Introductory Programming Using Python

Day 2

By Seow Khee Wei / Vincent Ng

Republic Polytechnic

Please change your log in screen name to resemble the registered name for the course

The instructor will take attendance

Course Material Link: https://bit.ly/py-oct20 (Same link as yesterday)

Trainers

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Programme Day Two

Morning

- Read and writing files
- Copying, moving and deleting files and folders
- Working with Excel
- Image Processing

Afternoon

- Connecting to the Web
- Sending emails
- Creating charts
- Generating PDF

Schedule

Time	Activity
9.00am – 10.20am	File I/O + File/Folder operations
10.20am – 10.40am	Break
10.40am – 12.00pm	Excel + Images
12.00pm – 1.30pm	Lunch
1.30pm – 2.50pm	Web + email
2.50pm – 3.10pm	Break
3.10pm – 4.30pm	PDF + charts
4.30pm – 5.00pm	Survey / Q&A

File Paths

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
```

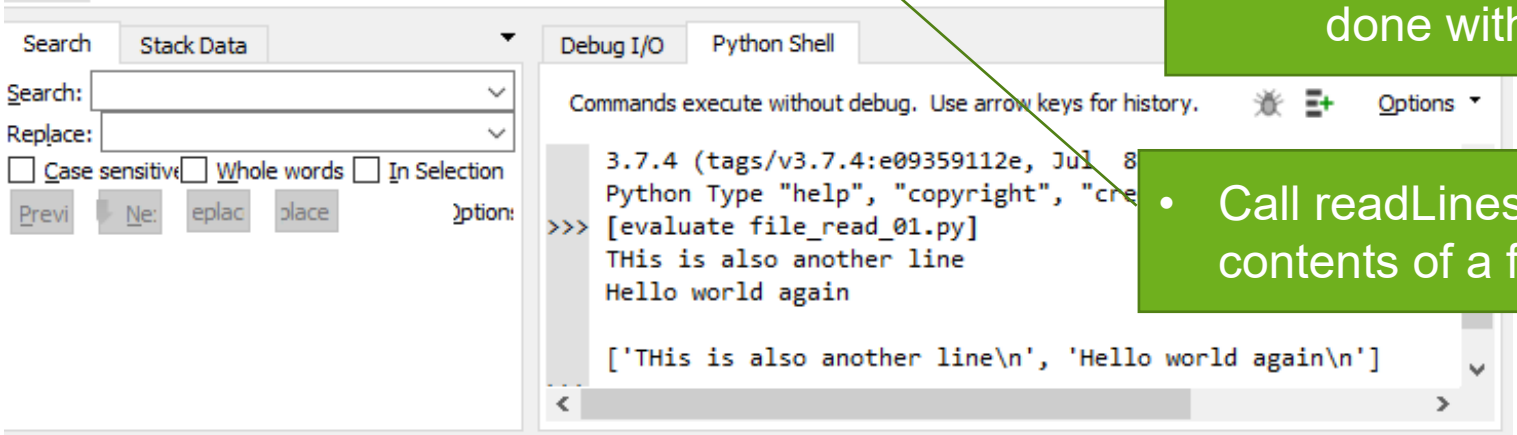
Open() will return a file object which has reading and writing related methods

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



file_read.py

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

Debug I/O | Python Shell

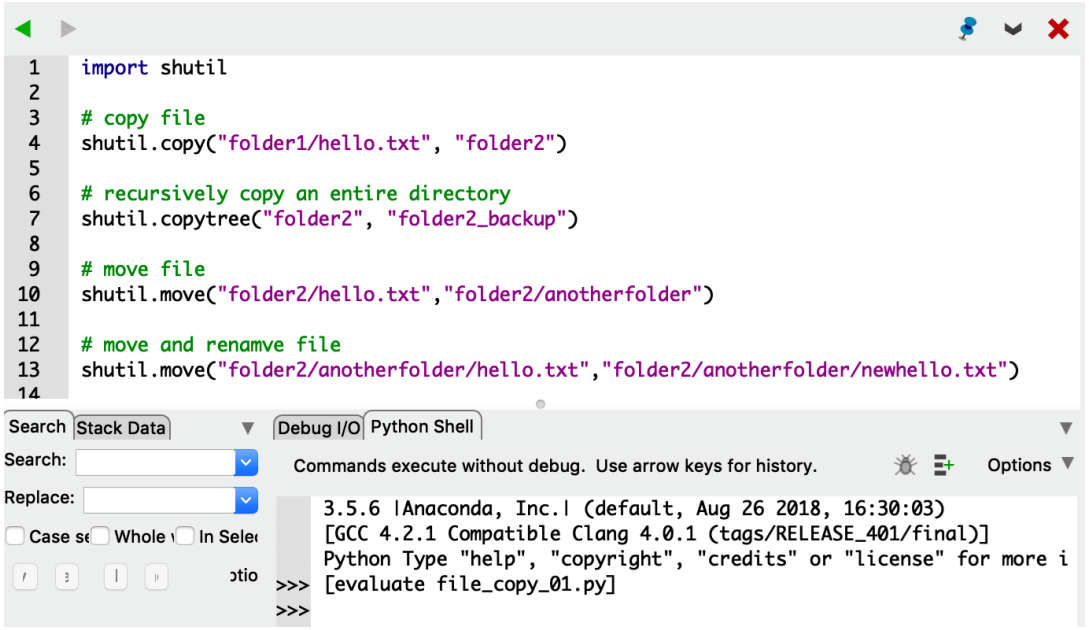
Commands execute without debug. Use arrow keys for history.

```
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]
THis is also another line

THis is also another line
Hello world again
```

file_write.py

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 renamve file
13 shutil.move("folder2/anotherfolder/hello.txt","folder2/anotherfolder/newhello.txt")
14
```

```
Search | Stack Data
Search:
Replace:
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                otio

Debug I/O | Python Shell
Commands execute without debug.  Use arrow keys for history.   Options

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 i
>>> [evaluate file_copy_01.py]
>>>
```

- 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

file_copy.py

Deleting files

```python
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")
```

- 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

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

```python
import os

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

Deleting can be dangerous, so do a dry run first

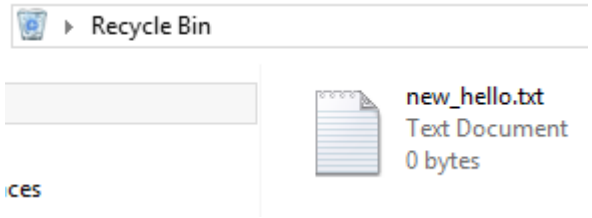
file_delete.py

send2Trash module

- Install send2trash module using pip.exe
  pip install send2trash
- send2trash.send2trash() will send a file or folder to the recycling bin

```
Administrator: Command Prompt
Microsoft Windows [Version 6.3.9600]
(c) 2013 Microsoft Corporation. All rights reserved.

C:\Users\charissa_chua>cd C:\Users\charissa_chua\PycharmProjects\ExerciseTwo\venv\Scripts

C:\Users\charissa_chua\PycharmProjects\ExerciseTwo\venv\Scripts>pip.exe install send2trash
Collecting send2trash
  Using cached https://files.pythonhosted.org/packages/49/46/c3dc27481d1cc57b9385aff41c474ceb7714f79
Installing collected packages: send2trash
Successfully installed send2trash-1.5.0
You are using pip version 10.0.1, however version 18.0 is available.
You should consider upgrading via the 'python -m pip install --upgrade pip' command.

C:\Users\charissa_chua\PycharmProjects\ExerciseTwo\venv\Scripts>
```

```
>>> import send2trash
>>> send2trash.send2trash("D:\\folder2\\new_hello.txt")
```

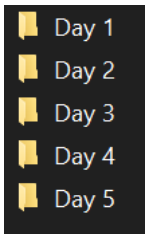


file_trash.py

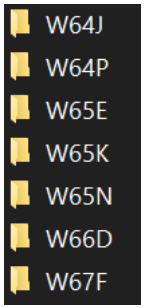
Use Case Sharing

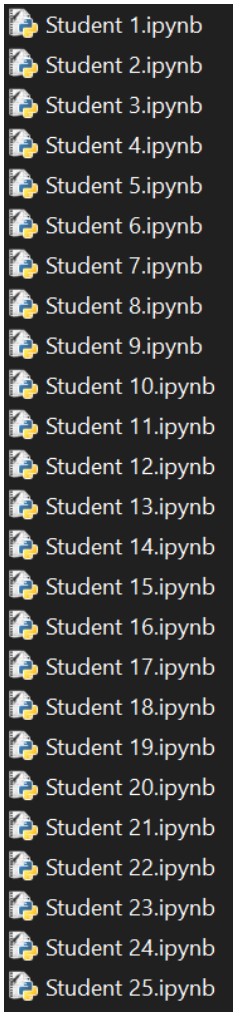
- Generating 600+ students assessment files, organized by day of week and classes folder
  - 5 Days of week
  - ~7 Classes a day
  - ~22+ students per class

1 Folder per day



1 sub-folder per class





1 assessment file per student

Other Use Cases

- 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:**

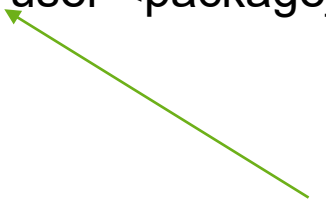
1. Create a file named: “myfile.txt”.
2. Write the following line of text into the file:
   - Programming is fun!
3. Close the file
4. Create a folder called “myfolder”
   - Use os.mkdir() command
5. Copy myfile.txt to myfolder

Python Package Index

- 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

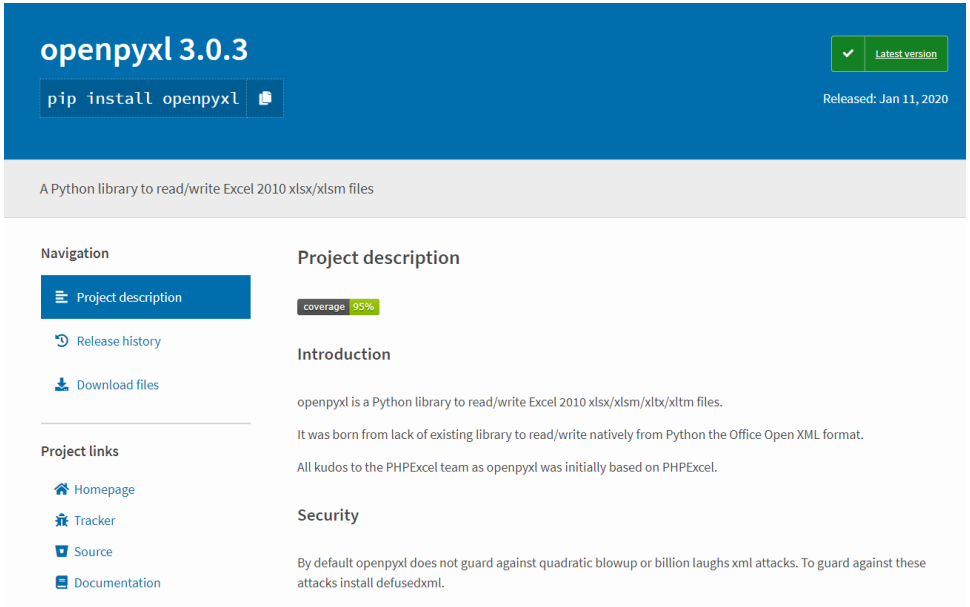
- **For all windows users by default**
  - Open command prompt
  - pip install <package_name>
- **For Mac User**
  - Open terminal
  - **pip3** install <package_name>
- **For RP staff using RP issued laptop**
  - Open command prompt
  - pip install --user <package_name>



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



Typical Workflow for Excel Automation

1. You are given some data in a spreadsheet
2. You want to do some or all of the following
   - Analyze the data
   - Manipulate the data
3. Output the processed data in another spreadsheet

Reading Excel file

1) Import openpyxl

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

```
import openpyxl

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

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

excel_read_bmi.py

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

excel_read_bmi.py

Update Excel file

```python
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

```python
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

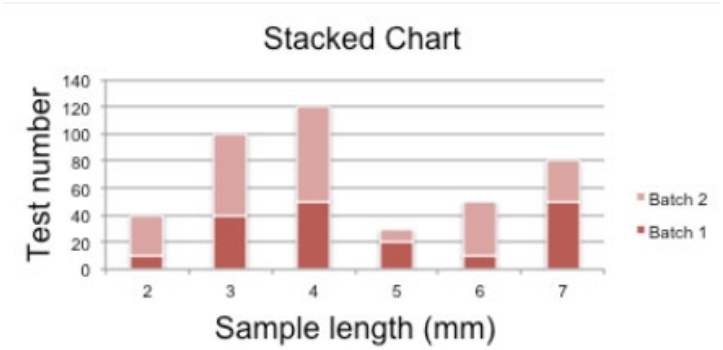
2) Setup colors and styles

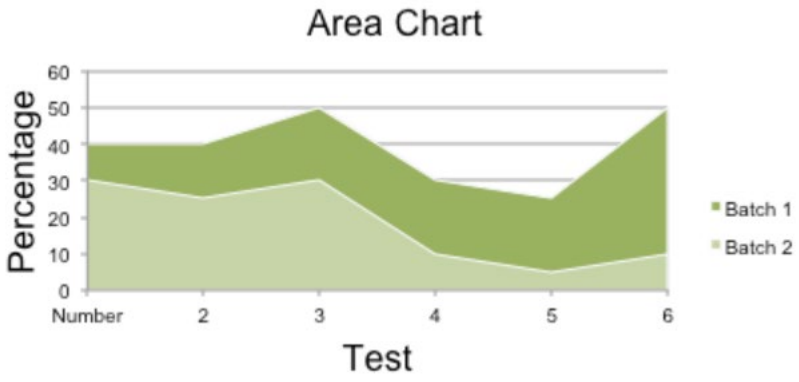
3) Loop through cell and set properties

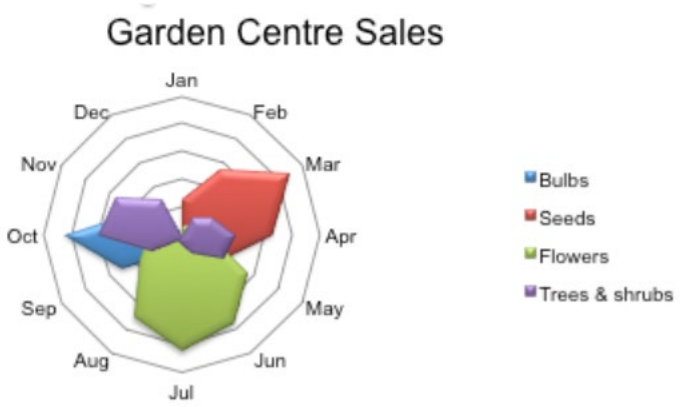
excel_format.py

Excel Charts

- Openpyxl supports the creation of many types of charts
  - Area Charts
  - Bar and Column Charts
  - Bubble Charts
  - Line Charts
  - Scatter Charts
  - etc







https://openpyxl.readthedocs.io/en/stable/charts/introduction.html

Create Excel Chart

```
import openpyxl
from openpyxl.chart import BarChart, Reference, Series

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


chart = BarChart()

labels = Reference(sheet, min_col=1, min_row=2, max_row=3)
data = Reference(sheet, min_col=3, min_row=1, max_row=3)

chart.add_data(data, titles_from_data=True)
chart.set_categories(labels)
chart.title = "Height"

sheet.add_chart(chart, 'E1')
workbook.save('bmi_chart.xlsx')
```

1) Import necessary functions

2) Load the data from excel file

3) Specify the label and the data range

4) Add the chart to the sheet, and save the file in another excel file.

Create Excel Chart

```
import openpyxl
from openpyxl.chart import BarChart, Reference, Series

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


chart = BarChart()

# first column is used as label, starting from row 2
labels = Reference(sheet, min_col=1, min_row=2, max_row=3)

# first row is used for header, that is why min_row is 1
data = Reference(sheet, min_col=3, min_row=1, max_row=3)

chart.add_data(data, titles_from_data=True)
chart.set_categories(labels)
chart.title = "Bar Chart"
chart.x_axis.title = "Name"
chart.y_axis.title = "Height"
chart.series[0].SeriesLabel = "height"

sheet.add_chart(chart, 'E1')
workbook.save('bmi_chart.xlsx')
```

1) Import necessary functions

2) Load the data from excel file

3) Specify the label and the data range

4) Specify values for title x-axis and y-axis for the chart

5) Add the chart to the sheet, and save the file in another excel file.

excel_chart.py

More Explanation on Chart Reference

- Write a script to list read an Excel file and output every even rows to a csv file.

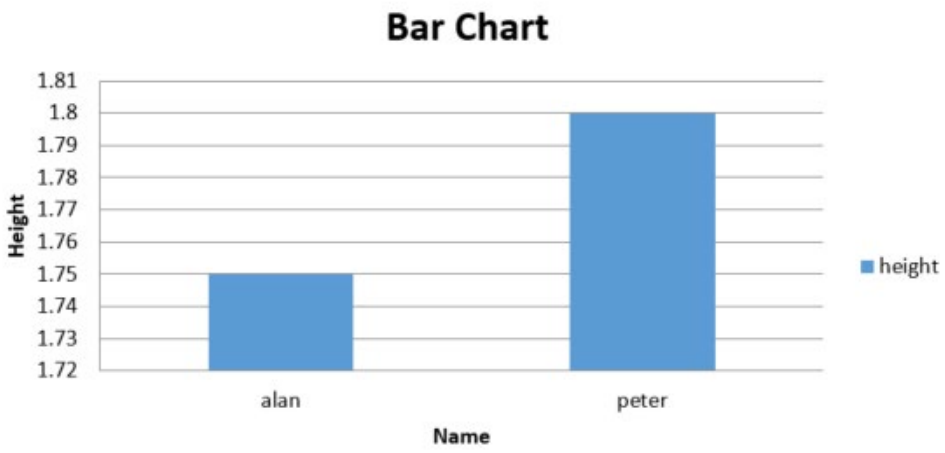
data = Reference(sheet, min_col=3, min_row=1, max_row=3)

	A	B	C
1	name	weight	height
2	alan	65	1.75
3	peter	70	1.8

min_col = 3 ← height

Min_col = 2 ← weight

labels = Reference(sheet, min_col=1 min_row=2, max_row=3)

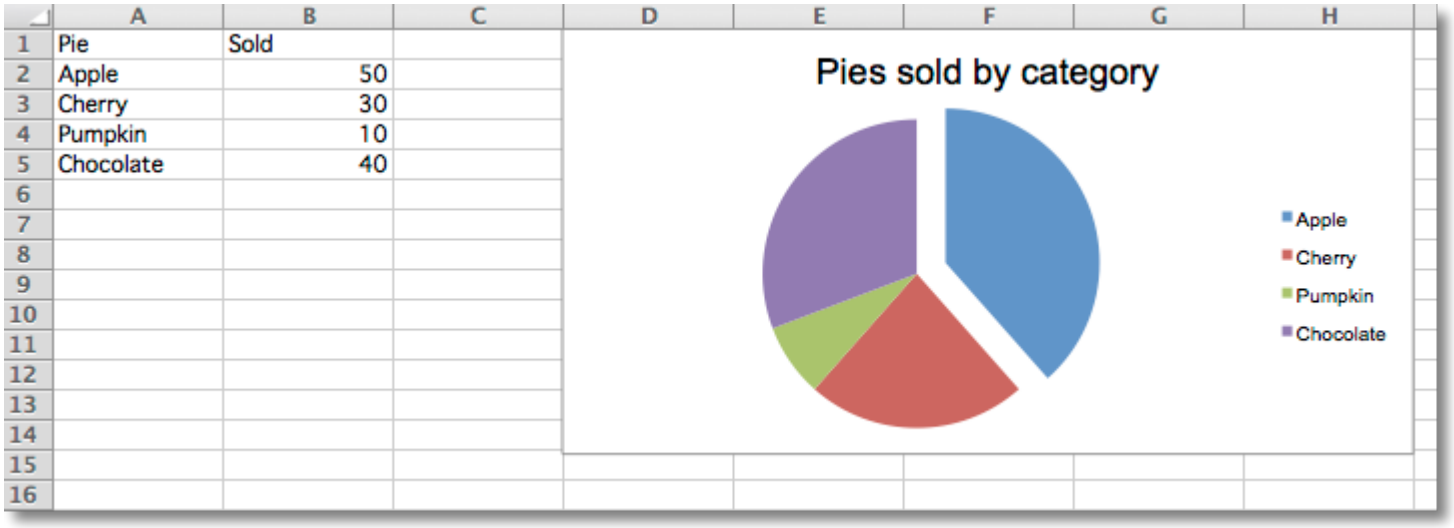


Exercise

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

1. Refer to the documentation at https://openpyxl.readthedocs.io/en/stable/charts/pie.html#id1

2. Follow the instruction to create the following pie chart.

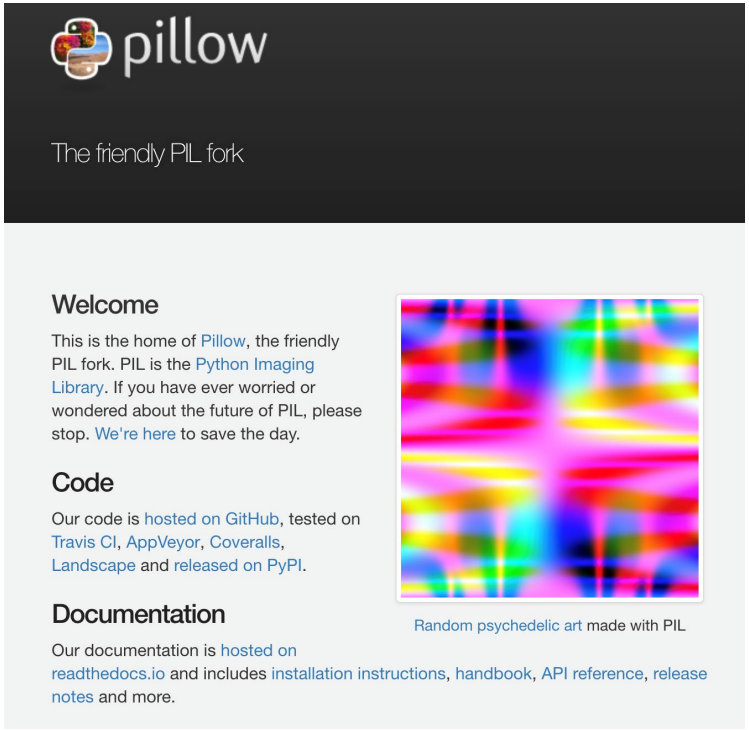


Typical Workflow for Excel Automation

1. You are given some data in a spreadsheet
2. You want to do some or all of the following
   - Analyze the data
   - Manipulate the data
   - Create visualization (Charts, Pivot Table etc)
3. Output the processed data in another spreadsheet

Image Processing with Python

Image Processing



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 | Python Shell | Messages | OS Commands

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()
```

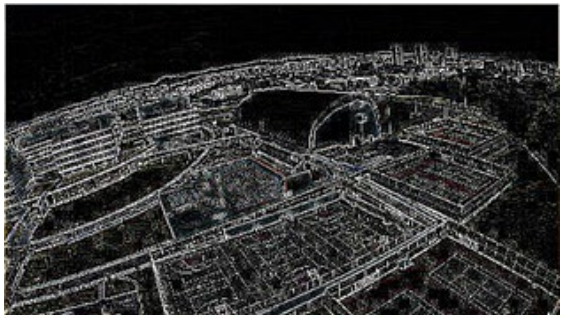
Pillow has many conversion and filters, to use filters we need to extend our import:
from PIL import Image, ImageFilter

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

Try other different filters!

image_blur_filter.py

Image processing - filters



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

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

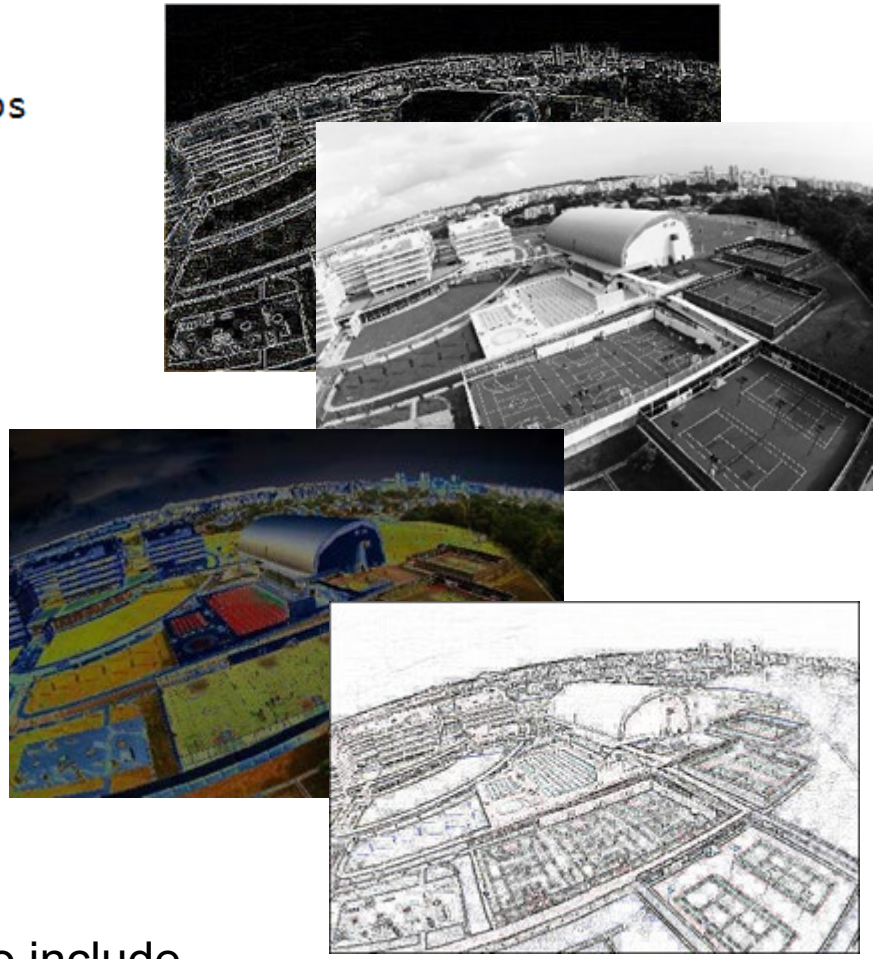
```
image = ImageOps.solarize(image)
```

```
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_other_filters.py

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_rotate.py

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_save.py

Image processing – Converting

```
>>> fname1 = "holiday.gif"
>>> fname2 = fname1.split(".")[0] + ".jpg"
>>> print(fname2)
holiday.jpg
>>>
```

```
>>> fname1 = "holiday.gif"
>>> f, e = os.path.splitext(fname1)
>>> fname2 = f + ".jpg"
>>> print(fname2)
holiday.jpg
>>>
```

Maybe you want to keep all your photos in the same format.
We have some gif files and maybe you would have bmp or png images.

Pillow understands the output file, and will convert if the output file is different from the input.

fname1		fname2
holiday.gif	->	holiday.jpg

How can we convert the string holday.gif to holiday.jpg ?

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_convert_ext.py

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.

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:

image_watermark.py

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")
```

image_batch_resize.py

Use Case II: Batch Rename

1. Find all the files in “img” folder with “.jpg” extension

1. Copy all the files to the renamed folder

1. Rename all the files with the “s-” prefix.

```
import os
import shutil

files = os.listdir('img')

for file in files:
    if file.lower().endswith(".jpg"):
        shutil.copyfile("img/" + file, "renamed/s-" + file[:-4] + ".jpg")
```

image_batch_rename.py

Web Automation with Python

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

web_request.py

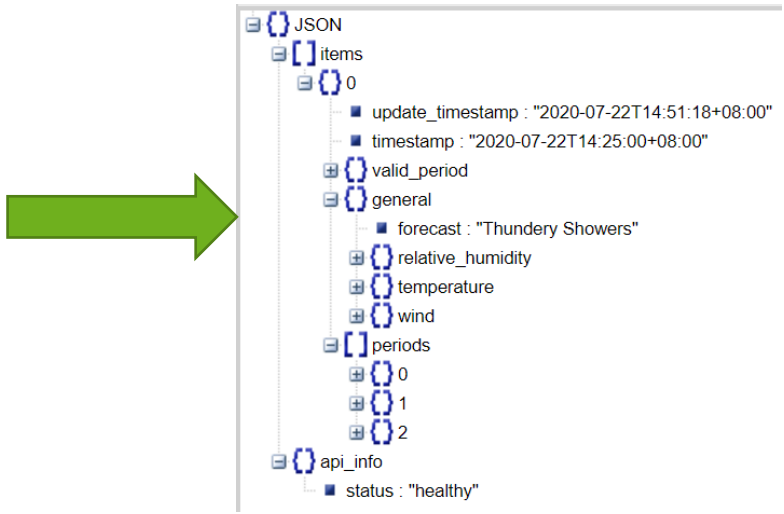
Connecting to the Web

- 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","timesta
"2020-07-22T14:25:00+08:00","valid_period":{"start":"2020-07-22T1
"end":"2020-07-23T12:00:00+08:00"},"general":{"forecast":"Thunder
"relative_humidity":{"low":70,"high":95},"temperature":{"low":22,"
"wind":{"speed":{"low":10,"high":20},"direction":"ESE"}},"periods"
"start":"2020-07-22T12:00:00+08:00","end":"2020-07-22T18:00:00+08
:{"west":"Moderate Rain","east":"Moderate Rain","central":"Light R
"Light Rain","north":"Light Rain"}},{"time":{"start":"2020-07-22T1
,"end":"2020-07-23T06:00:00+08:00"},"regions":{"west":"Partly Clou
"east":"Partly Cloudy (Night)","central":"Partly Cloudy (Night)","
"Partly Cloudy (Night)","north":"Partly Cloudy (Night)"}},{"time":
"2020-07-23T06:00:00+08:00","end":"2020-07-23T12:00:00+08:00"},"re
```

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
```

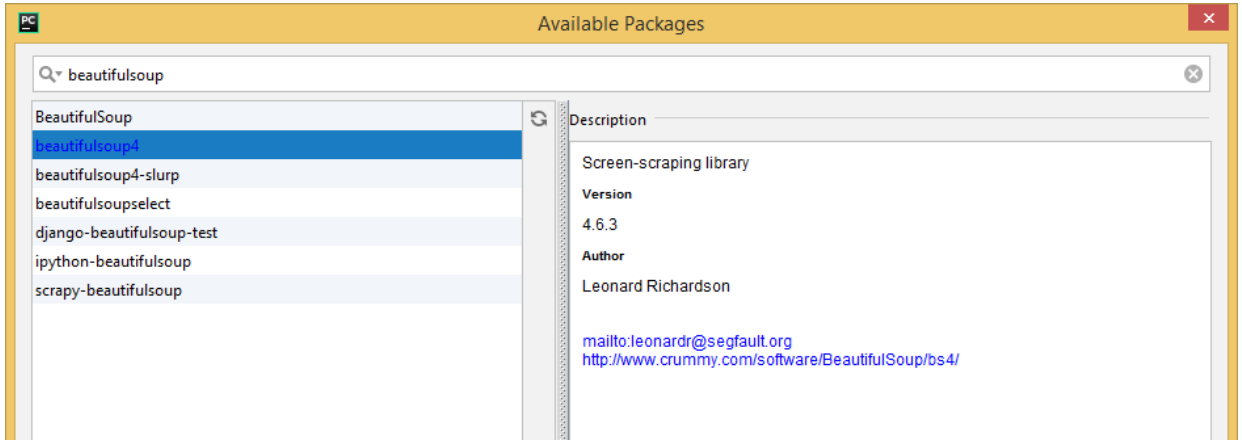
web_json.py

Connecting to the Web

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

Web Scraping – download and process Web content

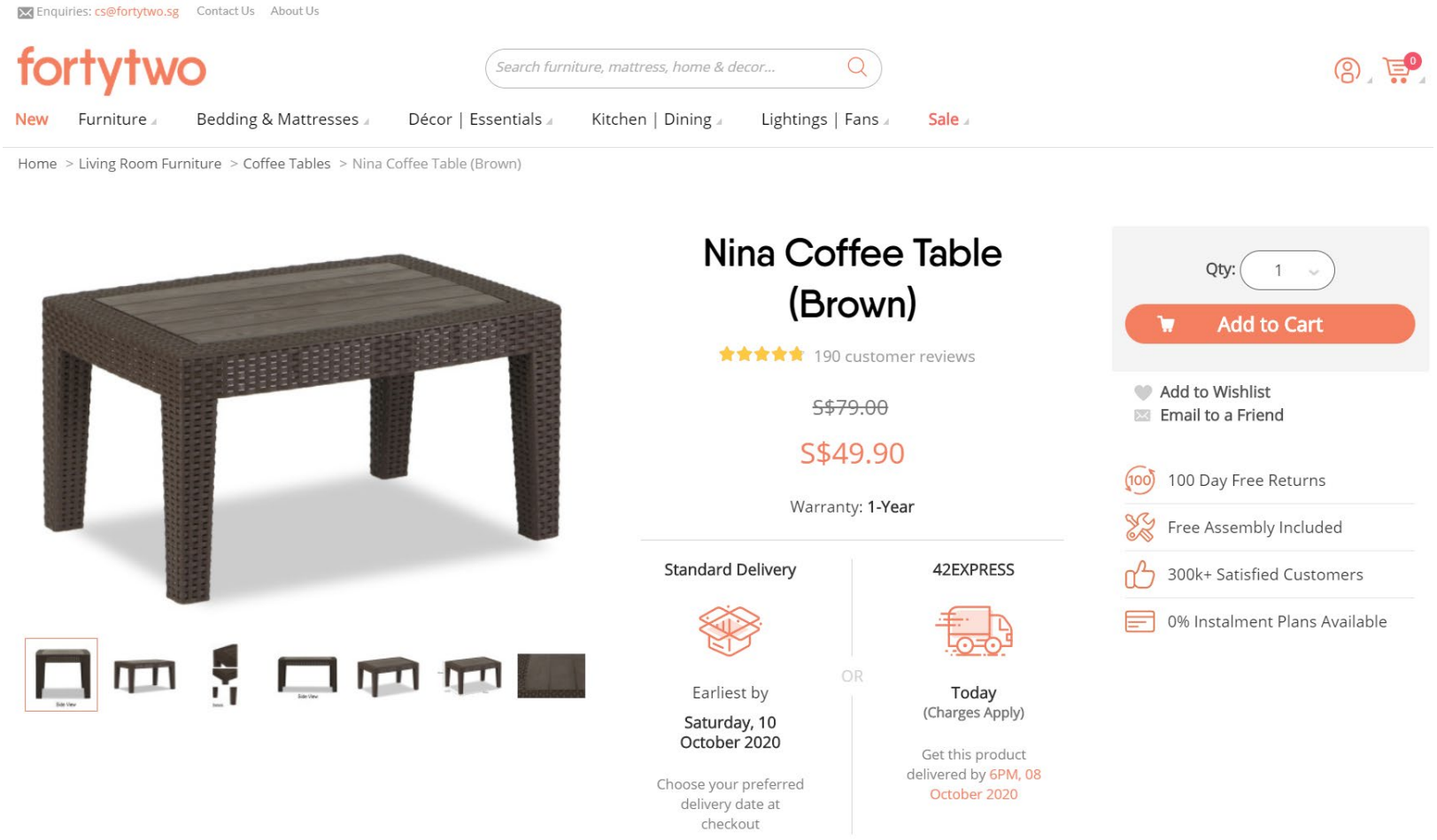
- Install Beautiful Soup 4 - **pip install beautifulsoup4**



Connecting to the Web

- What's the URL?

https://www.fortytwo.sg/living-room/coffee-table/nina-coffee-table-brown.html

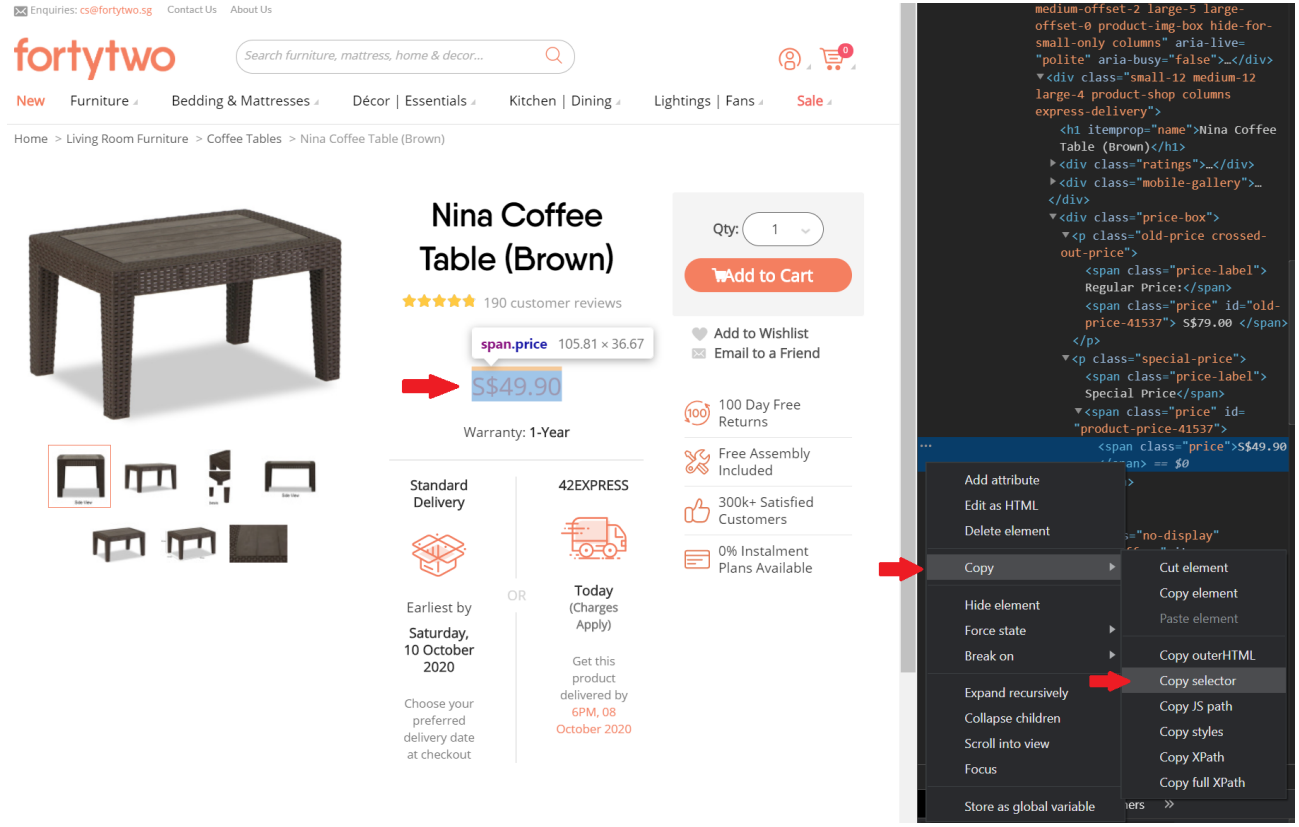


Connecting to the Web

- Get the url

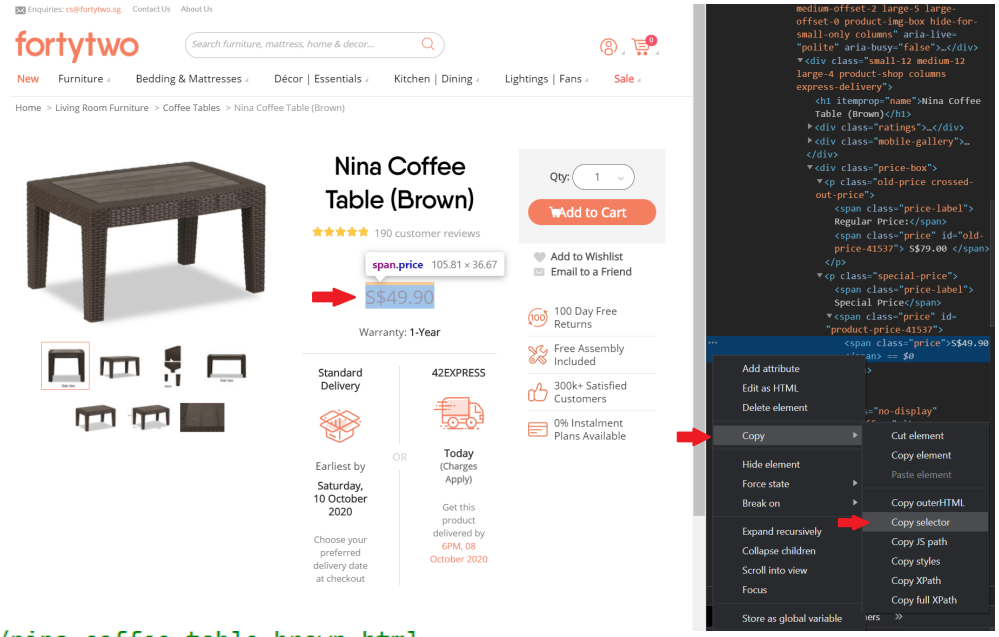
https://www.fortytwo.sg/living-room/coffee-table/nina-coffee-table-brown.html

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



Connecting to the Web

- Get the url
- Select the element to extract, right-click "Inspect"
- Right-click "Copy“ → "Copy selector"



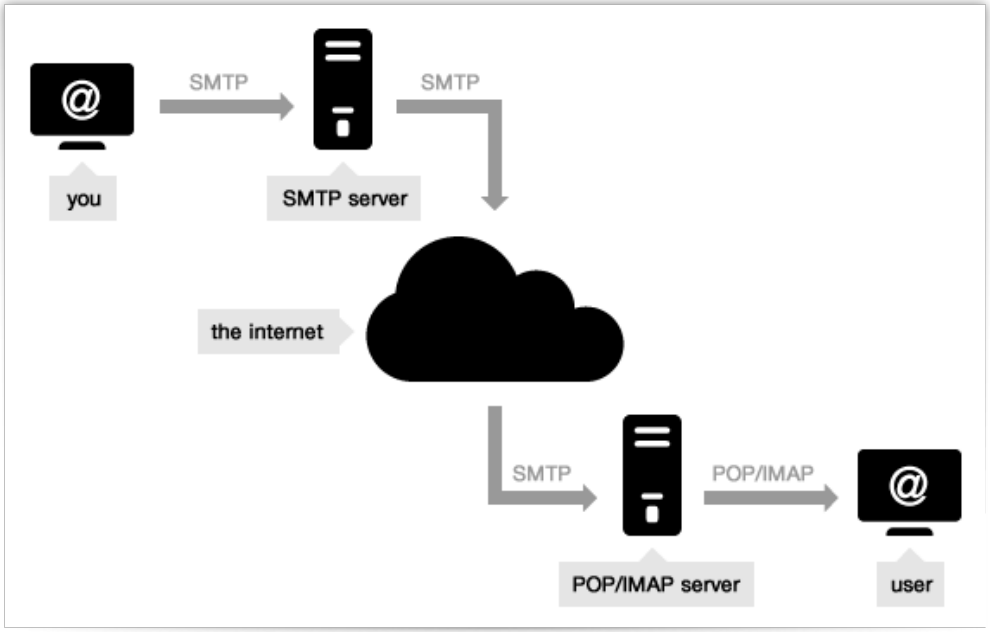

```
1   #https://www.fortytwo.sg/living-room/coffee-table/nina-coffee-table-brown.html
2
3   import bs4
4   import requests
5
6   requestObj = requests.get("https://www.fortytwo.sg/living-room/coffee-table/nina-coffee-table-brown.html")
7   requestObj.raise_for_status()
8   soup = bs4.BeautifulSoup(requestObj.text, 'html.parser')
9
10  elements = soup.select("#product-price-41537 > span") # $49.90
11  print("Current Price: " + elements[0].text)
12
13  elements = soup.select("#old-price-41537")  #  $79.00
14  print("\nOld Price: " + elements[0].text)
```

web_scrap.py

```
Debug I/O | Exceptions | Python Shell | M

Debug I/O (stdin, stdout, stderr) appears below

Current Price: S$49.90

Old Price:  S$79.00
```

Email Automation with Python

Send Email

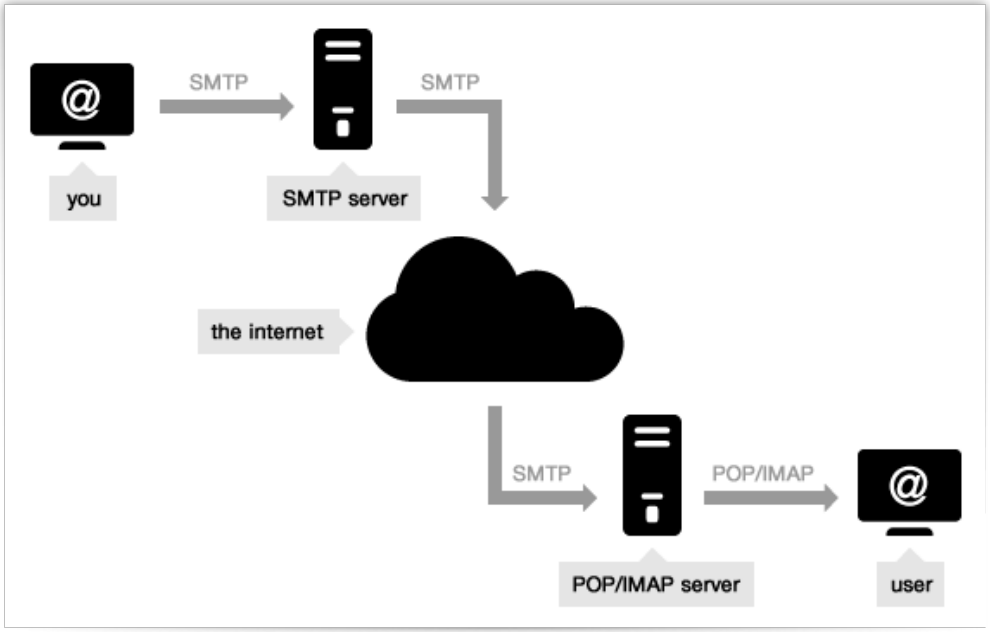


- SMTP (Simple Mail Transfer Protocol) is used for sending and delivering from a client to a server via port 25, 465 or 587: it's the **outgoing server**.
- IMAP and POP are two methods to access email. IMAP is the recommended method when you need to check your emails from several different devices,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

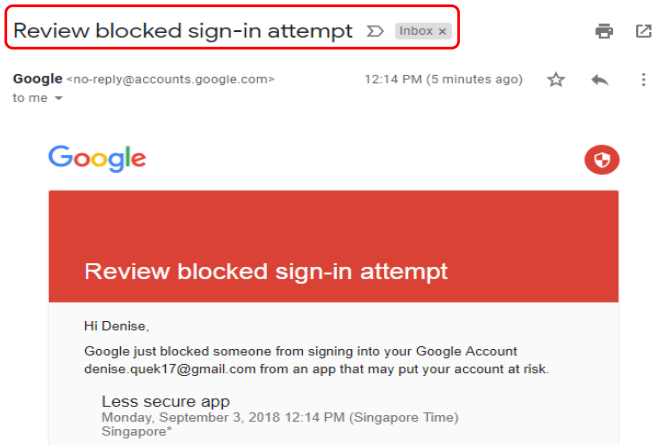
```
import smtplib

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."
```

➢ 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.

```
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()
```

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
```

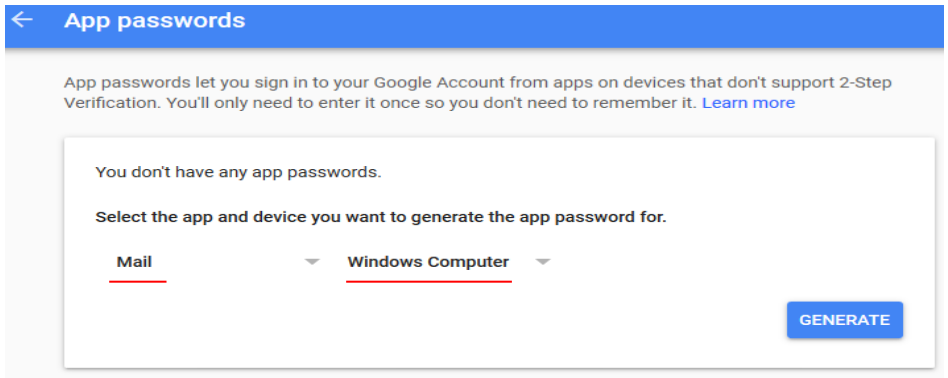
Send Email using Gmail

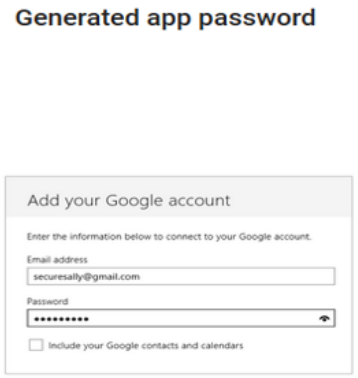
Steps To Create Google App Password

Step 1: Login to Gmail. Go to Account => Signing in to Google

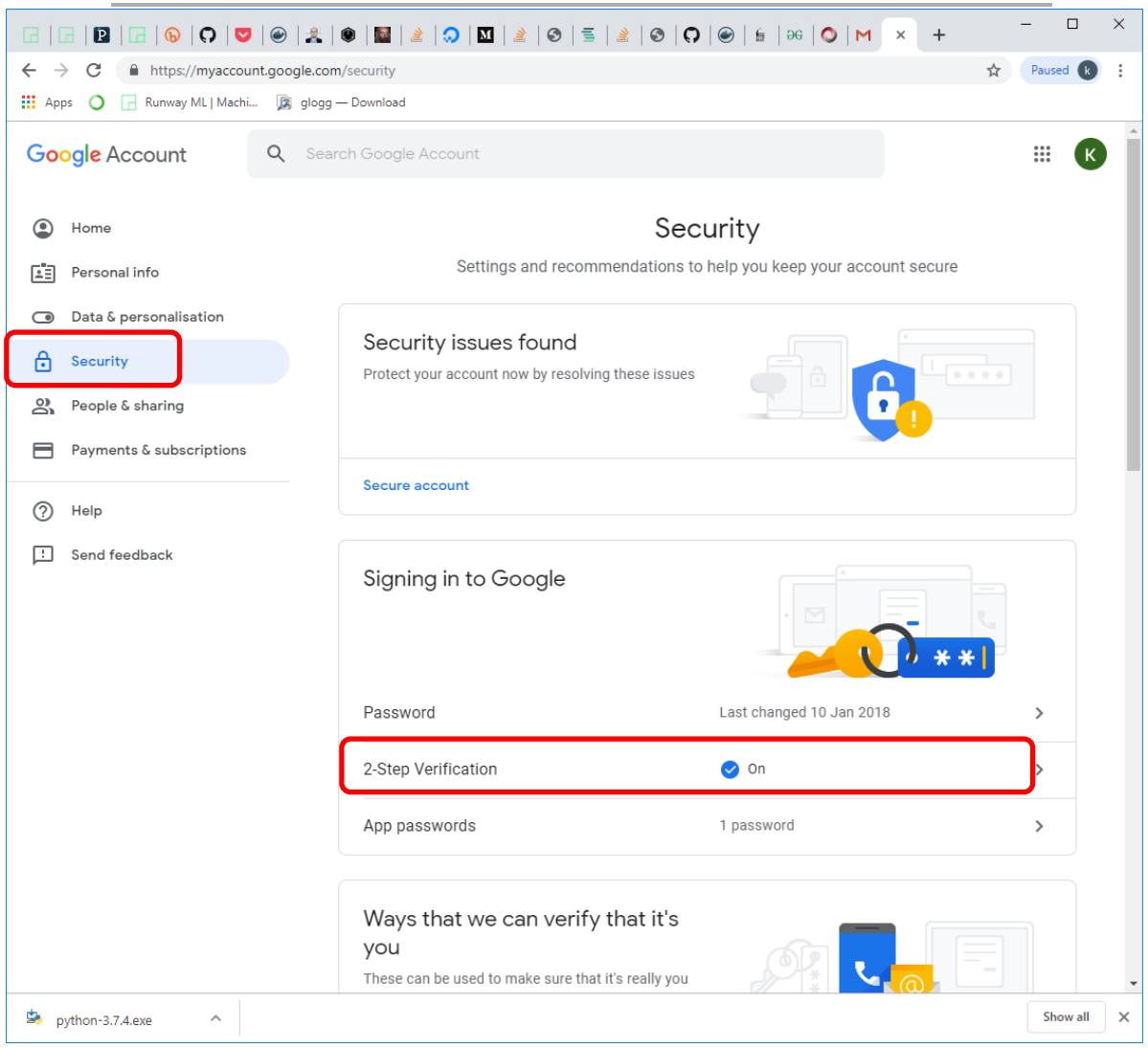
Step 2: Make sure that 2-Step Verification is on

Step 3: Create an App password





Send Email using Gmail



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 = "xxxxxxxxxxxxxxx"
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			

Sheet1

```python
#! python3

import openpyxl, smtplib

def sendEmail(name, emailTo):
    email_body = "Subject: Your attendance. \nDear %s, \nYou were absent for class.\n" %(name)

    smtpObj = smtplib.SMTP("smtp.gmail.com", 587)
    smtpObj.starttls()
    smtpObj.login("code.musically@gmail.com", "xxxxxxxxxxxx")
    smtpObj.sendmail('code.musically@gmail.com', emailTo, email_body)

    smtpObj.quit()
```

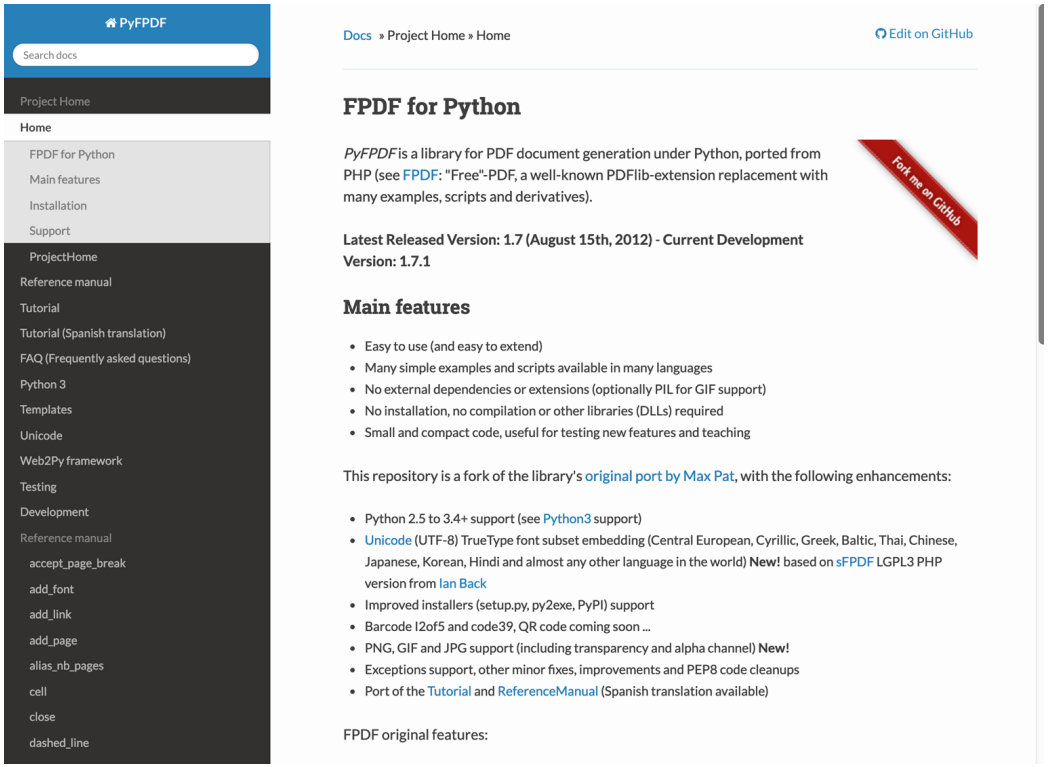
Use Case: Send Emails to Students

- 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
```

Generate PDF Report with Python

PDF



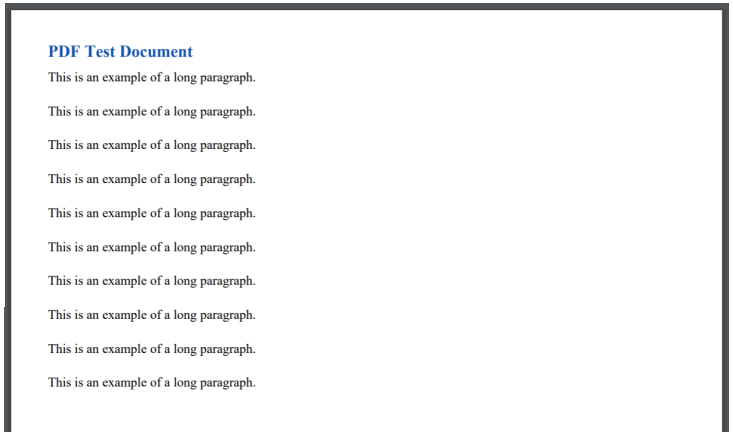
- Install fpdf
  - pip install fpdf

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

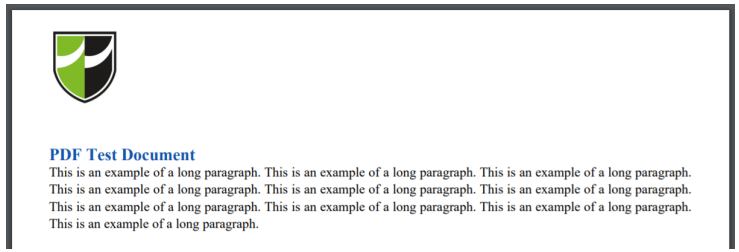


pdf_text.py

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



https://pyfpdf.readthedocs.io/en/latest/reference/image/index.html

pdf_image.py

PDF – Adding password

```
import fpdf
import PyPDF2

#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()

#save the document
document.output("pdf_report_before_pw.pdf")

#save the document into a new password protected/encrypted pdf
pdffile = open(r"pdf_report_before_pw.pdf", "rb")
pdfReader = PyPDF2.PdfFileReader(pdffile)
pdfWriter = PyPDF2.PdfFileWriter()
for pageNum in range(pdfReader.numPages):
    pdfWriter.addPage(pdfReader.getPage(pageNum))

pdfWriter.encrypt('123')
resultPDF = open(r"pdf_report_after_pw.pdf", "wb")
pdfWriter.write(resultPDF)
resultPDF.close()
pdffile.close()
```

- pip install PyPDF2

Password is 123

https://pythonhosted.org/PyPDF2/

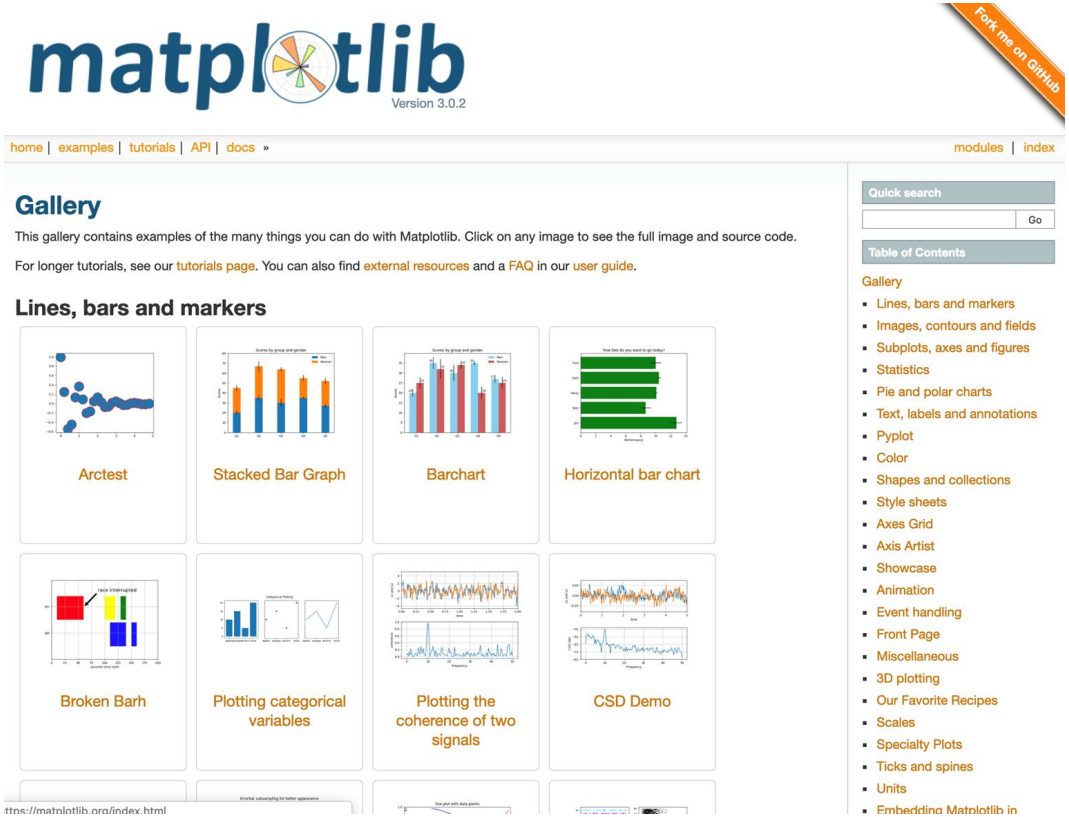
pdf_password.py

Use Cases

- Automation:
  - Generation of reports with data from spreadsheet or database
  - Generation of Course Certificates in PDF format
  - Password protection of banking statement in PDF file

Charting/Visualisation with Python

Charting



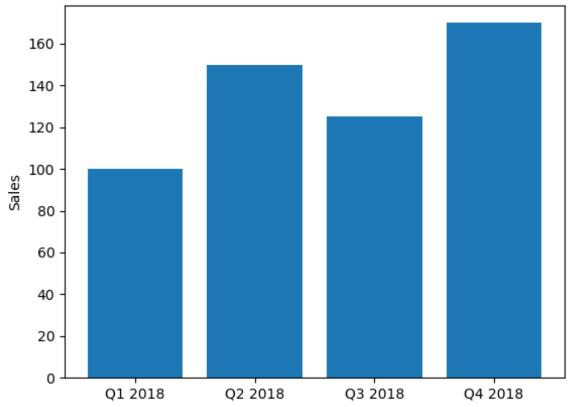
pip install matplotlib

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



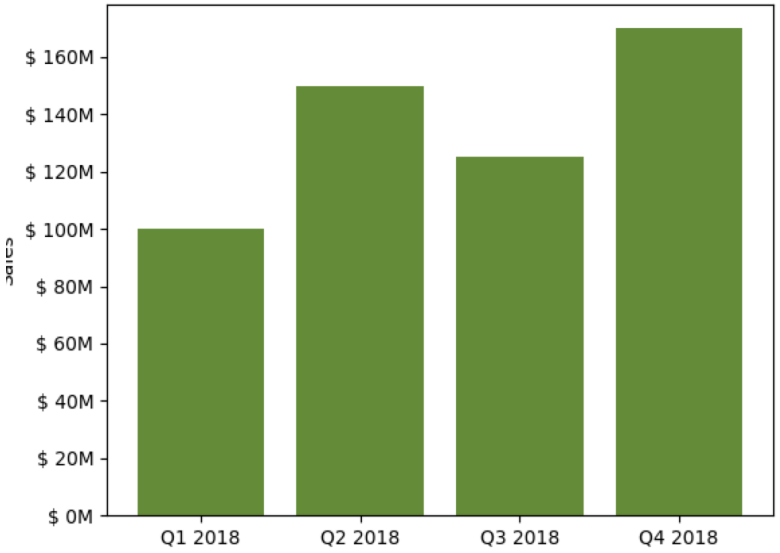
https://matplotlib.org/api/_as_gen/matplotlib.pyplot.bar.html

chart_bar.py

Charting - Formatting

```
1   import matplotlib.pyplot as plt
2   from matplotlib.ticker import FuncFormatter
3
4   def value_format(value, position):
5           return '$ {}M'.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



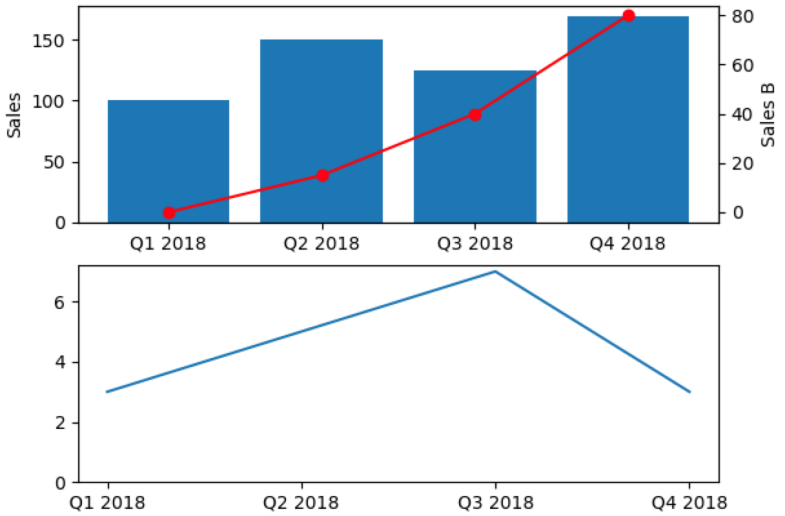
chart_bar_format.py

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)

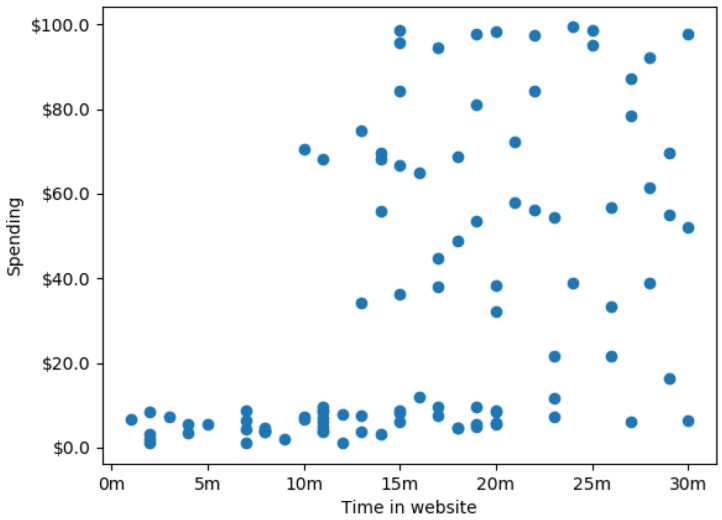


https://matplotlib.org/api/_as_gen/matplotlib.pyplot.subplot.html

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



chart_scatter.py

End of Day 2

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

Thank you !

QUESTIONS ?

TRAQOM survey

- **Link sent by SSG via Email or SMS**
- **Message looks like:**
  "You've completed a course supported by SSG. Pls complete the TRAQOM survey at this link: https://traqom.azcentric.com/xxxxx"
- **Do let us know if you have not received**
- **Please complete the survey found in the link**

Where to go from here ?

Getting started step by step
http://www.python.org/about/gettingstarted/

Run through the python tutorials:
http://docs.python.org/tutorial/index.html

Keep the API doc under your pillow:
http://docs.python.org/library/index.html

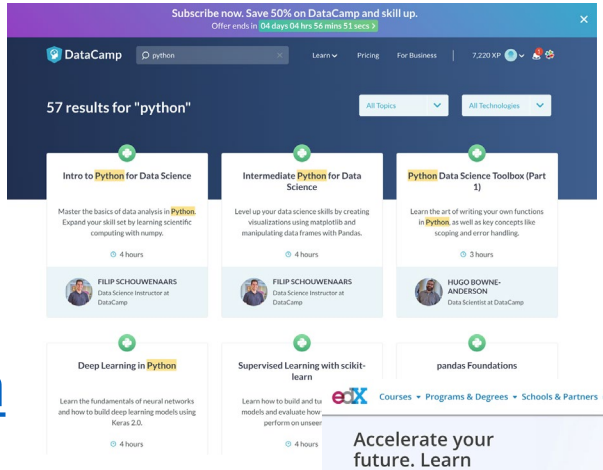
Advanced examples:
https://diveintopython3.problemsolving.io/

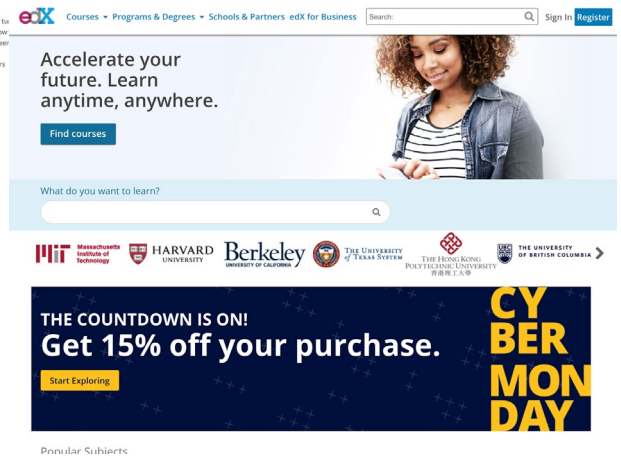
Where to go from here ?

MOOC:
DataCamp
https://www.datacamp.com/

Edx
https://www.edx.org/learn/python

Udemy
https://www.udemy.com/topic/python/





Where to go from here ?

How to think like a computer scientist is an introduction to Python programming for beginners. It starts with basic concepts of programming, and is carefully designed to define all terms when they are first used and to develop each new concept in a logical progression. Larger pieces, like recursion and object-oriented programming are divided into a sequence of smaller steps and introduced over the course of several chapters.

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https://buildmedia.readthedocs.org/media/pdf/howtothink/latest/howtothink.pdf

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+ An Introduction to Code-Free Machine Learning (1 day Beginner)