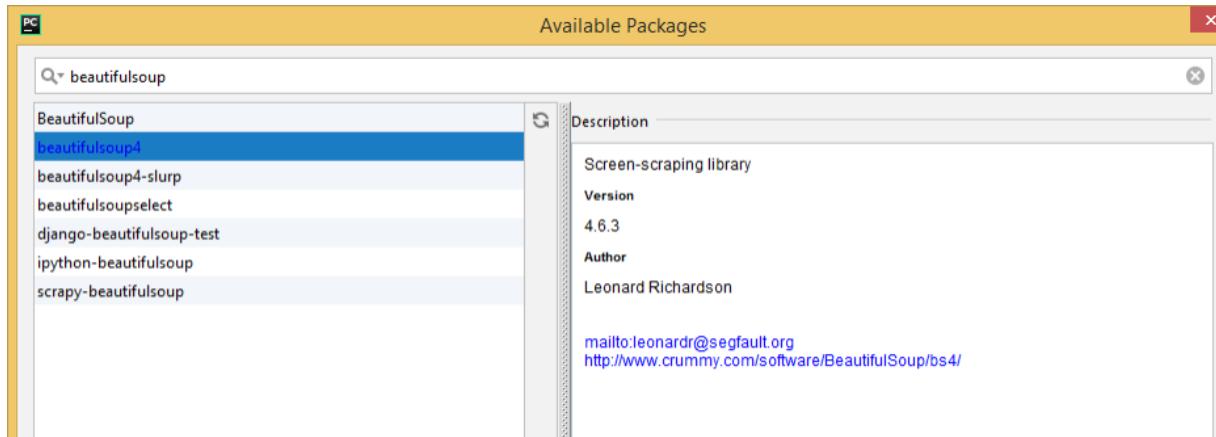


# Connecting to the Web

- Beautiful Soup – a third party module that parses HTML (web pages)

Web Scraping – download and process Web content

- Install Beautiful Soup 4 - **pip install beautifulsoup4**





# Connecting to the Web

- What's the URL?

<https://www.fortytwo.sg/dining/dining-tables/landon-regular-dining-table-coffee.html>

Enquiries: +65 6777 7667 | Mon - Fri (10am - 6pm)

The screenshot shows the FORTYTWO website. At the top, there is a phone icon followed by the text "Enquiries: +65 6777 7667 | Mon - Fri (10am - 6pm)". Below this is the FORTYTWO logo. To the right of the logo is a search bar with the placeholder "Search furniture, mattress, home & decor..." and a magnifying glass icon. Further to the right are user icons (person) and a shopping cart icon with a red notification bubble showing "0".

Navigation menu: New, Furniture ▾, Bedding & Mattresses ▾, Décor | Essentials ▾, Kitchen | Dining ▾, Lightings | Fans ▾, Sale ▾.

Breadcrumbs: Home > Dining Room Furniture > Dining Tables > Landon Regular Dining Table Coffee

Product details for "Landon Regular Dining Table Coffee":

- Image: A dark wood rectangular dining table with four legs.
- Name: Landon Regular Dining Table Coffee
- Rating: ★★★★☆ 6 customer reviews
- Price: S\$129.90 (crossed out), S\$69.90
- Warranty: 1 Year
- Delivery: Standard Delivery
- Other options: Add to Cart, Add to Wishlist, Email to a Friend, 100 Day Free Returns, Free Assembly Included

Below the main product image are four smaller thumbnail images of different dining tables.

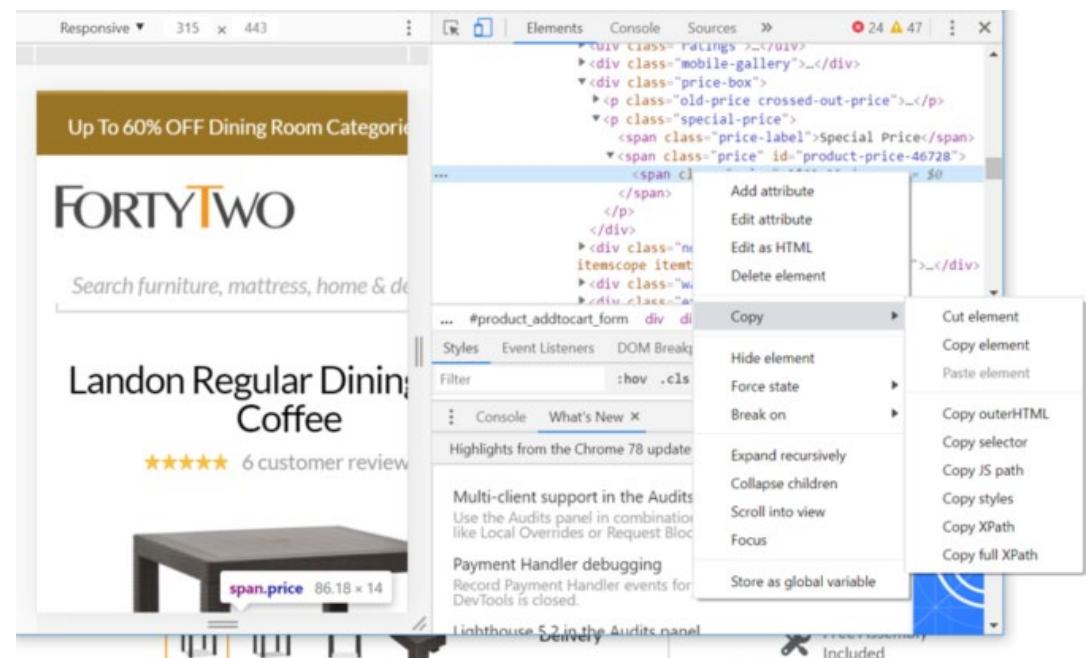


# Connecting to the Web

- Get the url

<https://www.fortytwo.sg/dining/dining-tables/landon-regular-dining-table-coffee.html>

- Select the element to extract, right-click "Inspect"
- Right-click "Copy", "Copy selector"





# Connecting to the Web

```
from urllib.request import Request, urlopen
from bs4 import BeautifulSoup

site= "https://www.fortytwo.sg/dining/dining-tables/landon-regular-dining-table-coffee.html"
hdr = {'User-Agent': 'Mozilla/5.0'}
req = Request(site,headers=hdr)
page = urlopen(req)
soup = BeautifulSoup(page, 'html.parser')

elements = soup.select("#product-price-46728") # $69.90
print(elements)
price = elements[0].text
print("Current Price: " + elements[0].text)

#old-price-46728
elements = soup.select("#old-price-46728") # $129.90
print("\nOld Price: " + elements[0].text)

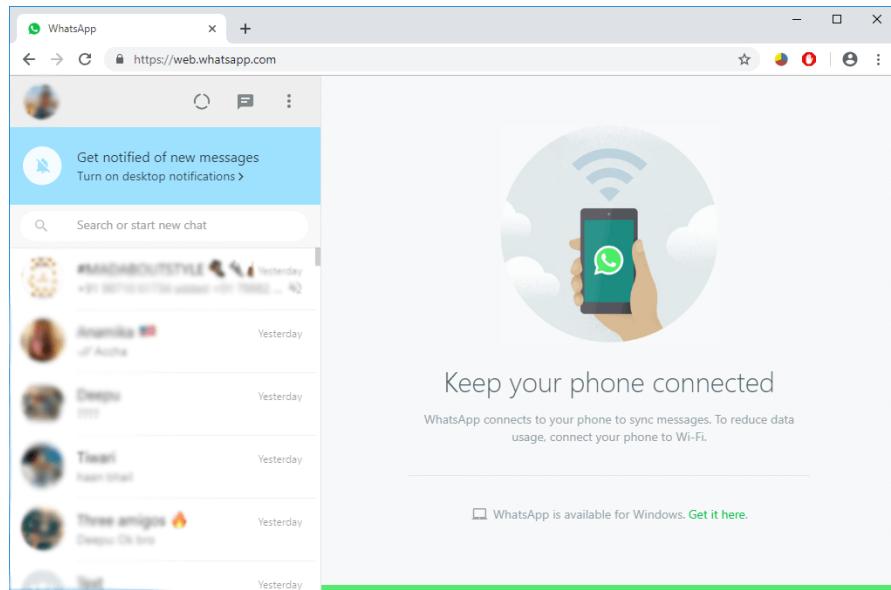
elements = soup.select('div[class="delivery est-date"]') # Earliest by Sunday, 31 May 2020
print(elements[0].text)
```

Debug I/O   Python Shell   Messages   OS C  
Debug I/O (stdin, stdout, stderr) appears below  
Current Price: S\$69.90  
Old Price: S\$129.90  
Delivery Date:  
Earliest by  
Sunday, 31 May 2020



# Sharing other Use Cases

- Using another library: selenium
  - Filling up google form
  - Sending WhatsApp message



selenium python automation

Name

Your answer

Gender

Male

Female



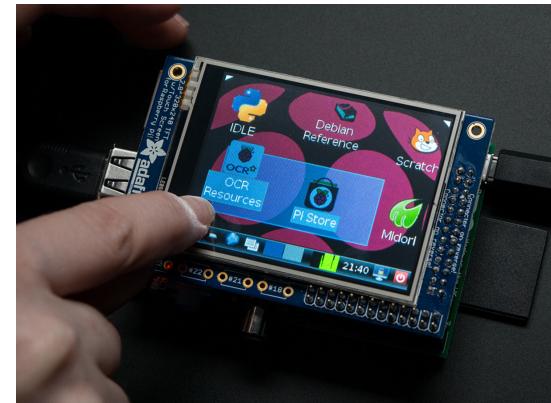
# Sharing other Use Cases



Collecting images for your projects



Getting data from Spotify (API) to predict song popularity

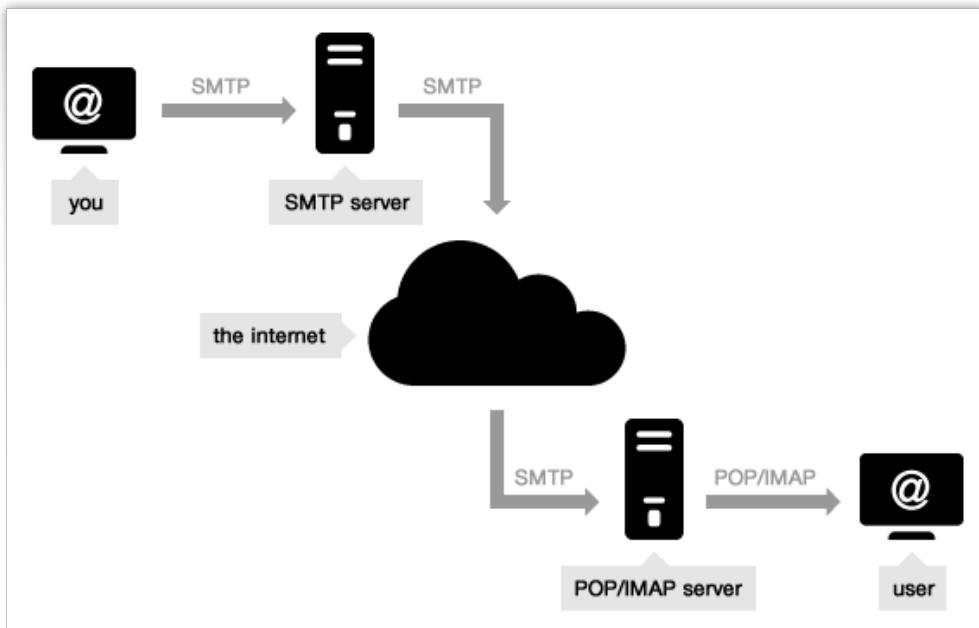


Use a raspberry pi to scrape job postings everyday

# Email Automation with Python



# Send Email



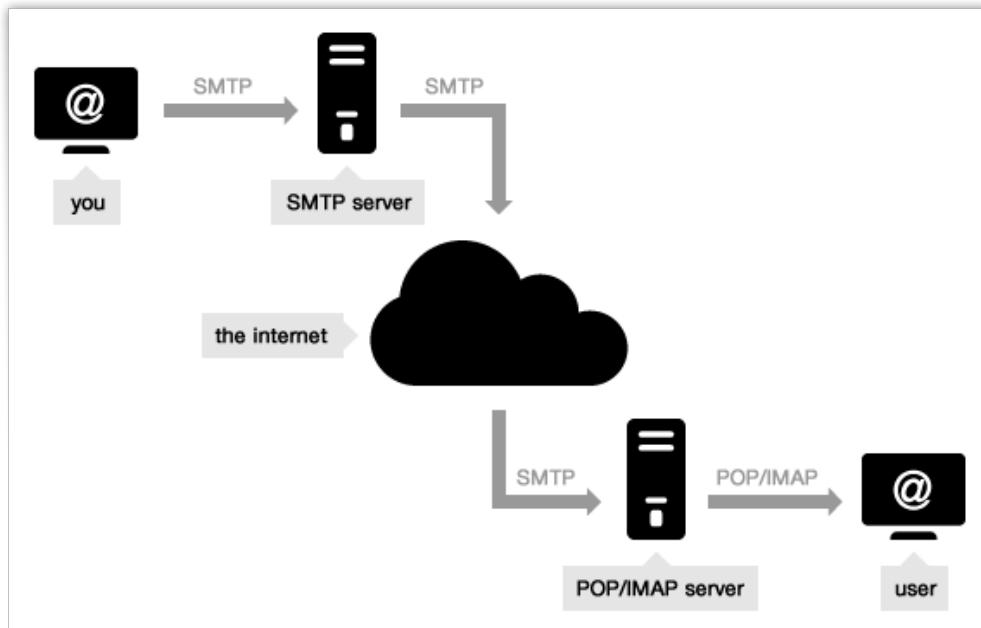
- SMTP (Simple Mail Transfer Protocol) is used for sending and delivering from a client to a server via port 25, 465 or 587: it's the **outgoing server**.
- IMAP and POP are two methods to access email. IMAP is the recommended method when you need to check your emails from several different devices, such as a phone, laptop, and tablet.

<https://www.mailgun.com/blog/which-smtp-port-understanding-ports-25-465-587/>

<https://serversmtp.com/what-is-smtp-server/>



# Send Email



- **Note:** The SMTP servers used when you send your emails- Hotmail, Gmail , Yahoo Mail – are **shared among users**
- Common providers establish some **strict limits** on the number of emails you can send (e.g. Yahoo's restriction is 100 emails per hour).
- If you plan to send a bulk email or set up an email campaign you should opt for a professional outgoing email server like turboSMTP,
- which guarantees a controlled IP and ensure that all your messages reach their destination.



# Send Email using Gmail

Incoming Mail (IMAP) Server	imap.gmail.com Requires SSL: Yes Port: 993
Outgoing Mail (SMTP) Server	smtp.gmail.com Requires SSL: Yes Requires TLS: Yes (if available) Requires Authentication: Yes Port for SSL: 465 Port for TLS/STARTTLS: 587
Full Name or Display Name	Your name
Account Name, User name, or Email address	Your full email address
Password	Your Gmail password

Note: If you are using your office network, most port numbers, including 587, may be blocked.



# Send Email using Gmail

---

- Import `smtplib` module
- Specify Gmail email & password, receiver's email address, email title & content
- Connect to SMTP server using Port 587
- Call `starttls()` to enable encryption for your connection
- Login using email and password
- Call `sendmail()`
- Call `quit()` to disconnect from the SMTP server

```
import smtplib

sender_email_address = "your_email_address@gmail.com"
sender_email_password = "xxxxxxxxxxxxxx"
receiver_email_address = "another_email_address@gmail.com"
email_title_content = "Subject: Sending Email Using Python\nThis is a test email."

email_title_content = "Subject: Sending Email Using Python\nThis is a test email.

print("Trying to connect to Gmail SMTP server")
smtpObj = smtplib.SMTP("smtp.gmail.com", 587)
smtpObj.starttls()

print("Connected. Logging in...")
smtpObj.login(sender_email_address, sender_email_password)

smtpObj.sendmail(sender_email_address, receiver_email_address, email_title_content)
print("Email sent successfully...")

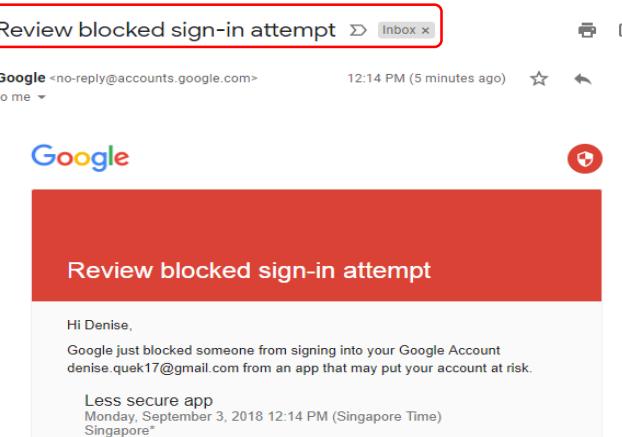
smtpObj.quit()
```

➤ The start of the email body must begin with "Subject:" for the subject line. The "\n" newline character separates the subject line from the main body content.



# Send Email using Gmail

- Google may block attempted sign-in from unknown devices that don't meet their security standards!



```
C:\Users\denise_quek\AppData\Local\Programs\Python\Python37\python.exe D:/CET_Python/Denise/TestEmail.py
Trying to connect to Gmail SMTP server
Connected. Logging in...
Traceback (most recent call last):
  File "D:/CET_Python/Denise/TestEmail.py", line 13, in <module>
    smtpObj.login(sender_email_address, sender_email_password)
  File "C:\Users\denise_quek\AppData\Local\Programs\Python\Python37\lib\smtplib.py", line 730, in login
    raise last_exception
  File "C:\Users\denise_quek\AppData\Local\Programs\Python\Python37\lib\smtplib.py", line 721, in login
    initial_response_ok=initial_response_ok)
  File "C:\Users\denise_quek\AppData\Local\Programs\Python\Python37\lib\smtplib.py", line 642, in auth
    raise SMTPAuthenticationError(code, resp)
smtplib.SMTPAuthenticationError: (534, b'5.7.9 Application-specific password required. Learn more at\n5.7.9')
```

Process finished with exit code 1



# Send Email using Gmail

## Steps To Create Google App Password

Step 1: Login to Gmail. Go to Account, Security, □ Signing in to Google

Step 2: Make sure that 2-Step Verification is on

Step 3: Create an App password

App passwords let you sign in to your Google Account from apps on devices that don't support 2-Step Verification. You'll only need to enter it once so you don't need to remember it. [Learn more](#)

You don't have any app passwords.

Select the app and device you want to generate the app password for.

Mail Windows Computer **GENERATE**

**Generated app password**

Your app password for Windows Computer

**[REDACTED]**

**How to use it**

1. Open the "Mail" app.
2. Open the "Settings" menu.
3. Select "Accounts" and then select your Google Account.
4. Replace your password with the 16-character password shown above.

Just like your normal password, this app password grants complete access to your Google Account. You won't need to remember it, so don't write it down or share it with anyone. [Learn more](#)

**DONE**



# Send Email using Gmail

Screenshot of the Google Account Security settings page.

The left sidebar shows navigation links: Home, Personal info, Data & personalisation, **Security** (highlighted with a red box), People & sharing, Payments & subscriptions, Help, and Send feedback.

The main content area is titled "Security" and describes settings to keep the account secure.

### Security issues found

Protect your account now by resolving these issues



[Secure account](#)

### Signing in to Google



Last changed 10 Jan 2018

2-Step Verification  On

App passwords 1 password

### Ways that we can verify that it's you

These can be used to make sure that it's really you



Show all X



# Send Email using Gmail

---

- Replace your actual password with the App password

```
import smtplib

sender_email_address = "your_email_address@gmail.com"
sender_email_password = "xxxxxxxxxxxxxx"
receiver_email_address = "another_email_address@gmail.com"
email_title_content = "Subject: Sending Email Using Python\nThis is a test email."
```

- Run your email program

```
C:\Users\denise_quek\AppData\Local\Programs\Python\Python37\python.exe D:/CET_Python/Denise/TestEmail.py
Trying to connect to Gmail SMTP server
Connected. Logging in...
Email sent successfully...

Process finished with exit code 0
```



# Use Case: Send emails to students

- Send email to students who were absent

	A	B	C
1	Student	Email	Status
2	Alicia	code.musically@gmail.com	Present
3	Bryan	code.musically@gmail.com	Present
4	Carol	code.musically@gmail.com	Absent
5	David	code.musically@gmail.com	Absent
6	Evelyn	code.musically@gmail.com	Present
7			

```
1 #! python3
2
3 import openpyxl, smtplib
4
5 def sendEmail(name, emailTo):
6     email_body = "Subject: Your attendance. \nDear %s, \nYou were absent for class.\n" %(name)
7
8     smtpObj = smtplib.SMTP("smtp.gmail.com", 587)
9     smtpObj.starttls()
10    smtpObj.login("code.musically@gmail.com", "xxxxxxxxxxxx")
11    smtpObj.sendmail('code.musically@gmail.com', emailTo, email_body)
12
13    smtpObj.quit()
```



# Use Case: Send Emails to Students

---

- Open an Excel file
- Send email to students who were absent

```
16     workbook = openpyxl.load_workbook("D:\\CET_Python\\students_attendance.xlsx")
17     sheet = workbook["Sheet1"]
18
19     max_row = sheet.max_row
20     max_column = sheet.max_column
21
22     for i in range(1, max_row+1):
23
24         attendance = sheet.cell(row=i, column=3).value
25
26         if attendance == "Absent":
27             name = sheet.cell(row=i, column=1).value
28             email = sheet.cell(row=i, column=2).value
29
30             print(name + " is absent.")
31             sendEmail(name, email)
32             print("Email sent to " + email)
33             print()
34
```



# Sharing other Use Cases

---

- Send Email to multiple parties when a report is generated
- Send reminder in a workflow

# Generate PDF Report with Python



# PDF

**PyFPDF**

Search docs

Project Home

- Home
- FPDF for Python
- Main features
- Installation
- Support
- ProjectHome
- Reference manual
- Tutorial
- Tutorial (Spanish translation)
- FAQ (Frequently asked questions)
- Python 3
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- add\_link
- add\_page
- alias\_nb\_pages
- cell
- close
- dashed\_line

[Docs](#) » Project Home » Home

[Edit on GitHub](#)

## FPDF for Python

PyFPDF is a library for PDF document generation under Python, ported from PHP (see [FPDF](#); "Free"-PDF, a well-known PDFlib-extension replacement with many examples, scripts and derivatives).

Latest Released Version: 1.7 (August 15th, 2012) - Current Development  
Version: 1.7.1



### Main features

- Easy to use (and easy to extend)
- Many simple examples and scripts available in many languages
- No external dependencies or extensions (optionally PIL for GIF support)
- No installation, no compilation or other libraries (DLLs) required
- Small and compact code, useful for testing new features and teaching

This repository is a fork of the library's [original port by Max Pat](#), with the following enhancements:

- Python 2.5 to 3.4+ support (see [Python3 support](#))
- [Unicode](#) (UTF-8) TrueType font subset embedding (Central European, Cyrillic, Greek, Baltic, Thai, Chinese, Japanese, Korean, Hindi and almost any other language in the world) **New!** based on [sPDF](#) LGPL3 PHP version from [ian Back](#)
- Improved installers (`setup.py`, `py2exe`, `PyPI`) support
- Barcode 128f5 and code39, QR code coming soon ...
- PNG, GIF and JPG support (including transparency and alpha channel) **New!**
- Exceptions support, other minor fixes, improvements and PEP8 code cleanups
- Port of the [Tutorial](#) and [ReferenceManual](#) (Spanish translation available)

FPDF original features:

- **Install fpdf**
- **pip install fpdf**

<https://pyfpdf.readthedocs.io/en/latest/Tutorial/index.html>



# PDF – Basic document

```
import fpdf

#create a new pdf
document = fpdf.FPDF()

#define font and color for title and add the first page
document.set_font("Times","B", 14)
document.set_text_color(19,83,173)
document.add_page()

#write the title of the document
document.cell(0,5,"PDF Test Document")
document.ln()

#write a long paragraph
document.set_font("Times", "", 11)
document.set_text_color(0)
document.multi_cell(0,10, "This is an example of a long paragraph. \n" * 10)
document.ln()

#save the document
document.output("pdf_report.pdf")
```

- Import fpdf
- Create a new pdf document
- Add page
- Add text
- Save file

**PDF Test Document**  
This is an example of a long paragraph.  
This is an example of a long paragraph.



# PDF – adding images

```
import fpdf

#create a new pdf
document = fpdf.FPDF()

#define font and color for title and add the first page
document.set_font("Times","B", 14)
document.set_text_color(19,83,173)
document.add_page()

#add a image
document.image("rp_logo.png", x=10, y=5, w=23)

document.set_y(40);

#write the title of the document
document.cell(0,5,"PDF Test Document")
document.ln()

#write a long paragraph
document.set_font("Times", "", 11)
document.set_text_color(0)
document.multi_cell(0,5, "This is an example of a long paragraph. " * 10)
document.ln()

#save the document
document.output("pdf_report.pdf")
```

- Import fpdf
- Create a new pdf document
- Add page
- Add text, logo
- Save file



## PDF Test Document

This is an example of a long paragraph. This is an example of a long paragraph.



# Use Cases

---

- Automation:
  - Generation of reports with data from spreadsheet or database
  - Generation of Course Certificates in PDF format

# Charting/Visualisation with Python



# Charting



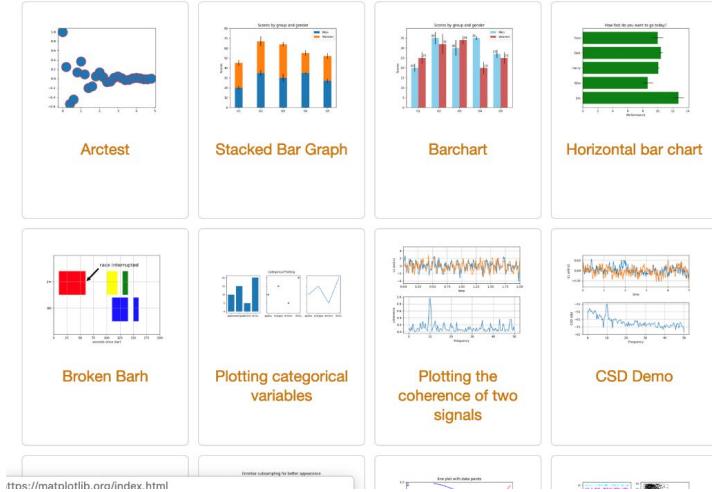
[home](#) | [examples](#) | [tutorials](#) | [API](#) | [docs](#) »

## Gallery

This gallery contains examples of the many things you can do with Matplotlib. Click on any image to see the full image and source code.

For longer tutorials, see our [tutorials page](#). You can also find [external resources](#) and a [FAQ](#) in our user guide.

### Lines, bars and markers



<https://matplotlib.org/index.html>



[modules](#) | [index](#)

Quick search  Go

### Table of Contents

#### Gallery

- Lines, bars and markers
- Images, contours and fields
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- Statistics
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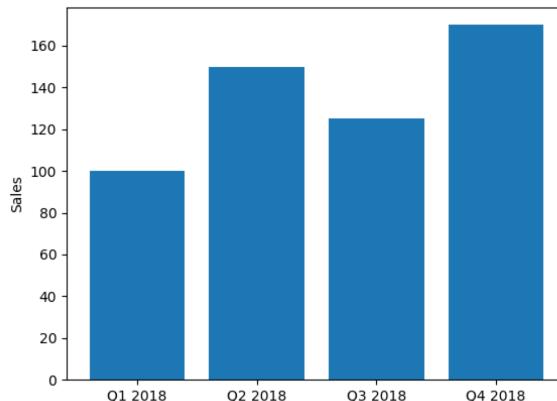
`pip install matplotlib`

Full documentation:  
<https://matplotlib.org/>



# Charting

```
1 import matplotlib.pyplot as plt
2
3 #set up values
4 VALUES = [100,150,125,170]
5 POS = [0,1,2,3]
6 LABELS = ['Q1 2018','Q2 2018','Q3 2018','Q4 2018']
7
8 #set up the chart
9 plt.bar(POS,VALUES)
10 plt.xticks(POS, LABELS)
11 plt.ylabel('Sales')
12
13 #to display the chart
14 plt.show()
```



- Install matplotlib
- Prepare data
- Create bar graph
- Display the chart

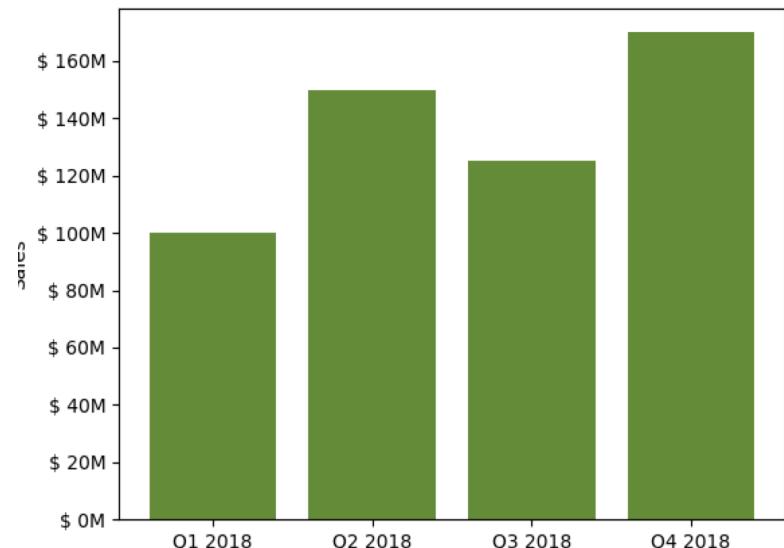
[https://matplotlib.org/api/\\_as\\_gen/matplotlib.pyplot.bar.html](https://matplotlib.org/api/_as_gen/matplotlib.pyplot.bar.html)



# Charting - Formatting

```
1 import matplotlib.pyplot as plt
2 from matplotlib.ticker import FuncFormatter
3
4 def value_format(value, position):
5     return '$ {}'.format(int(value))
6
7 # set up values
8 VALUES = [100, 150, 125, 170]
9 POS = [0,1,2,3]
10 LABELS = ['Q1 2018', 'Q2 2018', 'Q3 2018', 'Q4 2018']
11
12 # set up the chart
13 # Colors can be specified in multiple formats, as
14 # described in https://matplotlib.org/api/colors_api.html
15 # https://xkcd.com/color/rgb/
16 plt.bar(POS,VALUES, color='xkcd:moss green')
17 plt.xticks(POS, LABELS)
18 plt.ylabel('Sales')
19
20 # retreive the current axes and apply formatter |
21 axes = plt.gca()
22 axes.yaxis.set_major_formatter(FuncFormatter(value_format))
23
24 # to display the chart
25 plt.show()
```

- Install matplotlib
- Prepare data
- Customise graph options
- Create bar graph
- Display the chart





# Charting - Subplots

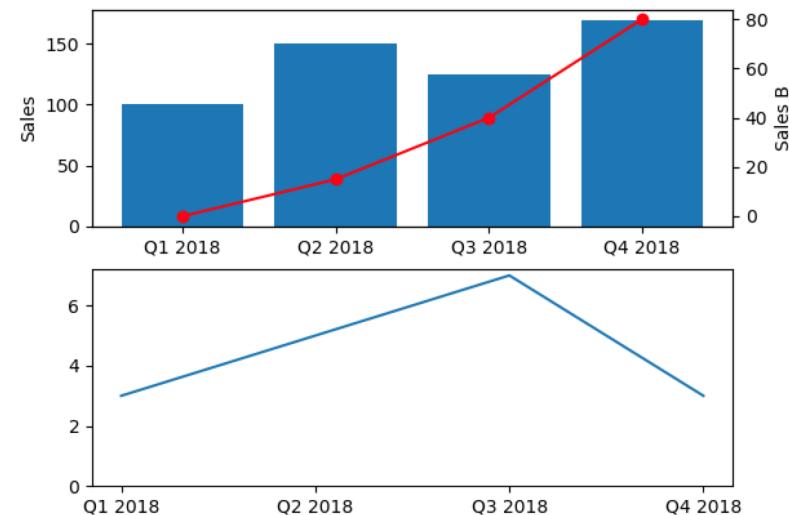
```

1 import matplotlib.pyplot as plt
2
3 #set up values
4 VALUESA = [100,150,125,170]
5 VALUESB = [0,15,40,80]
6 VALUESC = [3,5,7,3]
7 POS = [0,1,2,3]
8 LABELS = ['Q1 2018','Q2 2018','Q3 2018','Q4 2018']
9
10 # Create the first plot
11 plt.subplot(2,1,1) ←
12
13 #creata a bar graph with informaton about VALUESA
14 plt.bar(POS,VALUESA)
15 plt.ylabel('Sales')
16
17 #create a different Y axis, and add information
18 #about VALUESB as a line plot
19 plt.twinx()
20 plt.plot(POS,VALUESB,'o-',color='red')
21 plt.xticks(POS, LABELS)
22 plt.ylabel('Sales B')
23 plt.xticks(POS, LABELS)
24
25 #create another subplot and fill it iwth VALUESC
26 plt.subplot(2,1,2)
27 plt.plot(POS, VALUESC)
28 plt.gca().set_ylim(bottom=0)
29 plt.xticks(POS,LABELS)
30
31 plt.show()

```

- Multiple charts

2 rows, 1 column, index starting from 1)



[https://matplotlib.org/api/\\_as\\_gen/matplotlib.pyplot.subplot.html](https://matplotlib.org/api/_as_gen/matplotlib.pyplot.subplot.html)

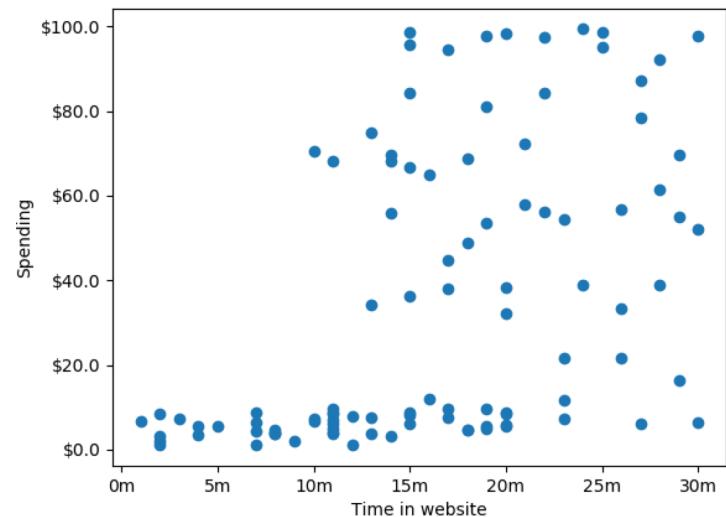


# Charting – Scatter Plot

```
1 import csv
2 import matplotlib.pyplot as plt
3 from matplotlib.ticker import FuncFormatter
4
5 def format_minutes(value, pos):
6     return '{}m'.format(int(value))
7
8 def format_dollars(value, pos):
9     return '${}'.format(value)
10
11 # read data from csv
12 fp = open("scatter.csv","r", newline='')
13 reader = csv.reader(fp)
14 data = list(reader)
15
16 data_x=[]
17 data_y=[]
18 for x, y in data:
19     data_x.append(float(x))
20     data_y.append(float(y))
21
22 plt.scatter(data_x, data_y)
23
24 plt.gca().xaxis.set_major_formatter(FuncFormatter(format_minutes))
25 plt.xlabel('Time in website')
26 plt.gca().yaxis.set_major_formatter(FuncFormatter(format_dollars))
27 plt.ylabel('Spending')
28
29 plt.show()
```

- To save a plot:  
plt.savefig(*filename*)

- Save the plot before you display





# End of Day 2

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This concludes the Introduction to Python,  
I hope you enjoyed it.

Thank you !

**QUESTIONS ?**

