

Introductory Programming using Python

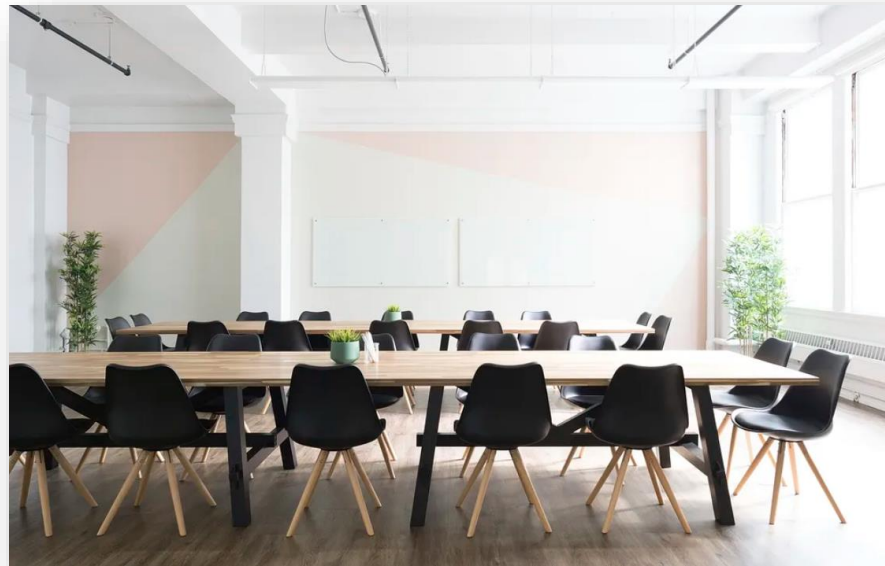
Day 2

Republic Polytechnic



Welcome and admin matters

- Please ensure that:
 - your attendance has been captured (via QR code scanning)
 - you have a learning laptop with you
 - you have a good view on the display

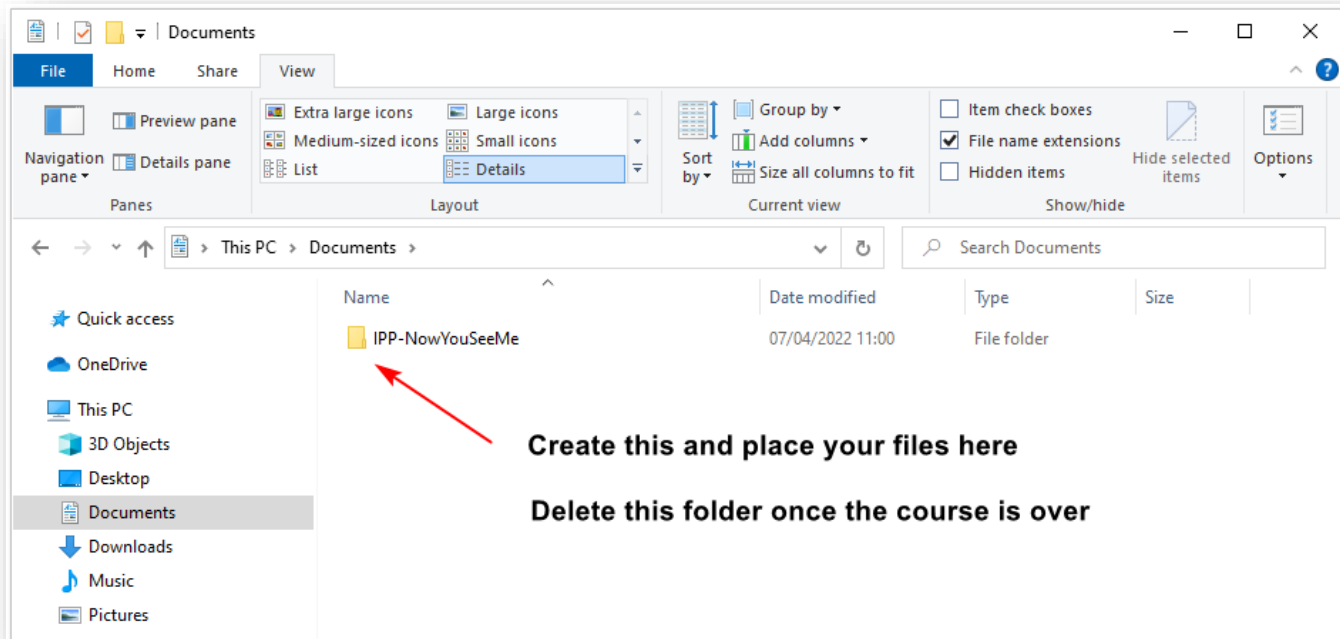


- Course material is also available at <https://bit.ly/IPP-MHA>



Welcome and admin matters

- A tidy/clean laptop is a good laptop for learning
- Created files on the laptop will linger on. To prevent this:
 - Create a folder in the "Documents" location for this workshop
 - E.g. "IPP-Alan" or "IPP-PeterPan"
 - All user created files to be placed in this folder
 - Delete that folder after the course



Objectives of MHQ Digital Upskilling

1. **Gain awareness of digital tools**, as they become essential in the future
2. Equip officers with skills and knowledge to **digitalise our work processes** where applicable

Four incandescent light bulbs are scattered on a wooden surface. One bulb on the left is lit, casting a warm glow. The other three bulbs are unlit. A spiral-bound notebook is open on the surface, with text written on its page.

MHQ officers should:

1. Be **OPEN** to **POSSIBILITIES** and explore use cases
2. **PARTICIPATE ACTIVELY** in activities and discussions to maximise learning time



Overview: Day Two

Morning	Afternoon
<ul style="list-style-type: none">• String functions• String formatting• Dictionary• Working with Excel	<ul style="list-style-type: none">• Connecting to the Web• Demo: Sending Emails (outlook)



String functions

- Split

```
>>> a='python or java'
>>> b=a.split(' ')
>>> type(b)
<type 'list'>
>>> b
['python', 'or', 'java']
>>>
```

```
>>> a='python or java'
>>> b=a.split('on')
>>> b
['pyth', ' or java']
>>>
```

- Join

```
>>> a=['python','and','java']
>>> b=' '.join(a)
>>> b
'python and java'
>>> c=','.join(a)
>>> c
'python,and,java'
>>>
```




String Slicing

```
>>> s = "freedom"  
>>> print(s[:4])  
free  
>>> print(s[-3:])  
dom  
>>> |
```

- Slicing works for any sequence (e.g. list), so it works for strings too.

`[:4]` gets from the start till the fourth character

`[-3:]` gets the last third till the last character



FIX_ME exercise

split or slice?

- Walkthrough on the following use case:
 - Extract the digit part of a Singapore NRIC number
 - Extract the user id from an email address
- Let's solve it together



Exercise – Find Longest Word

- Create the function **findLongestWord** that takes in a sentence and returns the longest word.

Hint: Use `split()`, repetitions



15 mins

findLongestWord.py



Strings – Useful functions

- Useful functions for validations
 - `String.isupper()` – Returns True if all characters in *String* are in uppercase.
 - `String.islower()` – Returns True if all characters in *String* are in lowercase.
 - `String.isalpha()` – Returns True if *String* contains alphabets only.
 - `String.isdigit()` – Returns True if all characters in *String* are numbers only.
 - `len(String)` – Returns the total number of characters (including spaces) in *String*
 - `String.count(text)` – Returns the number of times *text* appears in *String*.
 - `String.startswith(text)` – Returns True if *String* starts with *text*.
 - `String.endswith(text)` – Returns True if *String* ends with *text*.
- Useful functions for manipulations
 - `String.upper()` – Returns a String with all characters in the original String converted to uppercase
 - `String.lower()` – Returns a String with all characters in the original String converted to lowercase
 - `String.replace(x, y)` – Returns a String with all occurrences of *x* in the original String replaced with *y*



String formatting

- **String format() method**

- Use {} as a place holder for the text to be printed.
- Call the string dot format method
- Pass the desired value into the method

More about string formatting technique can be found here:
<https://docs.python.org/3/library/string.html>

In the earlier exercise on temperature_calculator.py, the output can be rewritten as:

```
print(name + "'s temperature is " + str(diff_from_369) + " degree from 36.9 degree celsius")
```



#Using String formatting:

```
print("{}'s temperature is {:.2f} degree from 36.9 degree celsius".format(name, diff_from_369))
```

- **Formatting types**

- :d Decimal
- :f Float
- :+ plus sign if results is positive
- :< Left aligns the result



Exercise – String formatting (1)

- Try this out yourself!
 - Open *string-format1.py*
 - Change the values for the value line
 - Execute and observe the effect

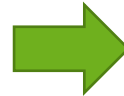
```
import math
```

```
a = math.pi
```

```
b = 5
```

```
c = 'python'
```

```
line = "{} {:.2f} {}".format(c, a, b)  
print(line)
```



```
python 3.14 5  
00005
```

```
line = "{:0>5}".format(b)  
print(line)
```



5 mins





Exercise – String formatting (2)

- Given the variable

```
x = "admin:$E*G$@R:/users/root:"
```

Write a program to display the following output:

User	: admin
Password	: \$E*G\$@R
Homedir	: /users/root



10 mins



Python Dictionary

```
dictionary = {'a':1, 'p':1, 'r':2, 't':1, 'o':1}
```

- A dictionary stores multiple **key-value** pairs
- Each key-value pair are separated by a colon (:)
- 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 Python list that uses square brackets []
- To access a value in the dictionary, we use the key as an index
 - e.g. `print(dictionary["r"]` displays value of 2



Python Dictionary

- You can *add*, *edit* and *delete* elements from a dictionary

```
# create dictionary with some elements
members = {'mary': 18, 'alan': 20, 'peter': 21}

# add element
members['john'] = 20

# edit element
members['mary'] = 25

# delete element
del members['alan']

# get number of element
print(len(members))

# display all the elements
print(members)
```

Key "john" **NOT IN** the *members* dict. This **ADDS** the key "john" and value 20 pair

Key "mary" **IS IN** the *members* dict. This **EDITS** the value of key "mary"



Python Dictionary

- We can traverse and iterate over a dictionary using *for* loop
 - e.g. assume members contain name (key) and age (value)
To calculate the average age:

```
1 total = 0
2 members = { "mary":18, "alan":20, "peter":21 }
3
4 for key in members: # Iterate the key:value pairs using a for loop
5     age = members[key] # Assign the value for each key in the variable age
6     total = total + age
7
8 average = total / len(members)
9 average = round(average, 2)
10 print("The average age is " + str(average) )
```



Exercise – Dictionary Operations

- Create a dictionary with the following key:value pairs
 - "alan" : 80001234
 - "mary": 90004567
 - "peter": 61234567
- Update the value for "mary" to 91110000
- Remove the element with "peter" as the key



5 mins

Excel Automation using Python



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

- Analyse the data
- Manipulate the data

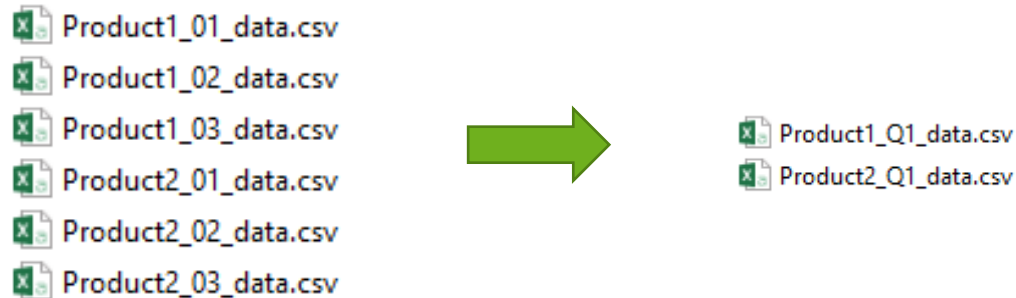
3

Output the processed data in another spreadsheet



Excel Use Case (Walkthrough)

- Finance department receives monthly sales data from the various product lines.
- Finance department would like to:
 - **Task 1:** Merge the product specific monthly sales files into quarterly files to observe the trends





Excel Use Case (Walkthrough)

- Finance department would like to:
 - **Task 2:** Simple data cleansing to remove duplicates or empty lines

Date	Customer	Order #	Revenue	Sales Rep Name	Commission Rate
1/1/2019	Alpha Soft	i-100001	\$202.33	Jimena Carrillo	10%
2/1/2019	Soul Soluti	i-100002	\$592.22	Emma Ford	10%
3/1/2019	Ironavigati	i-100003	\$59.44	Lily Grant	4%
4/1/2019	Ironavigati	i-100004	\$283.33	Jamie Webb	10%
5/1/2019	Soul Soluti	i-100005	\$19.00	Jamie Webb	0%
6/1/2019	Alpire	i-100006	\$43.03	Emma Ford	0%
7/1/2019	Oystertain	i-100007	\$23.34	Jimena Carrillo	0%
8/1/2019	Titanium Si	i-100008	\$230.30	Lily Grant	10%
9/1/2019	Surprise Mi	i-100009	\$430.33	Lily Grant	10%
10/1/2019	Apexshow	i-100010	\$492.32	Emma Ford	10%
10/1/2019	Apexshow	i-100010	\$492.32	Emma Ford	10%
10/1/2019	Ironavigati	i-100011	\$23.34	Jimena Carrillo	0%



Excel Use Case (Walkthrough)

- Finance department would like to:
 - **Task 3:** Perform mathematical calculations and create new columns to store the calculated information.

Date	Customer Name	Order #	Revenue	Sales Rep Name	Commission Rate	Total Commission
1/1/2019	Alpha Software	i-100001	\$202.33	Jimena Carrillo	10%	\$20.23
2/1/2019	Soul Solutions	i-100002	\$592.22	Emma Ford	10%	\$59.22
3/1/2019	Ironavigation	i-100003	\$59.44	Lily Grant	4%	\$2.38
4/1/2019	Ironavigation	i-100004	\$283.33	Jamie Webb	10%	\$28.33
5/1/2019	Soul Solutions	i-100005	\$19.00	Jamie Webb	0%	\$0.00
6/1/2019	Alpire	i-100006	\$43.03	Emma Ford	0%	\$0.00
7/1/2019	Oystertainment	i-100007	\$23.34	Jimena Carrillo	0%	\$0.00



Excel Use Case (Walkthrough)

- Finance department would like to:
 - **Task 4:** Glean some simple insights.
 - Total sales of product
 - Highest performing Sales rep
 - Customers with highest purchase value



Excel: Task 1

- **Merge the monthly files into quarterly files to observe trends**
- New concepts:
 - Libraries:
 - glob and pandas (<https://pypi.org/project/pandas/>)
 - Specifying the location of the data files:



Python Package Index

- Many of the tasks to be performed using a programming language are non unique.
- To make programming more efficient, there exists many pre-written, reusable chunks of codes that allow a programmer to quickly get its code up and working.
- These pre-written, reusable chunks of codes are known as modules (e.g. single functionality) or library (e.g., collection of functionalities)
- <https://pypi.org/> : is a repository of such codes for the Python Programming Language
 - E.g. send2trash, pillow, pandas, numpy 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 staff using company issued laptop with no Admin rights

- Open command prompt

`pip install --user <package_name>`

↑
Double-dash



Alternative

- If command prompt is inaccessible, we can try to install the packages programmatically
- Example below shows package installation via Python code

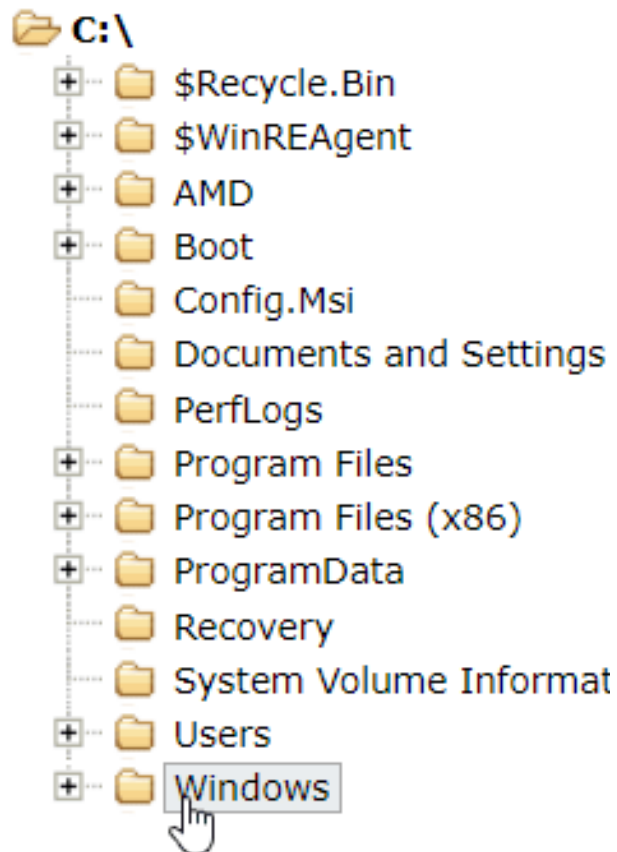
```
import subprocess
import sys

subprocess.check_call([sys.executable, "-m", "pip", "install", "openpyxl"])
subprocess.check_call([sys.executable, "-m", "pip", "install", "pillow"])
```

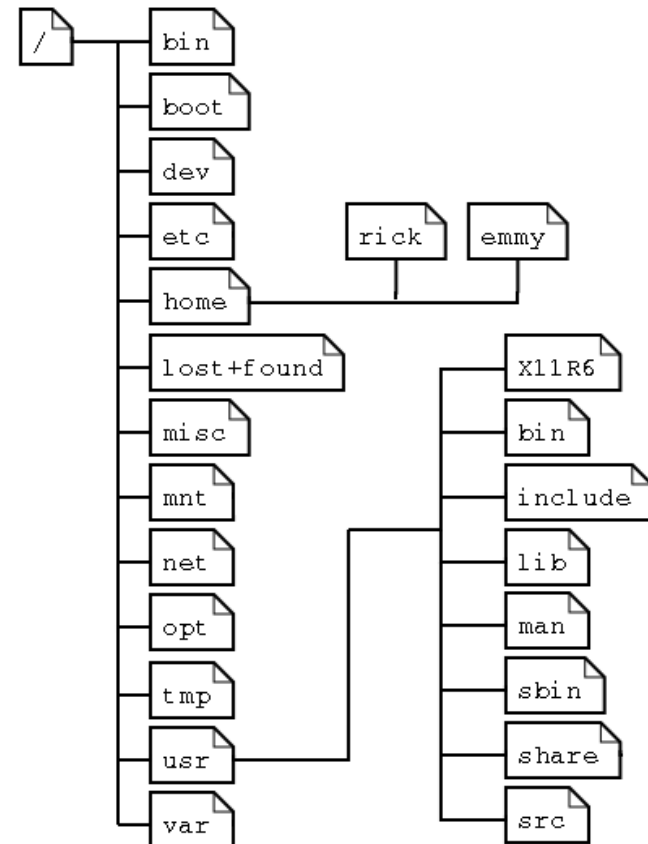


File Tree

- **Windows**



- **Linux**

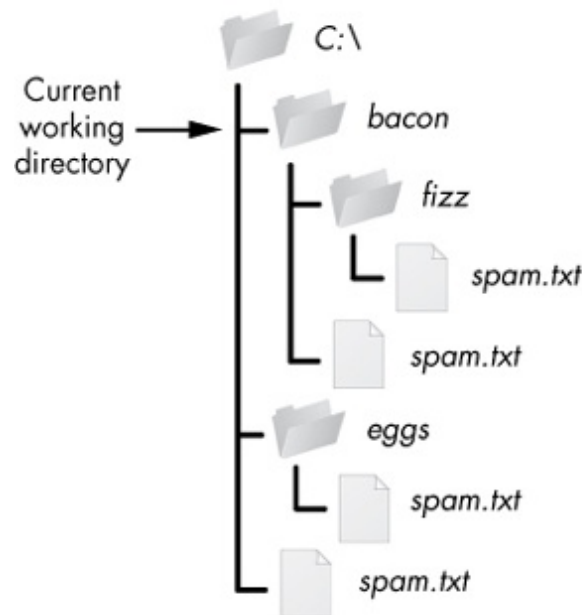




File Paths

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

A relative file path is interpreted from the perspective your current working directory.



Relative Paths	Absolute Paths
<code>..\</code>	<code>C:\</code>
<code>.\</code>	<code>C:\bacon</code>
<code>.\fizz</code>	<code>C:\bacon\fizz</code>
<code>.\fizz\spam.txt</code>	<code>C:\bacon\fizz\spam.txt</code>
<code>.\spam.txt</code>	<code>C:\bacon\spam.txt</code>
<code>..\eggs</code>	<code>C:\eggs</code>
<code>..\eggs\spam.txt</code>	<code>C:\eggs\spam.txt</code>
<code>..\spam.txt</code>	<code>C:\spam.txt</code>

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

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



Excel: Task 1 (Code)

#1. Import the necessary libraries

```
import glob #search files that matches required patterns
import pandas as pd #analyze data
```

2. Define path to the csv data files

```
path = './Data/'
```

3. Create a list using glob to store file names starting with
Product1 and ending with .csv

```
fileList = glob.glob(path + "Product1*.csv")
print (fileList)
```

4. Create empty list to store the csv file as pandas dataframes

```
dfList = []
```

Data
Excel_task1.py
Excel_task2.py
Excel_task3.py
Excel_task4.py

Product1_01_data.csv
Product1_02_data.csv
Product1_03_data.csv



Excel: Task 1 (Code)

```
# 5. Cycle through the files
for file in fileList:

    #read the file and convert to pandas dataframe
    data = pd.read_csv(file, encoding='utf-8')

    #append to the list of dataframes
    dfList.append(data)

# merge the data in the csvList into a single pandas dataframe
csvMerged = pd.concat(dfList)

# 6. Output the pandas dataframes as csv
csvMerged.to_csv(path+ './Output/Product1_Q1_data.csv', index=False)
```



Excel: Task 2

- **Clean data to remove duplicates or empty lines**
- New concepts:
 - Reading the documentations to identify useful functions
- Useful Pandas functions:
 - **dropna()** to remove rows that are empty
 - <https://pandas.pydata.org/docs/reference/api/pandas.DataFrame.dropna.html#pandas.DataFrame.dropna>
 - **drop_duplicates()** to remove rows that are exactly the same
 - https://pandas.pydata.org/docs/reference/api/pandas.DataFrame.drop_duplicates.html



Excel: Task 2 (Code)

```
# 5. Cycle through the files
for file in fileList:

    #read the file and convert to pandas dataframe
    data = pd.read_csv(file, encoding='utf-8')

    #Task 2: remove empty lines
    data.dropna(axis = 0, how='all', inplace=True)

    #Task 2: remove duplicates entries based on names
    data.drop_duplicates(inplace=True)
    |
    #append to the list of dataframes
    dfList.append(data)

# merge the data in the csvList into a single pandas dataframe
csvMerged = pd.concat(dfList)
```



Excel: Task 3

- **Perform mathematical calculations and create new columns to store the calculated information.**
- New concepts:
 - Specifying the required columns
 - Stripping the data of special characters
 - Converting the data type of the columns
 - Performing simple mathematical functions on column values
 - Creating a new column to store the values of the calculations



Excel: Task 3 (Code)

#Task 3: Calculate Total Commission

```
data['Revenue'] = data['Revenue'].str.replace('$', '', regex=True)
```

```
data['Revenue'] = data['Revenue'].astype(float)
```

```
data['Commission Rate'] = data['Commission Rate'].str.replace('%', '', regex=True)
```

```
data['Commission Rate'] = data['Commission Rate'].astype(float)
```

```
|
```

#Create a new column and perform the mathematical calculations

```
data['Total Commission'] = data['Revenue']*(data['Commission Rate']/100)
```




Excel: Task 4

- **Task 4: Glean some simple insights.**
 - Total sales of a product
 - Single largest customer order
 - Highest performing Sales rep of a product
- New concepts:
 - Extract values based on conditions
 - Group data by conditions



Excel: Task 4 (Code)

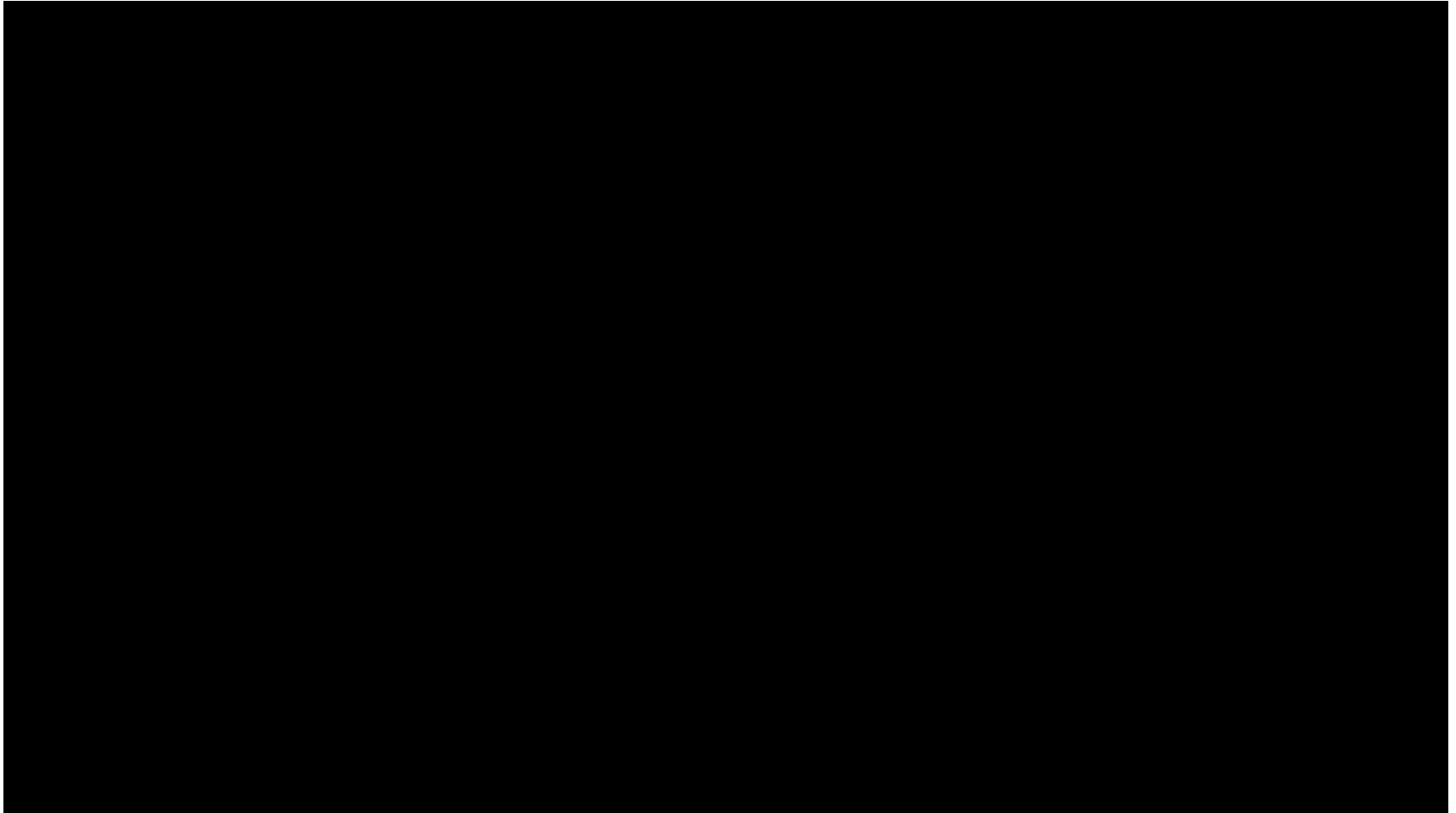
```
#-----  
#Task 4: Generating insights  
#-----  
  
# Total sales of a product in the quarter  
totalSales=sum(csvMerged['Revenue'])  
print ("Total sales of product 1 in this quarter is {:.2f} \n".format(totalSales))  
  
# What is the single largest customer order?  
largestOrder = csvMerged['Revenue'].max()  
customer = csvMerged[csvMerged['Revenue']==largestOrder]['Customer Name'].to_string(index=False)  
salesRep = csvMerged[csvMerged['Revenue']==largestOrder]['Sales Rep Name'].to_string(index=False)  
print("Customer with singles largest order is {} by {} served by {}".format(largestOrder, customer, salesRep))  
  
#Which sales rep brought in the highest revenue  
salesByRep = csvMerged.groupby("Sales Rep Name")['Revenue'].sum()  
salesByRepByProportion = salesByRep/totalSales  
print(salesByRepByProportion)
```

Summary

Lunch Break



What is Python?



Web Automation with Python



Connecting to the Web

- requests – download files and web pages from the Web

pip install requests

```
import requests
```

Get the required information from the given URL

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





Connecting to the Web

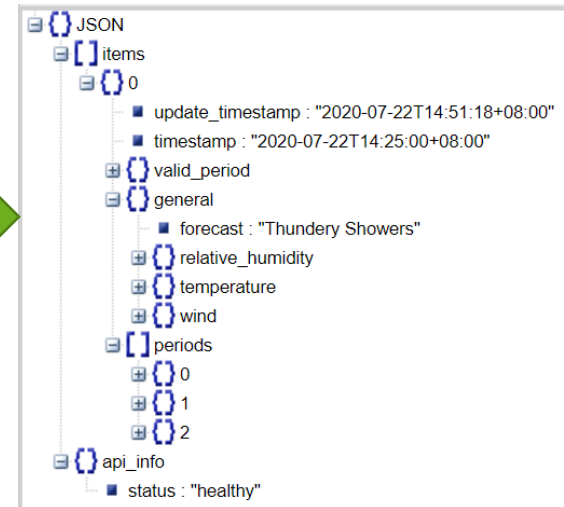
- Data is in JSON format
- Use a JSON formatter tool to present the data in a nicer form

<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": "2020-07-22T14:25:00+08:00",
        "end": "2020-07-23T12:00:00+08:00"
      },
      "general": {
        "forecast": "Thundery 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",
          "forecast": {
            "west": "Moderate Rain",
            "east": "Moderate Rain",
            "central": "Light Rain",
            "north": "Light Rain"
          }
        },
        {
          "start": "2020-07-22T18:00:00+08:00",
          "end": "2020-07-23T06:00:00+08:00",
          "forecast": {
            "west": "Partly Cloudy (Night)",
            "east": "Partly Cloudy (Night)",
            "central": "Partly Cloudy (Night)",
            "north": "Partly Cloudy (Night)"
          }
        },
        {
          "start": "2020-07-23T06:00:00+08:00",
          "end": "2020-07-23T12:00:00+08:00",
          "forecast": {
            "west": "Partly Cloudy (Night)",
            "east": "Partly Cloudy (Night)",
            "central": "Partly Cloudy (Night)",
            "north": "Partly Cloudy (Night)"
          }
        }
      ]
    }
  ]
}
```





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
```



FIX_ME exercise

Get weather info

- Get the weather information for “Ang Mo Kio”
- Produce the output as below

```
name : Ang Mo Kio, forecast : Cloudy
```

- Try to fix it, could you?



Exercise

- **Car Park Availability Data:**

- 1.url: <https://api.data.gov.sg/v1/transport/carpark-availability>
2. Write the code to get the timestamp and the Carpark Number for the first set of carpark data.
3. Print out the result as shown.

```
{
  - items: [
    - {
      timestamp: "2021-08-19T13:23:28+08:00",
      - carpark_data: [
        - {
          - carpark_info: [
            - {
              total_lots: "105",
              lot_type: "C",
              lots_available: "0"
            }
          ],
          carpark_number: "HE12",
          update_datetime: "2021-08-19T13:10:03"
        },
        - {
          - carpark_info: [
            - {
```

Update time: 2021-08-19T11:49:27+08:00
Carpark number: HE12

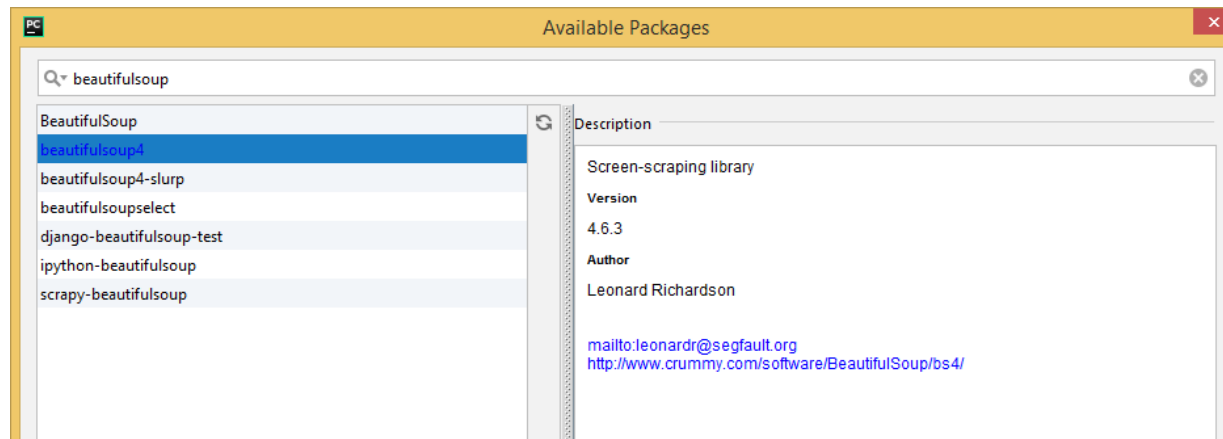


Connecting to the Web

- 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)

FORTYTWO

Search furniture, mattress, home & decor...



New Furniture Bedding & Mattresses Décor | Essentials Kitchen | Dining Lightings | Fans Sale

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



Landon Regular Dining Table
Coffee

★★★★★ 6 customer reviews

~~S\$129.90~~
S\$69.90

Warranty: 1 Year

Qty: 1

Add to Cart



Add to Wishlist



Email to a Friend



100 Day Free
Returns



Standard
Delivery

42EXPR



Free Assembly
Included

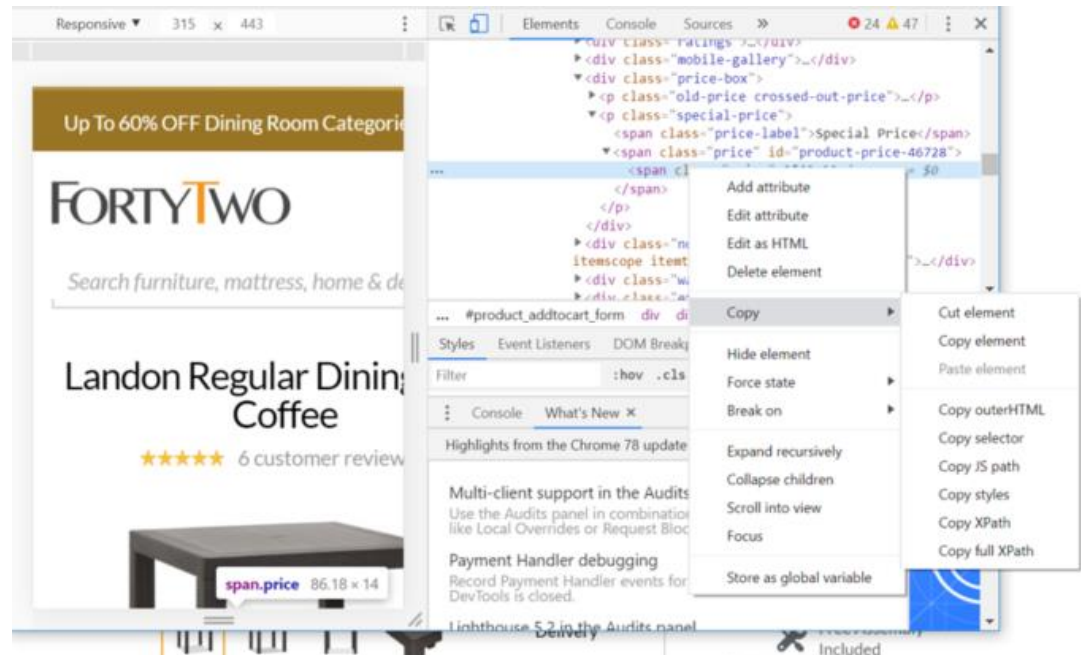


Connecting to the Web

- Get the url

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

- Select the element to extract
 - right-click -> "Inspect"
 - hover to "Copy"
 - click on "Copy selector"





Connecting to the Web

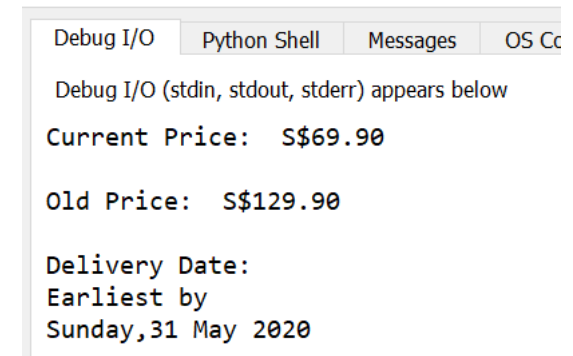
```
from urllib.request import Request, urlopen
from bs4 import BeautifulSoup
```

```
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)
```

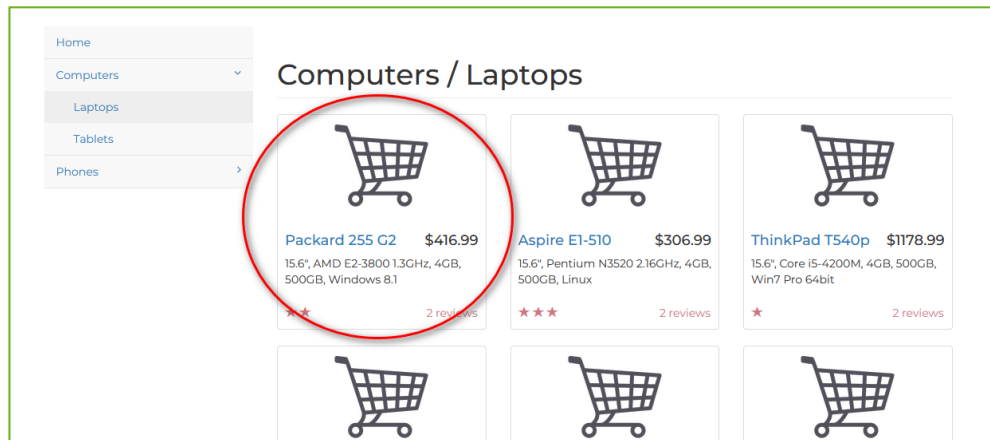




FIX_ME exercise

Getting item information

- Extract the item name and price, and produce the output below:



Item: Packard 255 G2
Price: \$416.99

- Try to fix it, could you?



Exercise

- **Table Tennis Bat Price:**

- 1.url: https://www.tabletennis11.com/other_eng/butterfly-viscaria
2. Write the code to get the price of the table tennis bat
3. Print out the result as shown.

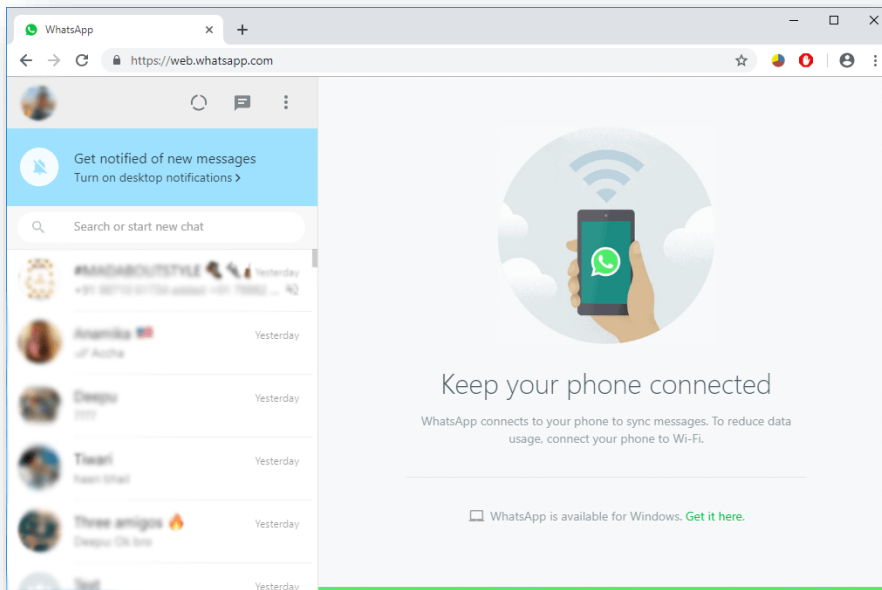


Current Price:
€133.25



Sharing other Use Cases

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



selenium python automation

Name

Your answer

Gender

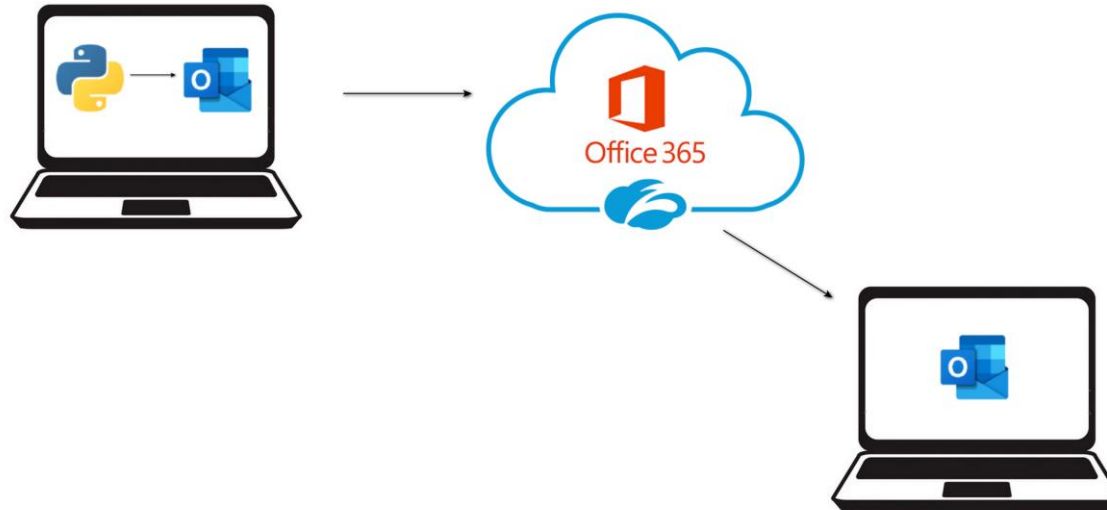
☐ Male

☐ Female

Email Automation with Python



pywin32 package



- This assumes that we are using MS Outlook on the machine the python code is run
- pywin32 package is used to allow Python to access MS Outlook
- Python is not accessing the Outlook server directly, but it is using existing account set up in the MS Outlook



Send Email using Outlook

```
import win32com.client

subject = 'email subject'
body = '<html><body>' + 'This is a test email. Oct Python 2021<br />' + '</body></html>'
recipient = 'jason_lim@rp.edu.sg'

#Create and send email
obj = win32com.client.Dispatch("Outlook.Application")
newMail = obj.CreateItem(0)
newMail.Subject = subject
newMail.HTMLBody = body
newMail.To = recipient

newMail.Send()
```

- The code above sends a simple HTML (meaning we can have tables, text formatting in it)
- No credentials are needed for the Python program as Python uses MS Outlook



Create appt using Outlook

```
import win32com.client

outlook = win32com.client.Dispatch("Outlook.Application")
appt = outlook.CreateItem(1)
appt.Start = "2021-10-08 15:30"
appt.Subject = "Meeting 1"
appt.Duration = 60
appt.Location = "Library"
appt.MeetingStatus = 0
appt.display()
appt.Save()
```

- The code above creates a calendar appointment
- No credentials are needed for the Python program as Python uses MS Outlook



Sharing Use Cases

- Sending Emails using Outlook to students
- Create Appointments using Outlook



Other Python Libraries

- Play music using winsound
- Generate QR code using qrcode
- Face detection using opencv





Where to go from here ?



Think Python 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.

Think Python is a Free Book. It is available under the [Creative Commons Attribution-NonCommercial 3.0 Unported License](http://creativecommons.org/licenses/by-nc/3.0/), which means that you are free to copy, distribute, and modify it, as long as you attribute the work and don't use it for commercial purposes.
<http://greenteapress.com/thinkpython/thinkpython.pdf>



Interested to apply Python at work?

Follow the steps below (*Note: You need to download BOTH applications!*):

App Library (Desktop) > ① Search bar: “Python” > “Python310” > “Request Install” &
> ② Search bar: “Wing” > “WingIDE” > “Request Install”



Please log a case with AFM Helpdesk if you face technical difficulties



End of Course Survey

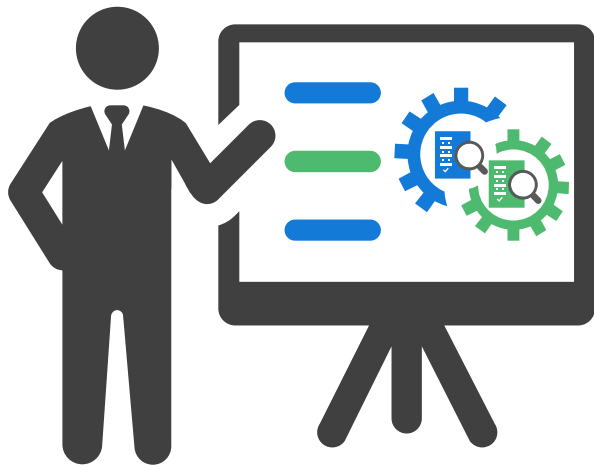


Course Run ID: _____

**Please kindly complete this survey before leaving
the class**



Thank you



Email us at:

Learning material & source code:
<https://bit.ly/IPP-MHA>