



Business Process Automation with VBA and Python

Mr. Eddie Chow / 13 Sept 2025



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Introduction to business process automation

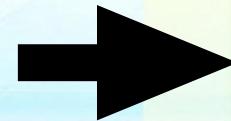
Business Process automation with VBA

Business process automation with Python

Introduction to project management for business process automation

Development and implementation of business process automation

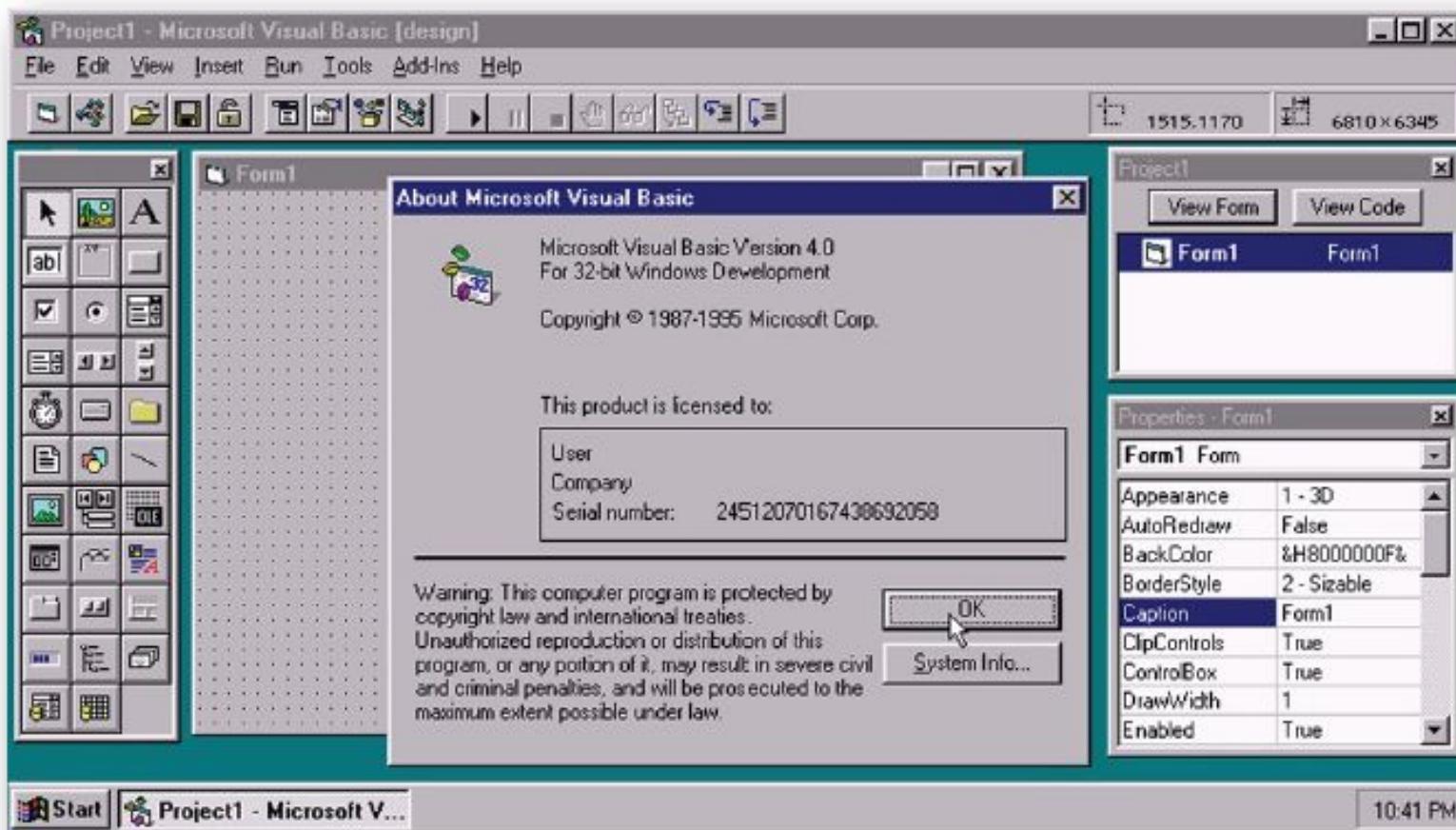
Final Group Presentation



Business Process Automation with VBA

VBA - Visual Basic

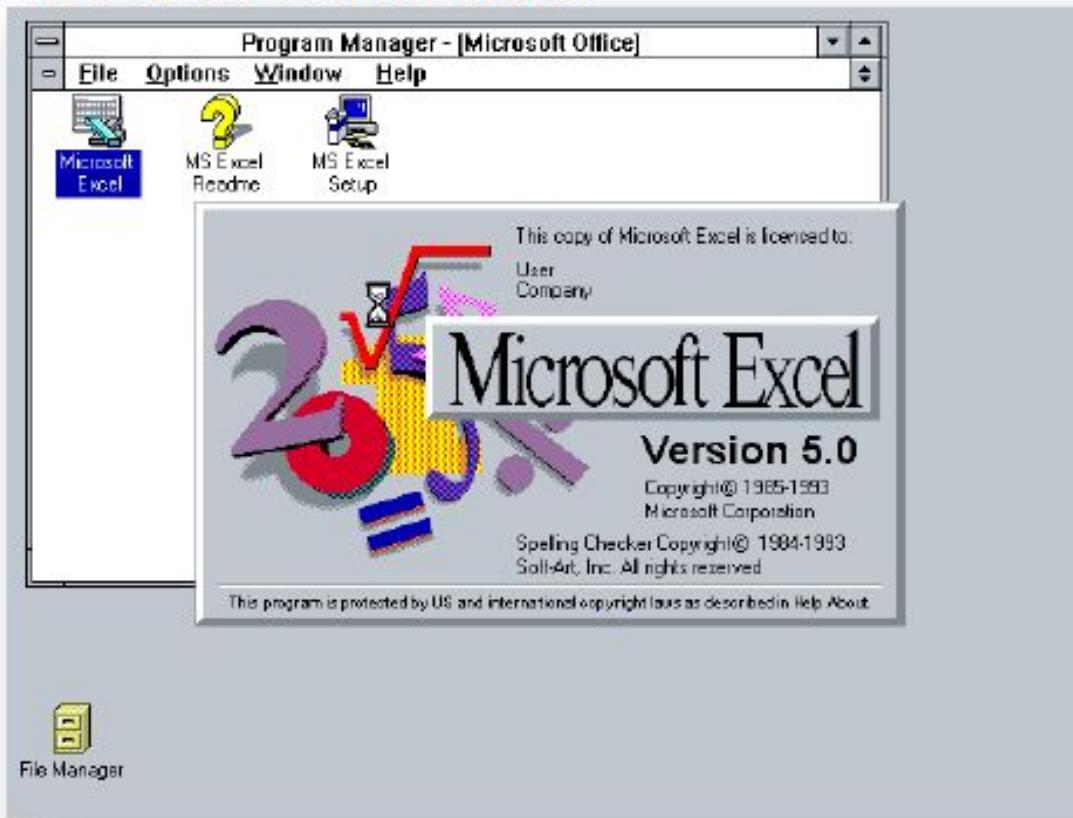
- VB was “The” Microsoft way to write programs



Business Process Automation with VBA

VBA - Visual Basic for Applications

- Introduced to Excel 5.0 in 1993



- Microsoft Excel 5.x. WinWorld. <https://winworldpc.com/product/microsoft-excel/5x>

Business Process Automation with VBA

VBA - Visual Basic for Applications

- Introduced to Excel 5.0 in 1993

The screenshot shows the Microsoft Excel 5.0 interface with the title bar "Microsoft Excel - SAMPLES.XLS". The ribbon tabs include File, Edit, View, Insert, Run, Tools, Window, and Help. The "Run" tab is selected. A toolbar with various icons is visible above the ribbon. The main area displays VBA code:

```
Microsoft Excel - SAMPLES.XLS
File Edit View Insert Run Tools Window Help
Run Start F5 End
Reset Step Into F8 Step Over Shift+F8
Toggle Breakpoint F9 Clear All Breakpoints
----->>>VVISUAL BASIC
To get more information about a keyword, select Microsoft Excel 4.0 help for these procedures
other keyword, select Microsoft Excel 4.0 help for these procedures
are located on the Moving sheet of this workbook.

To ensure explicit declaration of variables, use the "Option Explicit" parameter. This is not necessary, but should be done for clarity and optimum performance.
Option Explicit

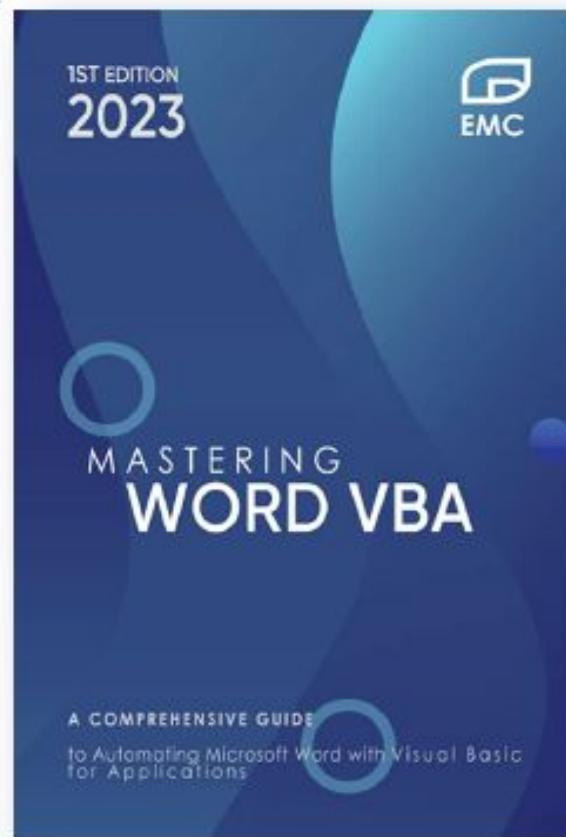
Sub VB_Sort_Database()
    ' Sorts a database or list on the active sheet by values in the first
    ' column, leaving field names in the first row.
    ' Run this macro from any worksheet that contains a list named
    ' Database.
    Range("database").Offset(1, 0).Resize(Range("database").Rows.Count - 1, Range("database").Columns.Count).Select
    Selection.Sort Key1:=ActiveCell, Order1:=xlAscending
End Sub
```

At the bottom, there is a navigation bar with icons for back, forward, contents, and other functions like Worksheet Functions, Application Table, Moving, and VBMoving. Below the navigation bar, the text "Execute macros, set breakpoints, step through code" is displayed.

- Microsoft Excel 5.x. WinWorld. <https://winworldpc.com/product/microsoft-excel/5x>

VBA - Visual Basic for Applications

- Gradually extended to Microsoft Office
- VB classic → ended in 2008
- VB.NET → evolution ended in 2020¹
- VBA → still supported (e.g., M365)



1. Team, N. (2020, March 11). *Visual Basic support planned for .NET 5.0*. Visual Basic Blog.
<https://devblogs.microsoft.com/vbteam/visual-basic-support-planned-for-net-5-0/>

Business Process Automation with VBA

VBA – Why?

- Automation
- User interaction
- Widely used in the industry



1. O. (2022, June 8). Getting started with VBA in Office. Getting Started With VBA in Office | Microsoft Learn.
<https://learn.microsoft.com/en-us/office/vba/library-reference/concepts/getting-started-with-vba-in-office>

Business Process Automation with VBA

VBA - Automation

- Macros → Microsoft's response to automation
- Naming:
 - Micro-instruction vs **Macro**-instruction
 - 1 key to perform series of commands / actions

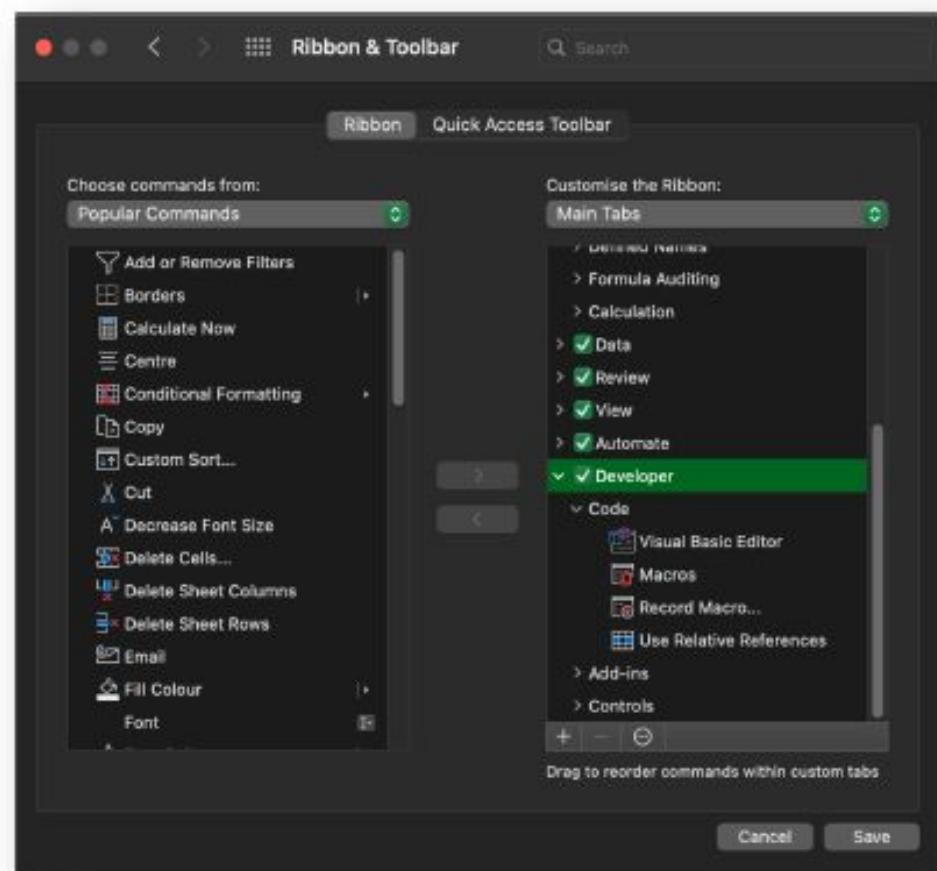


1. Why is Excel VBA called "Macros"? Why Is Excel VBA Called "Macros"? <https://www.excelforum.com/the-water-cooler/791161-why-is-excel-vba-called-macros.html>

Business Process Automation with VBA

Macros – Where?

- “Developer” tab
 - Hidden by default
 - File
 - ➔ Options
 - ➔ Customize Ribbon
 - Turn on “Developer”

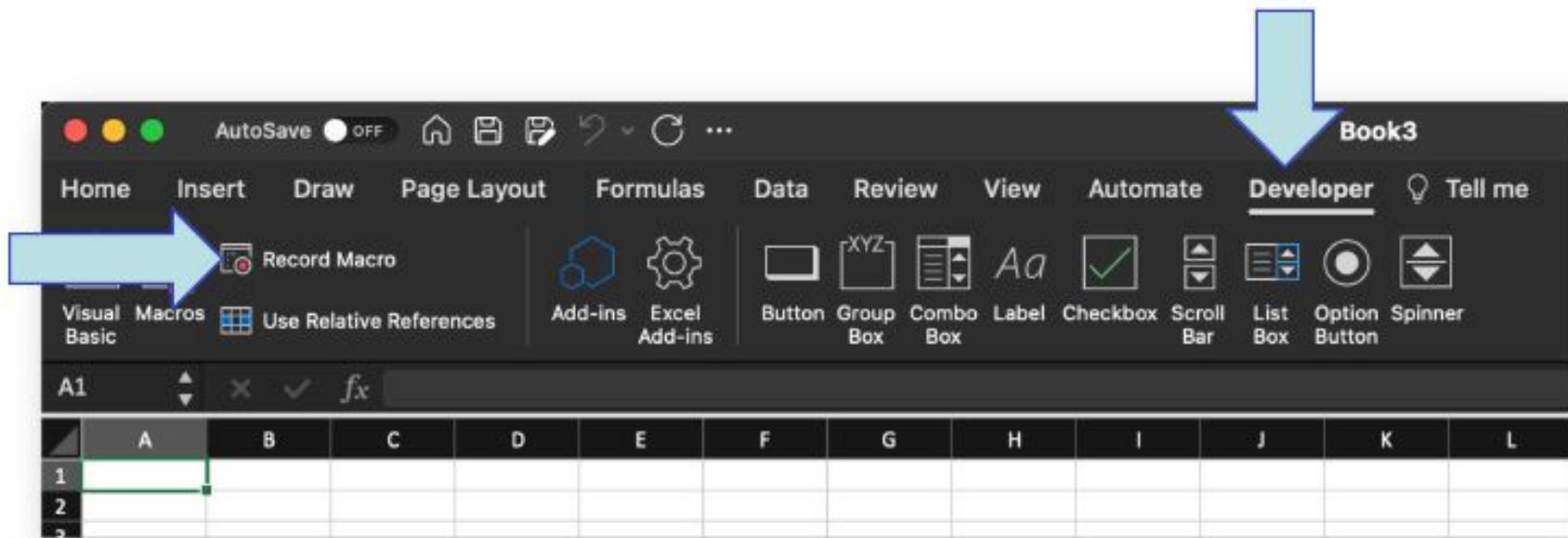


1. Show the Developer tab - Microsoft Support. Show the Developer Tab - Microsoft Support.
<https://support.microsoft.com/en-us/office/show-the-developer-tab-e1192344-5e56-4d45-931b-e5fd9bea2d45>

Business Process Automation with VBA

Practice 1 - Your first macro

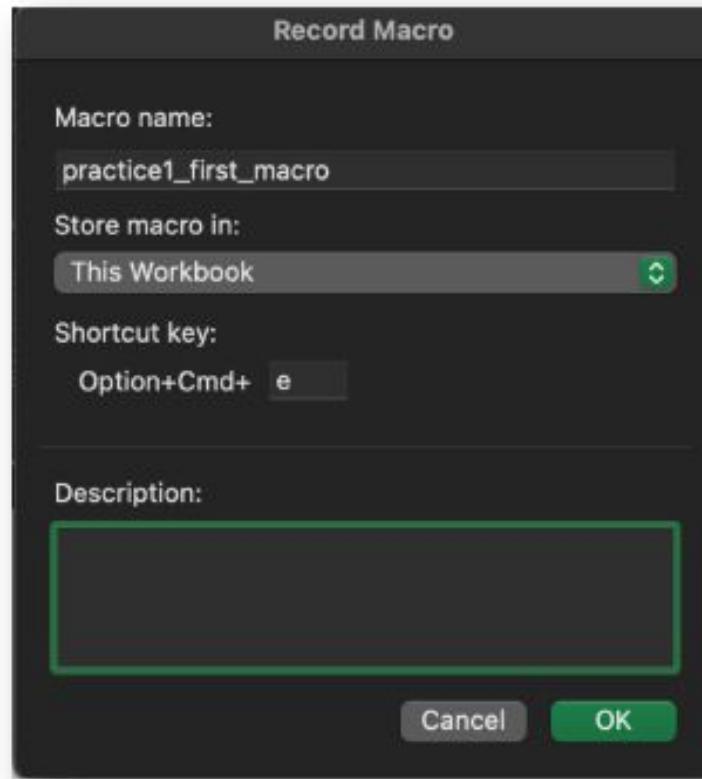
- Click “Record Macro”



Business Process Automation with VBA

Practice 1 - Your first macro

- Type in a name (use “_” instead of spaces)
- Set a shortcut key
- Click OK



Practice 1 - Your first macro

- The recording has started
- Add a new sheet with the “+” at the bottom-left



Business Process Automation with VBA

Practice 1 - Your first macro

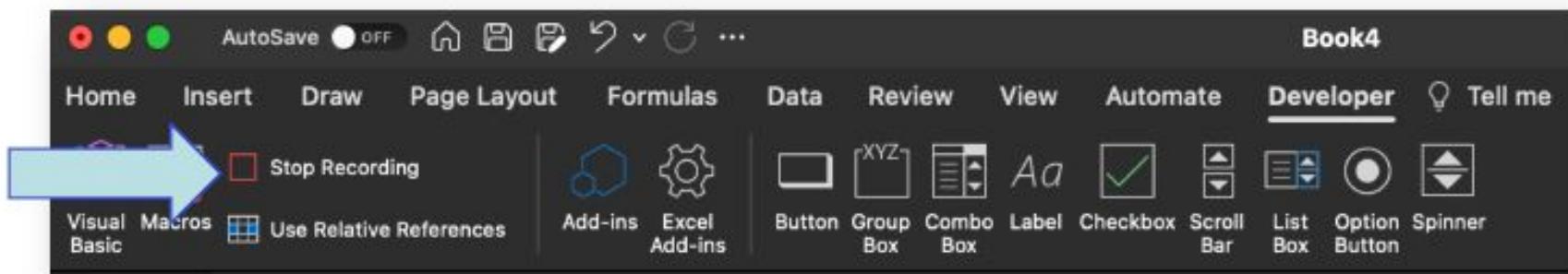
- Go back to “Home” tab
- Select Cells A1 to D1 → Merge
- Enter “Application Form” at the top-left
- Style it: e.g., Font size + Bold + Underline

The screenshot shows the Microsoft Excel ribbon with the "Home" tab selected. The font group on the ribbon shows "Calibri (Body)" and "36". Below the font group are buttons for Bold (B), Italic (I), Underline (U), and other styling options. The text "Application Form" is entered in cell A1 and is merged across cells A1 to D1. The cell A1 has a black background and contains the text "Application Form" in bold, underlined black font. The rest of the cells in the row are white.

Business Process Automation with VBA

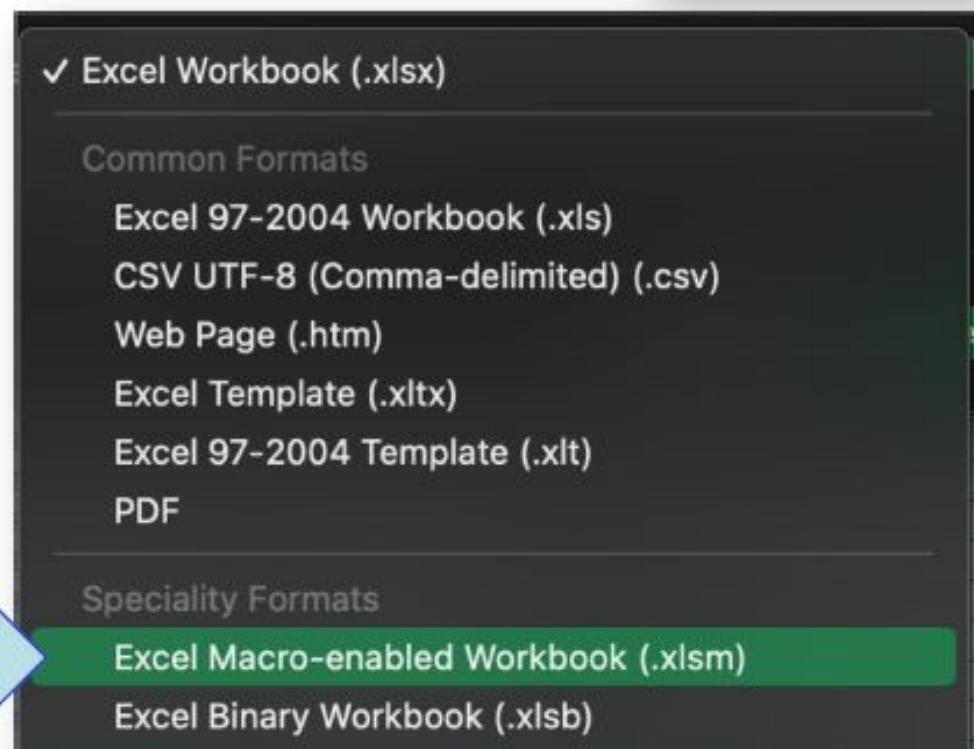
Practice 1 - Your first macro

- Go back to “Developer” tab
- Hit “Stop Recording”



Practice 1 - Your first macro

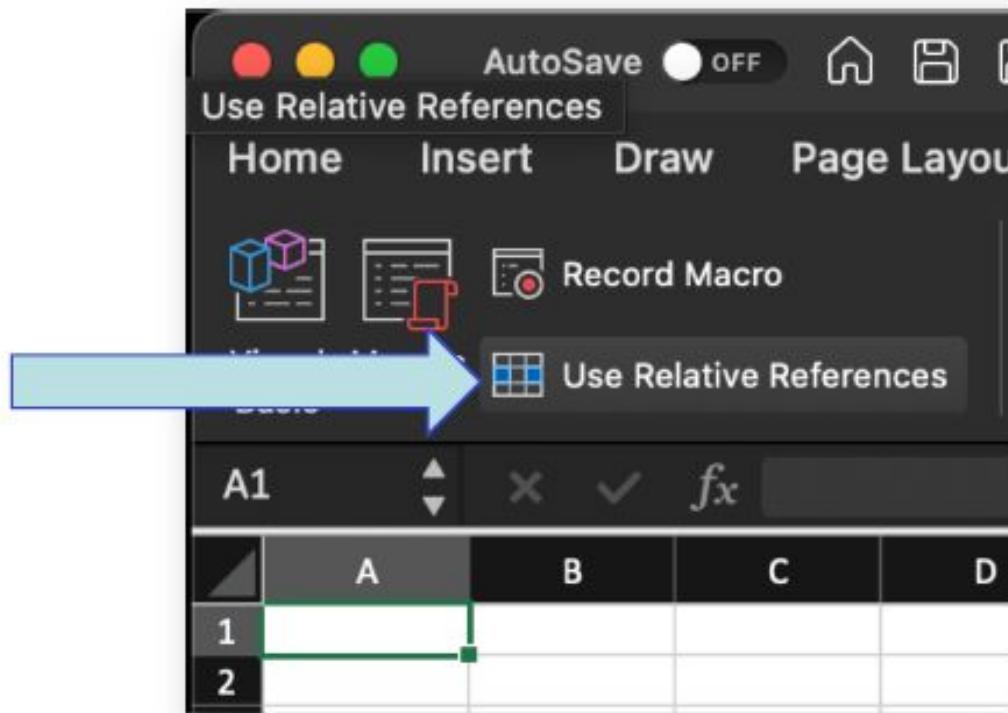
- Save as .xlsm to preserve your macros!



Business Process Automation with VBA

Relative Reference

- Record and execute based on “current selection”
- Click BEFORE “Record Macro”



Business Process Automation with VBA

Practice 2 – Relative References

- Create a new macro to generate below

The image shows two side-by-side screenshots of Microsoft Excel.

Left Screenshot: Record Macro Dialog

- Macro name:** practice2_relative_references
- Store macro in:** This Workbook
- Shortcut key:** Option+Cmd+ r
- Description:** (Empty text area)

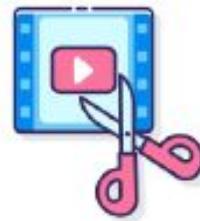
Right Screenshot: Excel Worksheet and Macro Recording Interface

- Macro Recording Tools ribbon:** Shows tabs for Visual Basic, Macros, and Use Relative References (selected).
- Worksheet:** A1:F11 grid with columns labeled A through F and rows labeled 1 through 11.
- Form:** A data entry form located in the bottom right corner of the worksheet area. It contains three text input fields:
 - Name:** _____
 - Phone:** _____
 - Address:** _____

Business Process Automation with VBA

VBA - Why not just use macros?

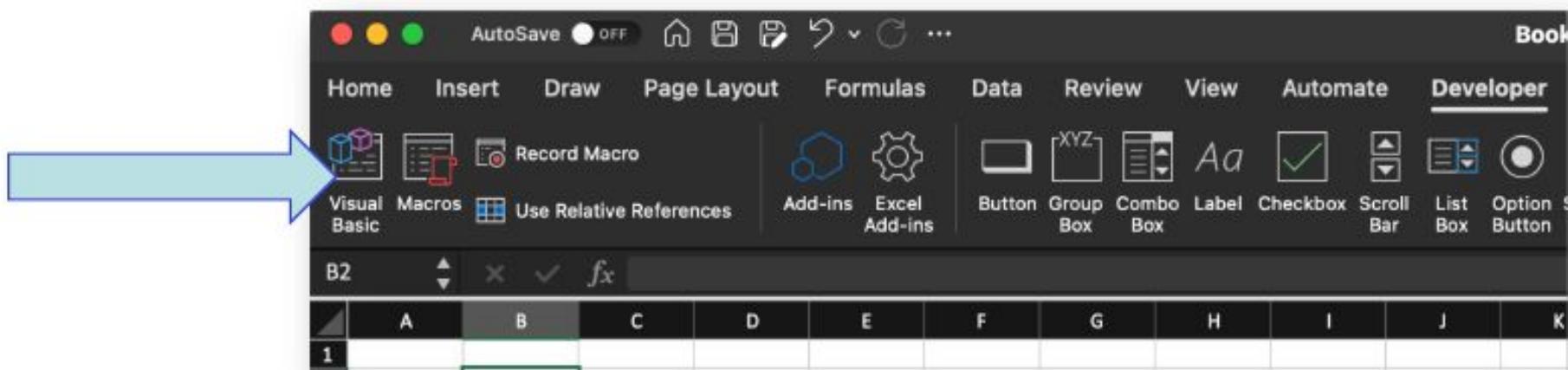
- Macros → great for repetition
- Need → More flexibility and interactivity
- Solution → Dig into the codes



Business Process Automation with VBA

Entering Visual Basic Mode

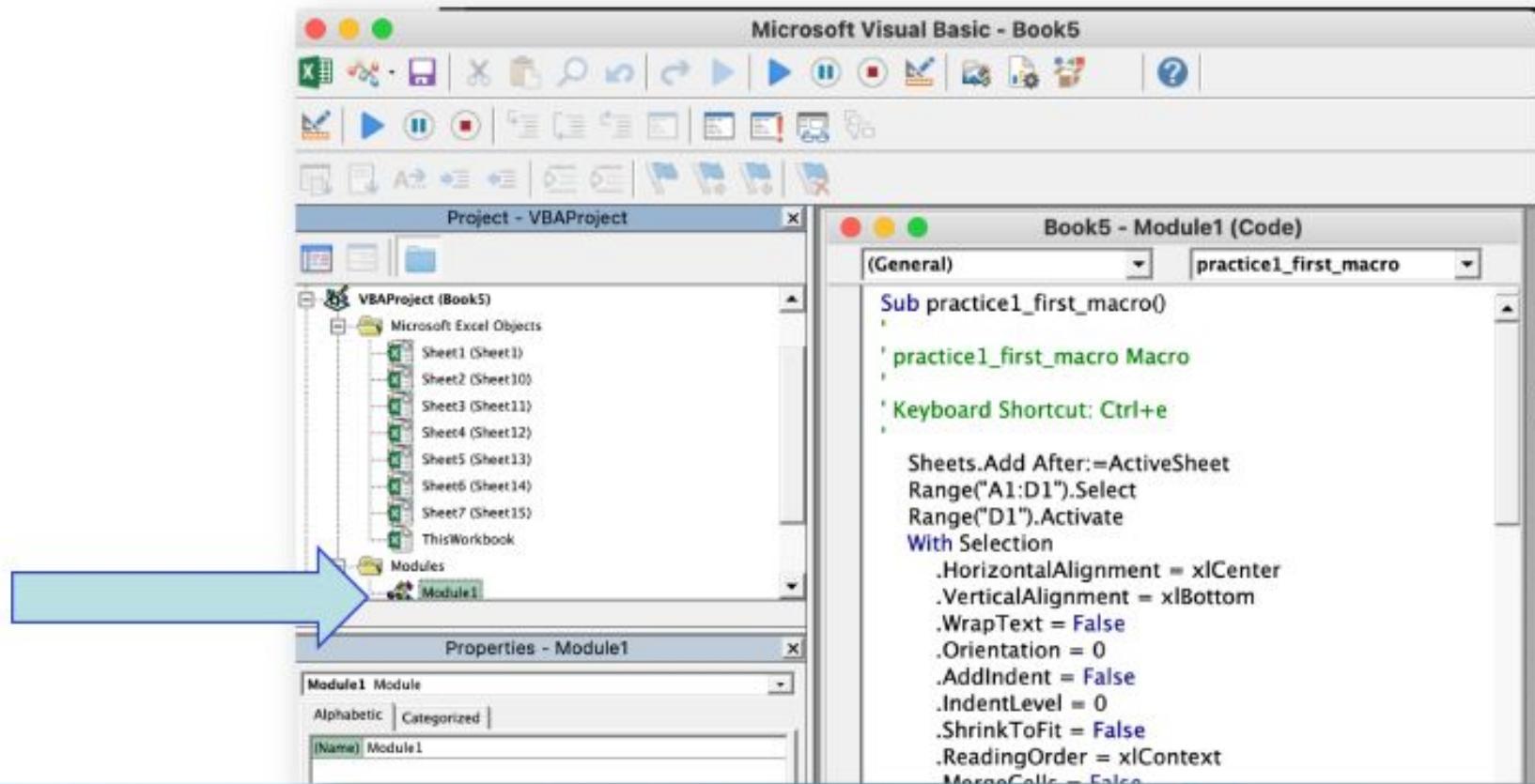
- Developer tab → Visual Basic



Business Process Automation with VBA

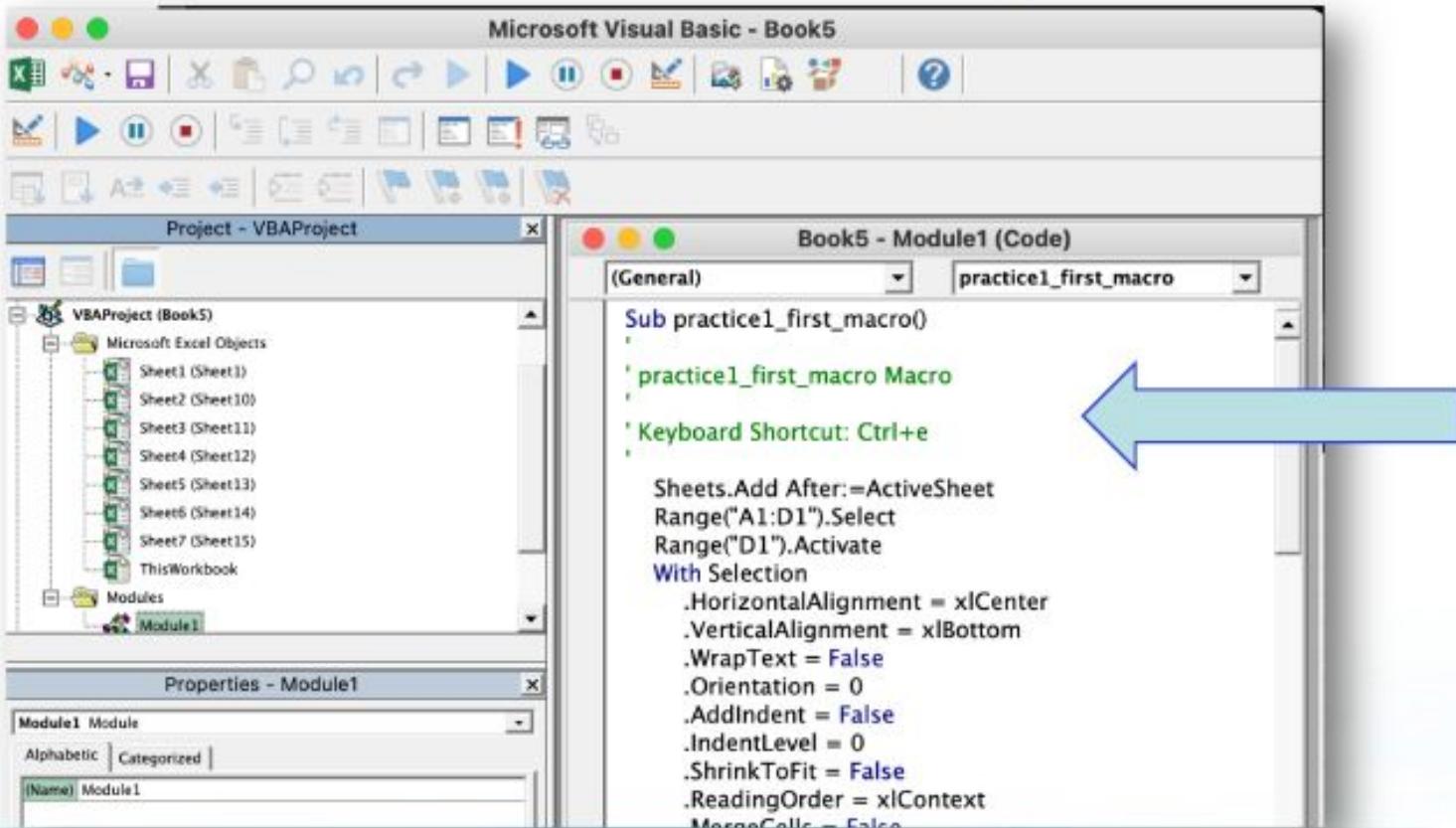
Entering Visual Basic Mode

- Integrated Development Environment (IDE)
- Modules = where codes are usually stored



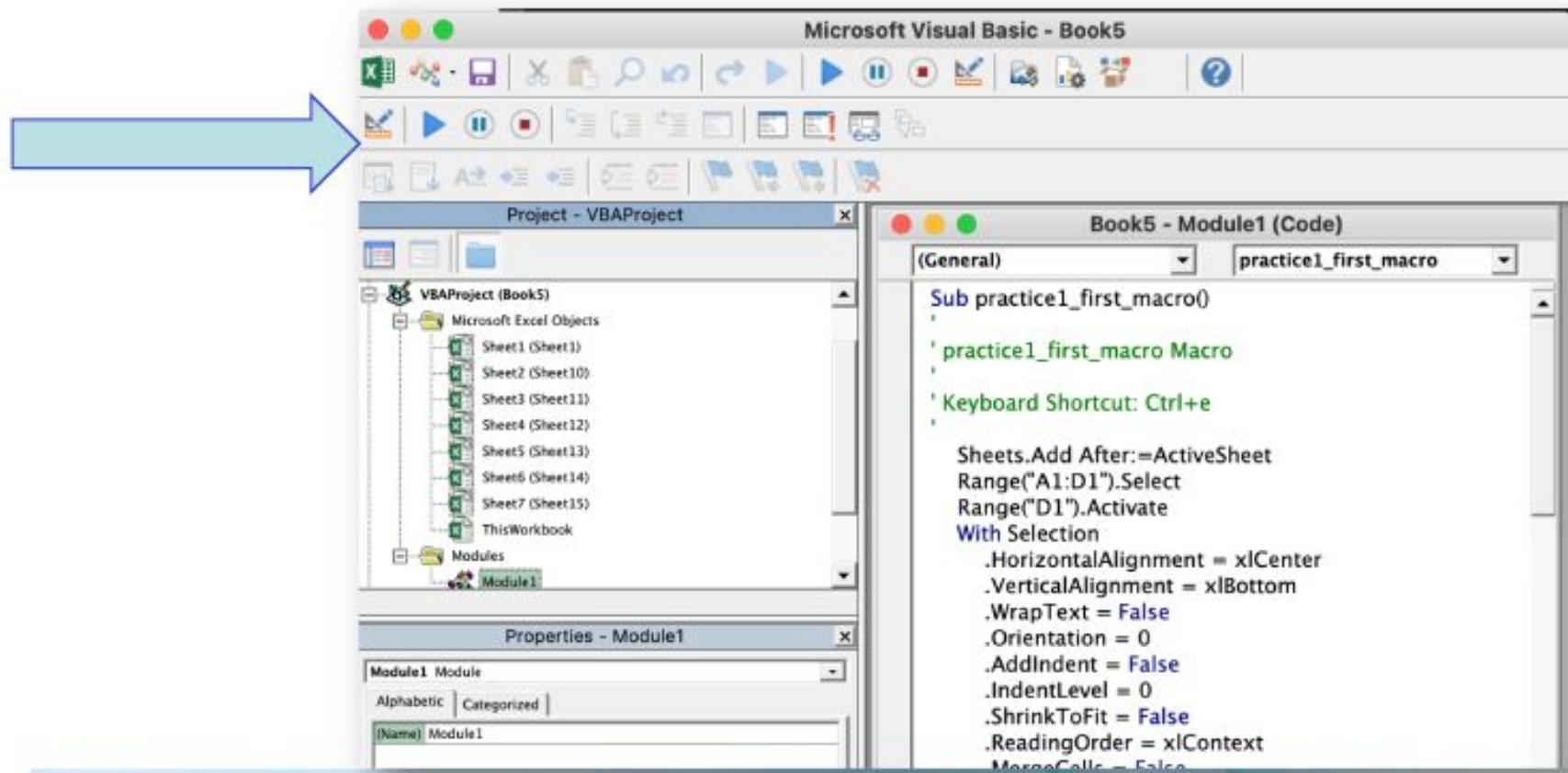
Entering Visual Basic Mode

- Main editor on the right
- Modules → 1 or more “Sub” (sub-routines) or “Function”



Entering Visual Basic Mode

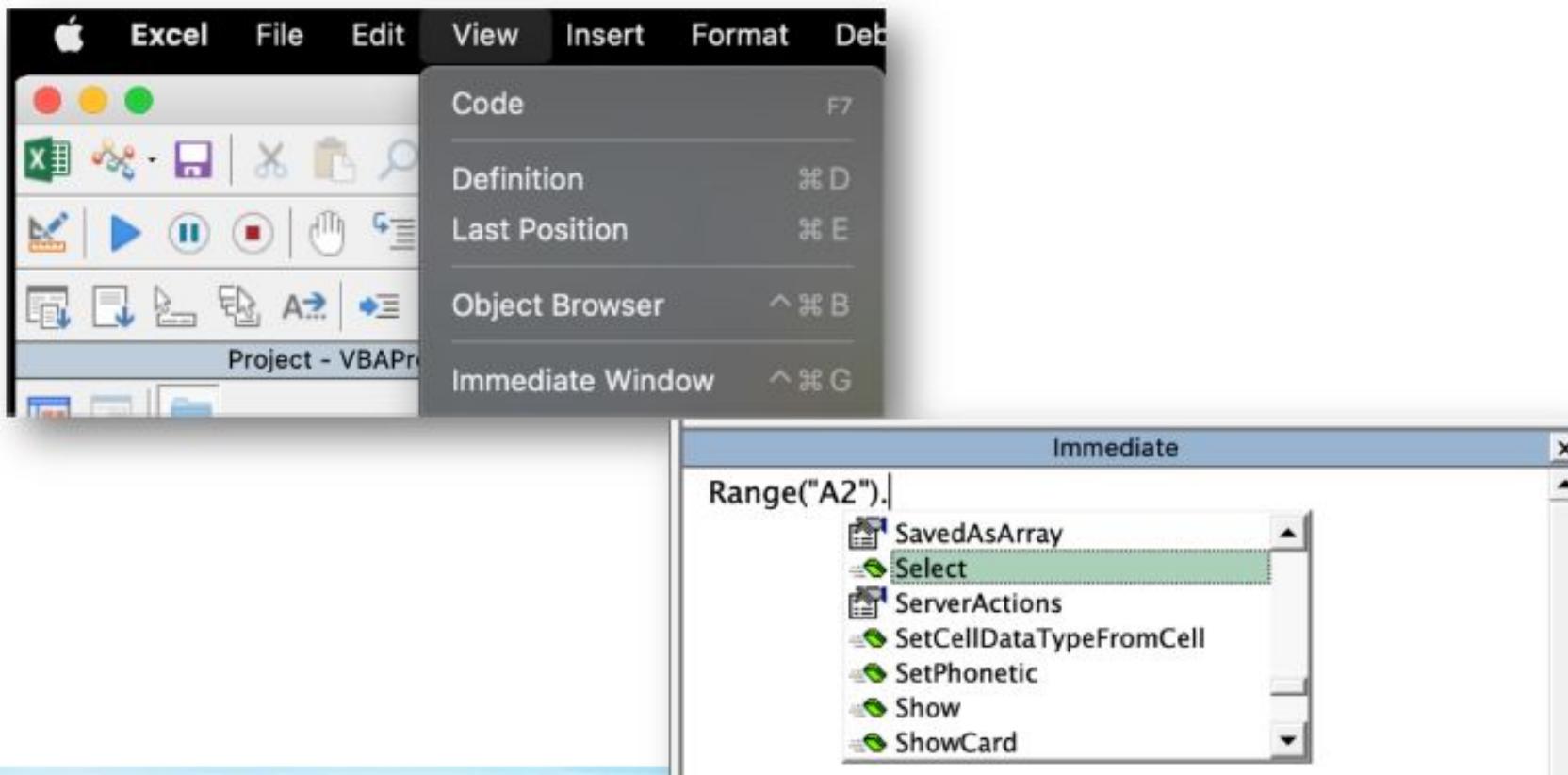
- Debugging toolbar at the top



Business Process Automation with VBA

Immediate Window

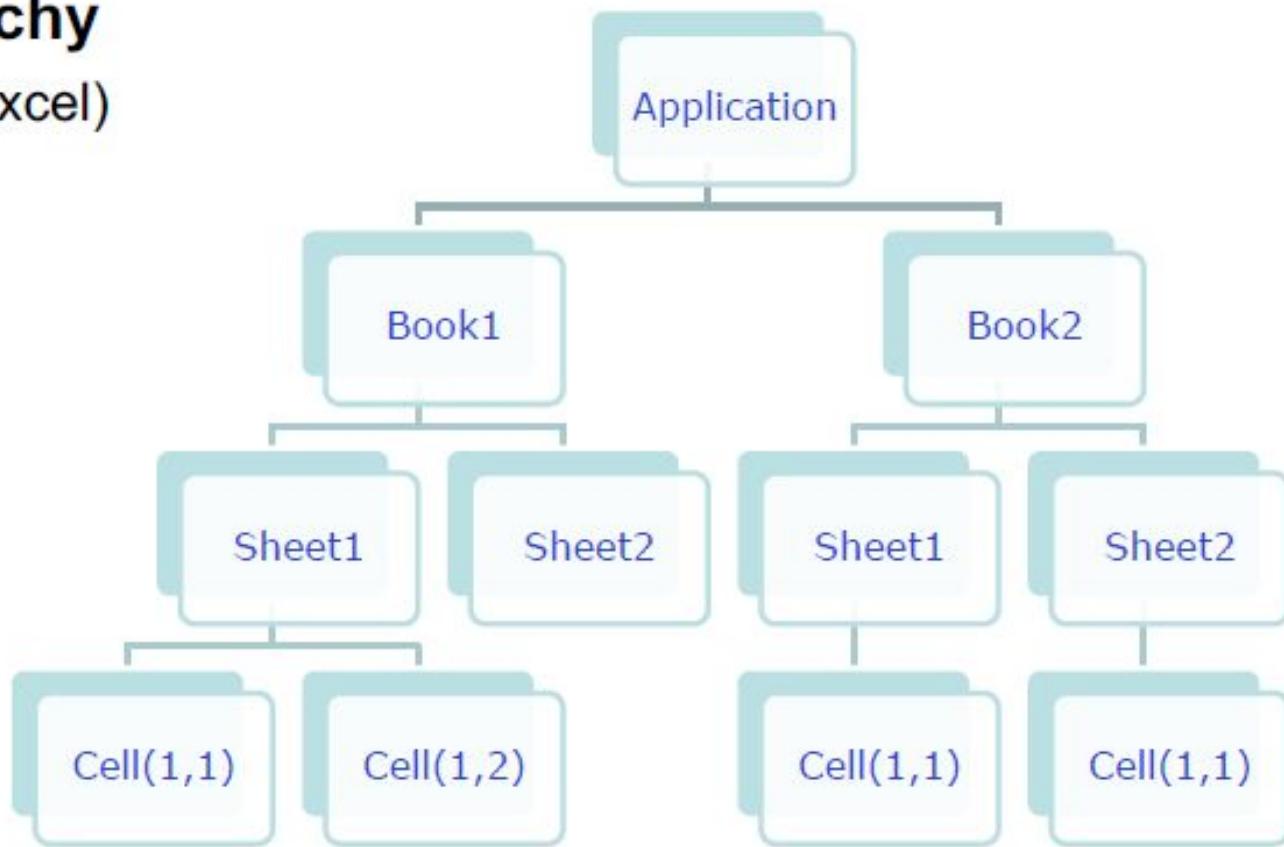
- View → Immediate Window
- Useful for trying out codes (Thanks to Auto-complete)



Business Process Automation with VBA

Object hierarchy

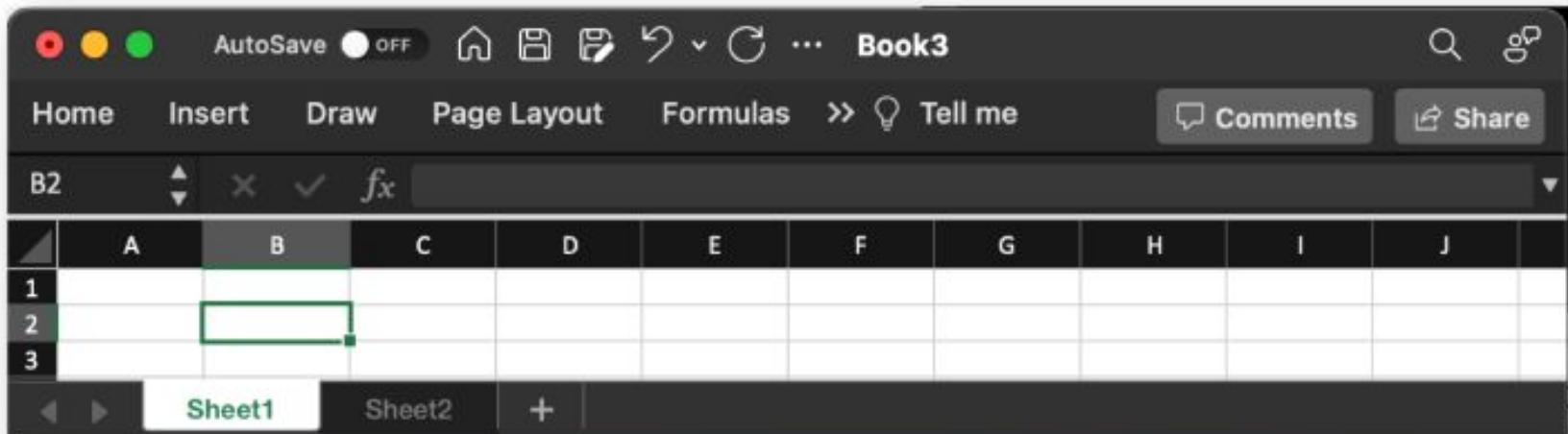
- Application (Excel)
- Workbooks
- Worksheets
- Cells



Business Process Automation with VBA

Object reference – Call something by name

- English: This man / that girl / “Mr. Chan”
- VBA
 - Application → Excel.Application / Outlook.Application / etc
 - Workbooks("Book1")
 - Worksheets("Sheet1") / Worksheets(1)
 - Cells(2,3)
 - Range("B2")



Object reference - Implied naming

- English: Here / Today
- VBA
 - ActiveWorkbook
 - ActiveSheet
 - Selection
 - If you write:
 - Range("A1:D1").Select
 - From that moment onwards:
 - Selection → Same as Range("A1:D1")

* ThisWorkbook

- This = Where the macro is stored
- Active = Changeable by user

Business Process Automation with VBA

Object reference - Offset

- English: Is it that building? No, the one on the right
- VBA
 - Range("B2").Offset(1, 2)
 - Worksheets(ActiveSheet.Index + 1).Select

	A	B	C	D
1				
2		B2		
3	1			
4		2		

Range("B2").Offset(1, 2)



Object reference – Offset

- Region
 - `Selection.CurrentRegion.Select`

B2	A	B	C
1			
2			
3			
4			
5			
6			
7			

- Boundary
 - `Range("A1").End(xlDown).Select`

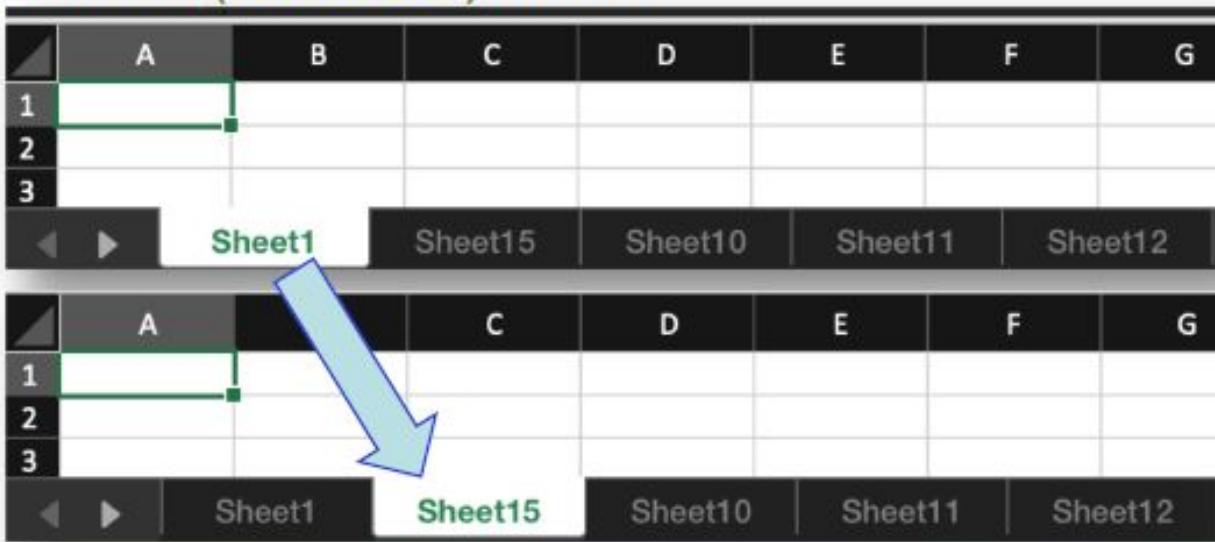
```
?Range("A1").End(xlDown).Row  
6
```

A	1	1
1		2
2		3
3		4
4		5
5		
6		6

Business Process Automation with VBA

Object properties – Actions

- English
 - Jackie runs / That person sings
- VBA (Actions are also known as Methods)
 - ActiveSheet.PrintOut
 - Workbooks("Book5").PrintPreview
 - Worksheets("Sheet15").Select



Business Process Automation with VBA

Object properties – More actions

- VBA – Some methods require parameters



- Copy & Paste
 - Range("B2").Copy Range("B3")
- Export to PDF
 - ActiveSheet.ExportAsFixedFormat Type:=xlTypePDF, Filename:="demo.pdf"

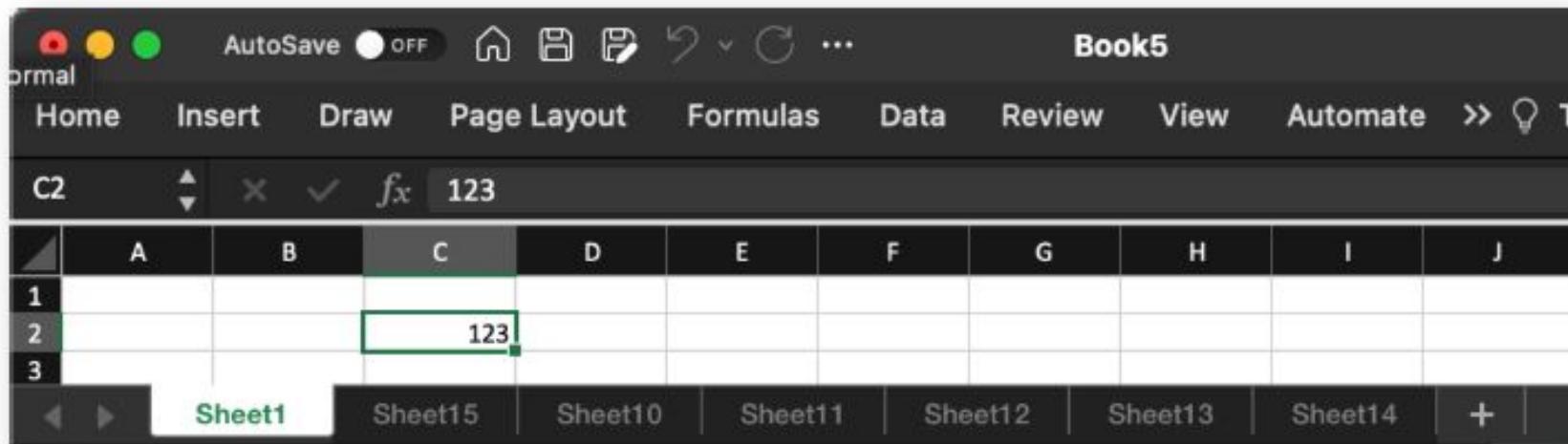
	A	B
1		
2		
3		testing
4		testing

Name	Size	Kind
demo.pdf	13 KB	PDF Document
Book5.xlsm	28 KB	Micros...(xlsm)

Business Process Automation with VBA

Object properties – Value

- English
 - HSBC → Account 123-654321-012 → Value → \$1000
- VBA
 - `Workbooks("Book5").Worksheets("Sheet1").Cells(2,3).Value = 123`



Object properties – Other properties

- VBA
 - Worksheets("Sheet1").Range("B2").Font.Size = 36
 - Worksheets("Sheet1").Range("B2").Font.Color = vbRed

	A	B	C
1			
2			
3		testing	

Object properties – Editing many properties

- “With” statement
 - Reduce redundancy
 - Example from Practice 1

The screenshot shows the Microsoft VBA Editor window titled "Book5.xlsxm - Module1 (Code)". The code editor displays the following VBA code:

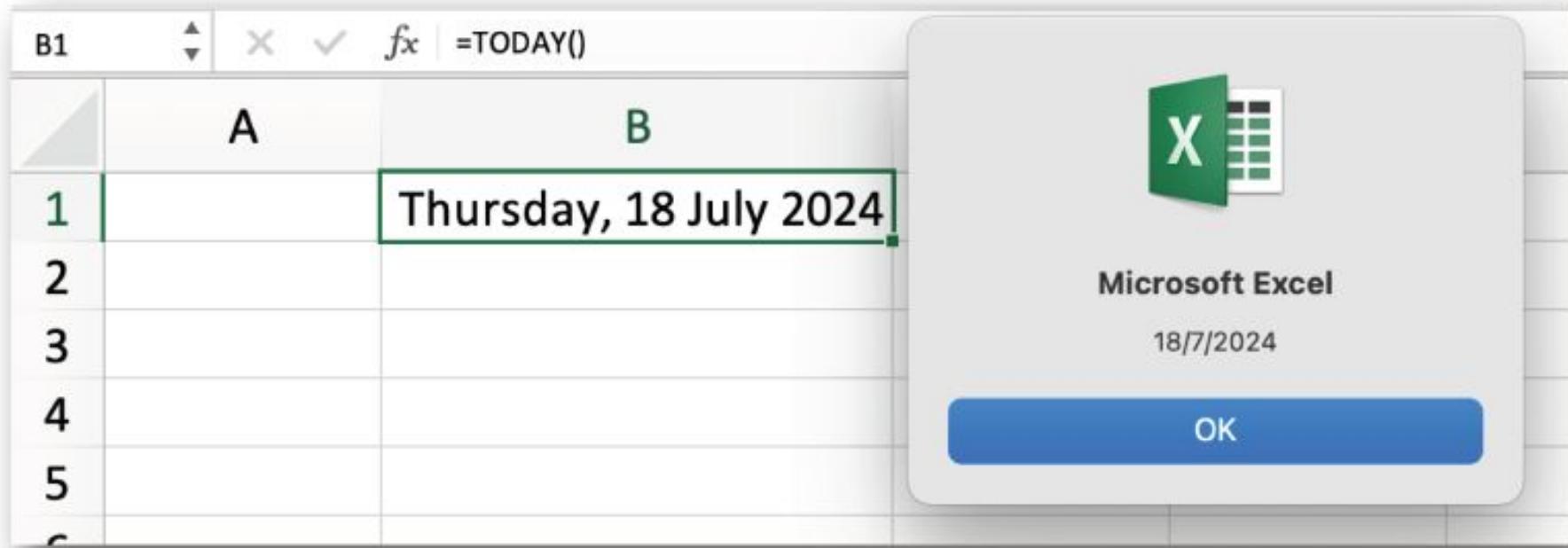
```
ActiveCell.FormulaR1C1 = "Application Form"
Range("A1:D1").Select
With Selection.Font
    .Name = "Calibri"
    .Size = 36
    .Strikethrough = False
    .Superscript = False
    .Subscript = False
    .OutlineFont = False
    .Shadow = False
    .Underline = xlUnderlineStyleNone
    .ThemeColor = xlThemeColorLight1
    .TintAndShade = 0
    .ThemeFont = xlThemeFontMinor
End With
```

The line "With Selection.Font" is highlighted with a blue rectangular selection box.

Business Process Automation with VBA

Object properties – Value check

- Use “MsgBox”
 - `MsgBox(Worksheets("Sheet1").Range("B1").Value)`



Business Process Automation with VBA

Object properties – Value check

- Use “Debug.Print()”

```
Sub HighlightCell()
    If Range("B1").Value > 50 Then
        Range("B1").Interior.Color = vbYellow
    Else
        Range("B1").Interior.Color = vbGreen
    End If
    Debug.Print (Range("B1"))
End Sub
```

40

- Use “?” in the immediate window
 - ?ActiveWorkbook.Sheets.Count
 - ?Range("B2").Formula

Immediate
?ActiveWorkbook.Sheets.Count
7

?Range("B2").Formula
=TODAY()

Business Process Automation with VBA

Checkpoint – Value swapping

- How to swap (switch) values between 2 cells?

The diagram illustrates the process of swapping values between two cells in a table. It consists of two tables separated by a large blue arrow pointing from left to right.

Initial State (Left):

	A	B
1		
2		ABC
3	DEF	

Final State (Right):

	A	B
1		
2		DEF
3	ABC	

Business Process Automation with VBA

Checkpoint – Value swapping

- How to swap (switch) values between 2 cells?
 - 1 solution...

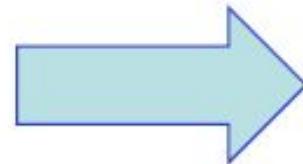
	A	B
1		
2		ABC
3		DEF

	A	B
1		
2		DEF
3		ABC

The diagram shows a table with three rows and two columns. Row 1 has empty cells for both A and B. Row 2 has an empty cell for A and the value 'ABC' in cell B. Row 3 has an empty cell for A and the value 'DEF' in cell B. A large blue arrow points downwards from the original state to this state.

	A	B
1		
2	ABC	ABC
3	DEF	DEF

1) Copy



The diagram shows a table with three rows and two columns. Row 1 has empty cells for both A and B. Row 2 has the value 'ABC' in cell A and the value 'DEF' in cell B. Row 3 has the value 'ABC' in cell A and the value 'ABC' in cell B. A large blue arrow points upwards from the 'Overwrite' state to this state.

	A	B
1		
2	ABC	DEF
3	ABC	ABC

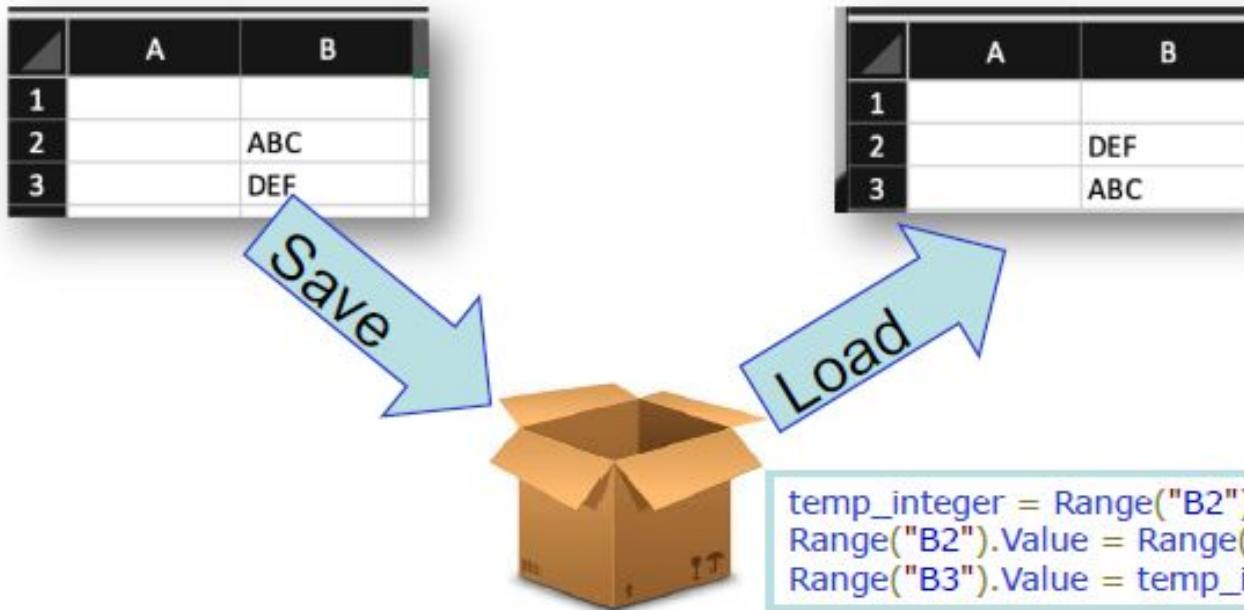
2) Overwrite



3) Clean up

Variables – Motivation

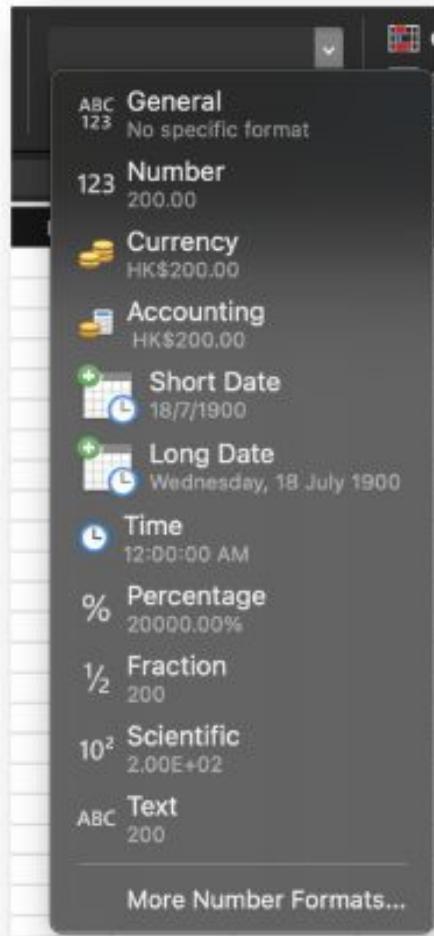
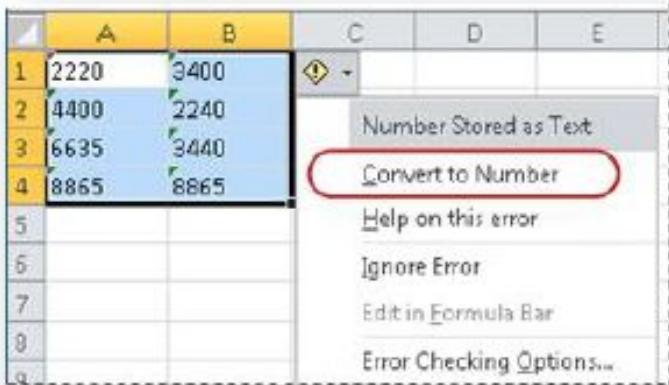
- Storage of values without changing the sheets
- Meaningful references during calculation



Business Process Automation with VBA

Variables – Data Types

- Excel is good at detecting types
 - Numbers / Date / Text
- Though sometimes can still be wrong



1. Fix text-formatted numbers by applying a number format - Microsoft Support. Fix Text-formatted Numbers by Applying a Number Format - Microsoft Support. <https://support.microsoft.com/en-us/office/fix-text-formatted-numbers-by-applying-a-number-format-6599c03a-954d-4d83-b78a-23af2c8845d0>

Variables – Data Types

- Best to define variables with types

Commonly Used VBA Data Types		
Data Type	Bytes Used	Range of Values
Integer	2	-32,768 to 32,767
Long	4	-2.147 Billion to 2.147 Billion
Single	4	45 digits (left or right of decimal point)
Double	8	308 digits (left or right of decimal point)
Currency	8	-922 T to 922 T (4 digits after decimal point)
Date	8	1/1/100 to 12/31/9999
Boolean	2	True or False
String	1 per char	Varies according to number of characters
Variant	Varies	Any data type

Variables – Data Types

- Integer
 - Dim year As Integer
 - year = 2024
- Double
 - Dim pi As Double
 - pi = 3.14125
- Smart conversion during calculation



?TypeName(2)	Integer
?TypeName(3.3)	Double
?TypeName(2 * 3.4)	Double
?TypeName(5-3)	Integer

?TypeName("A" & 3)
String

?"A"&3
A 3

Variables – Data Types

- Date
 - Dim today As Date
 - today = DateSerial(2024, 7, 1)
 - today = Date()
- String
 - Dim message As String
 - message = "Welcome!"
- Boolean
 - Range("A1").Font.Bold = True
 - Range("A1").Font.Underline = False



Common functions - Numbers

- IsNumeric() → Check if a text is number

```
?IsNumeric("123")  
True
```

```
?IsNumeric("ABCD")  
False
```

- CInt() / CDbl() → Text to number

```
?CInt("123")  
123
```

```
?CInt("123.45")  
123
```

```
?CDbl("123.45")  
123.45
```

```
?CDbl("123")  
123
```

Common functions - Numbers

- Round() → Rounding to a certain decimal place

```
?Round(5.1234)  
5
```

```
?Round(5.1234, 2)  
5.12
```

- Log() / Exp() → For financial / engineering calculation

```
?exp(2)  
7.38905609893065
```

```
?log(10)  
2.30258509299405
```

```
?log(exp(1))  
1
```

Common functions - Date

- DateSerial → Create a date literal

```
?DateSerial(2024, 12, 25)  
25/12/2024
```

- Date() → Today's date

```
?Date()  
18/7/2024
```

- Year() / Month() / Day() → Extract

```
?Year(DateSerial(2024, 12, 25))  
2024
```

```
?Month(DateSerial(2024, 12, 25))  
12
```

```
?Day(DateSerial(2024, 12, 25))  
25
```

Business Process Automation with VBA

Common functions - Date

- DateDiff – Difference of 2 dates

The screenshot shows a Microsoft Excel window with the title bar "VBA DateDiff Function Template.xlsxm - Mo [Run Sub/UserForm (F5)]". The formula bar displays "(General) Formula". The code editor contains the following VBA code:

```
Sub DateDiff_Example1()
    Dim Date1 As Date
    Dim Date2 As Date
    Dim Result As Long

    Date1 = "15-01-2018"
    Date2 = "15-01-2019"

    Result = DateDiff("D", Date1, Date2)
    MsgBox Result
End Sub
```

A callout box highlights the `DateDiff("D", Date1, Date2)` line, which is also highlighted with a red rectangle. A tooltip window titled "Microsoft Excel" shows the result "365" with an "OK" button. Below the code editor, two additional examples are shown:

?DateDiff("M", DateSerial(2024, 12, 1), DateSerial(2024, 12, 10))
0

?DateDiff("M", DateSerial(2024, 11, 30), DateSerial(2024, 12, 1))
1

Common functions - String

- **CDate()** → Text to Date

```
?CDate("2023-03-25")  
25/3/2023
```

```
?CDate("April 1, 2023")  
1/4/2023
```

```
?CDate("25/2")  
25/2/2023
```

- **Format()** → Date to Text

```
?Format(DateSerial(2023, 3, 25), "M")  
3
```

```
?Format(DateSerial(2023, 3, 25), "MM")  
03
```

```
?Format(DateSerial(2023, 3, 25), "MMM")  
Mar
```

```
?Format(DateSerial(2023, 3, 25), "MMMM")  
March
```

```
?Format(DateSerial(2023, 3, 25), "DD-MMM-YYYY")  
25-Mar-2023
```

Common functions - String

- Left() / Right() → Substring

```
?Left("0005.HK", 4)  
0005
```

```
?Right("0005.HK", 2)  
HK
```

- Split() → Tokenizing into a string array

```
?Split("A,B,C", ",")(0)  
A
```

```
?Split("A,B,C", ",")(2)  
C
```

```
?UBound(Split("A,B,C", ","))  
2
```

Business Process Automation with VBA

Common functions - String

- Trim() → Remove empty spaces
 - Note: "" gives 1 quote
- InStr(x, y) → Find y in x
 - Case sensitive

```
?"""" & Trim("Hello! ") & """"  
"Hello!"
```

```
?InStr("Search here", "Search")  
1
```

```
?InStr("Search here", "here")  
8
```

```
?InStr("Search here", "nothing")  
0
```

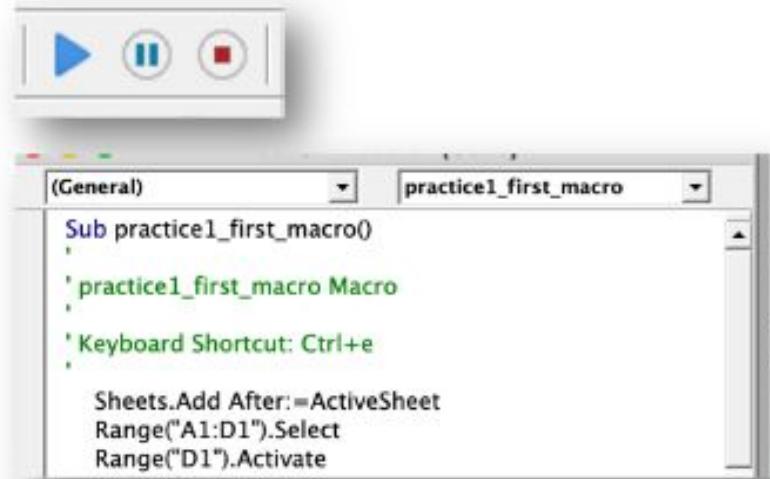
```
?InStr("Search here", "search")  
0
```

```
?Lcase("HeLLo")  
hello
```

```
?InStr(Lcase("Search here"), "search")  
1
```

Sub-routines

- Macros recorded are wrapped with “Sub … End Sub”
- Sub-routines are just reusable codes
- Within the scope of a sub-routine
 - Click the “Play” button to execute



Business Process Automation with VBA

Control flow – If, Then, Else

- Example: speed check

	A	B
1	Speed	40
2		
	A	B
1	Speed	50
2		
	A	B
1	Speed	70
2		

```
Sub HighlightCell()
```

```
    If Range("B1").Value > 50 Then  
        Range("B1").Interior.Color = vbYellow  
    Else  
        Range("B1").Interior.Color = vbGreen  
    End If
```

```
End Sub
```

Control flow – If, Then, Else

- Mark → Grade

<i>Mark</i>	<i>Letter Grade</i>
90+	A+
85-89	A
80-84	A-
77-79	B+
73-76	B
70-72	B-
67-69	C+
63-66	C
60-62	C-
57-59	D+
50-56	D
0-49	F

Control flow – Select, Case

- Range check

```
?GetGrade(90)  
A
```

```
?GetGrade(80)  
B
```

```
Function GetGrade(score As Integer) As String  
    Select Case score  
        Case Is >= 90  
            GetGrade = "A"  
        Case Is >= 80  
            GetGrade = "B"  
        Case Is >= 70  
            GetGrade = "C"  
        Case Is >= 60  
            GetGrade = "D"  
        Case Else  
            GetGrade = "F"  
    End Select  
End Function
```

Control flow – Select, Case

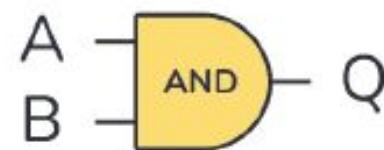
- Grade → Marks

```
Dim letter_grade As String
Dim grade_point As Double

Select Case letter_grade
Case "A", "A+"
    grade_point = 4.0
Case "A-"
    grade_point = 3.7
Case "B+"
    grade_point = 3.3
...
Case Else
    grade_point = 0.0
End Select
```

Control flow – Conditions

- AND
 - (True AND True) → True
 - e.g., Month validity: $1 \leq \text{month} \text{ AND } \text{month} \leq 12$
- OR
 - (True OR False) → True
 - e.g., Game Area: $\text{gold} > 1000 \text{ OR } \text{level} > 10$
- NOT
 - NOT $x=0$ is same as $x \neq 0$



A	B	Q
0	0	0
0	1	0
1	0	0
1	1	1

Loops – Using “For”

- Iterating through the rows
- What is changing?
 - A1 → A2 → A3 → A4...

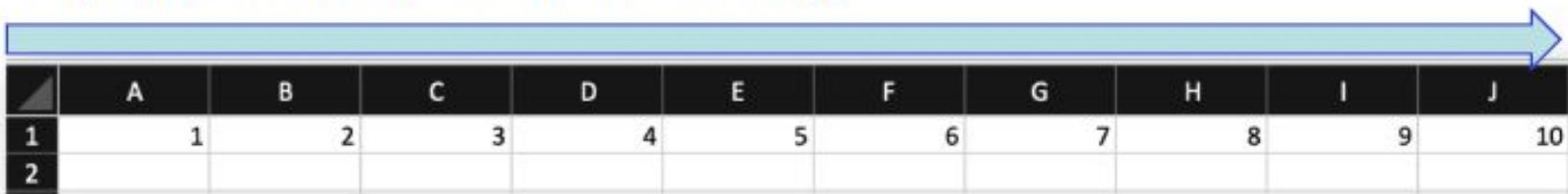


	A	B	C
1	1		
2	2		
3	3		
4	4		
5	5		
6	6		
7	7		
8	8		
9	9		
10	10		

```
Sub LoopThroughRows()
    For i = 1 To 10
        Range("A" & i).Value = i
    Next i
End Sub
```

Loops – Using “For”

- Iterating through the columns
- Again, track the change: A1 → B1 → C1 → ...
- Option 1: Make use of offset()



	A	B	C	D	E	F	G	H	I	J
1	1	2	3	4	5	6	7	8	9	10
2										

```
Sub LoopThroughColumns()
    For i = 1 To 10
        Range("A1").Offset(0, i - 1).Value = i
    Next i
End Sub
```

Business Process Automation with VBA

Loops – What is happening?

- Temporary variable + “Array”

```
Sub LoopThroughRows()
    For i = 1 To 10
        Range("A" & i).Value = i
    Next i
End Sub
```

```
Sub LoopThroughColumnsWithCells()
    Dim i As Integer: i = 1
    For Each cell In Range("A1:J1").Cells
        cell.Value = i
        i = i + 1
    Next cell
End Sub
```

Loops – What is happening?

- Array = many variables

VBA Arrays

The screenshot shows the Microsoft Visual Basic for Applications (VBA) environment. On the left, an Excel spreadsheet window displays a table with columns A and rows 1 to 5. The value '20' in cell A1 is highlighted with a red border. On the right, the VBA editor window has the title 'Microsoft Visual Basic for Applications - VBA Arrays ...'. It contains a code module named 'VBA Arrays Excel Test' with the following code:

```
Sub Array_Example()
    Dim x(1 To 5) As Long, i As Integer
    x(1) = 20
    x(2) = 25
    x(3) = 44
    x(4) = 78
    x(5) = 96
    For i = 1 To 5
        Cells(i, 1).Value = x(i)
    Next i
End Sub
```





Agenda

1. Introduction to Python
2. Python Data Types and Method
3. Preparing Weather Data using Make.com
4. HKO Weather Data Collection - Reading API
5. Introduction of Web Scraping
6. Overview of Web Scraping
7. Scraping Tools and Technologies
8. Scraping Environment Setup
9. Introduction to HTML and CSS
10. Beautiful Soup for Web Scraping

Business Process Automation with Python

Motivation – Scope

- How about outside of Microsoft Office?
- Program trading¹ / Web / AI / Business Intelligence

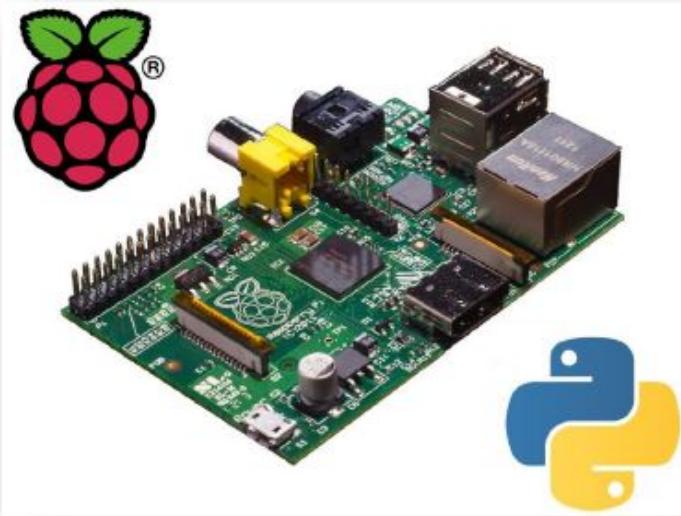


1. Nicholas Pongratz (2021). Sam Bankman Fried Explains His Arbitrage Techniques. Yahoo! Finance. <https://finance.yahoo.com/news/sam-bankman-fried-explains-arbitrage-132901181.html>

Business Process Automation with Python

Motivation – Scope

- How about outside of Microsoft Office?
- e.g., Drones / Security cameras / Firewalls

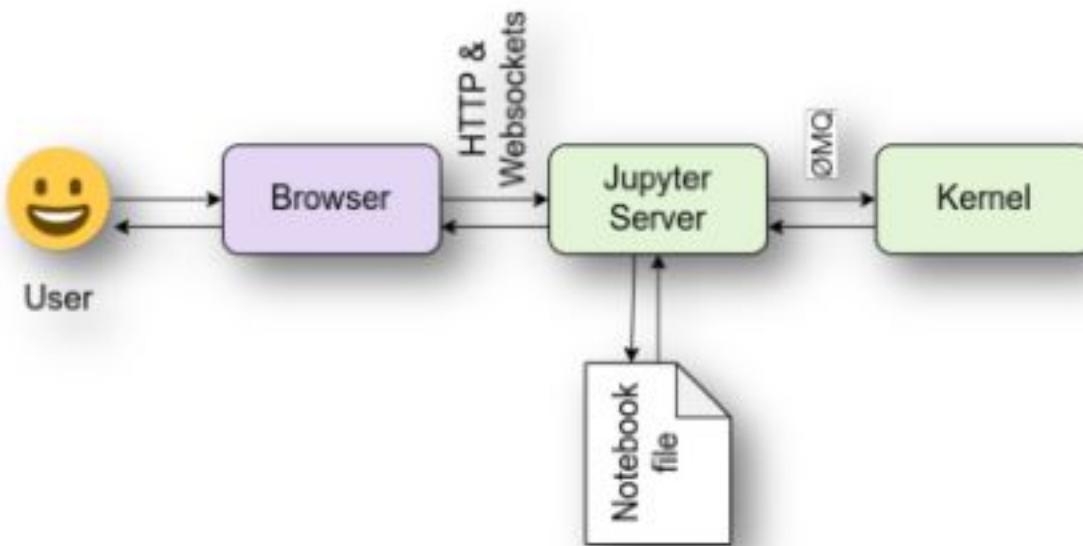


1. *Python and Drones Coding Course for High Schools. CODE4FUN: <https://www.youtube.com/watch?v=FyJrnFUgPA>*

Business Process Automation with Python

How to run Python – Jupyter Notebook

- Web-based interactive platform
 - Accessible: Python runtime on a web server



1. Architecture — Jupyter Documentation 4.1.1 Alpha Documentation.
<https://docs.jupyter.org/en/latest/projects/architecture/content-architecture.html>

How to run Python – Jupyter Notebook

- Notebook
 - Self-explainable → Code & Text blocks
 - Cached results

The screenshot shows a Jupyter Notebook interface with the title "Simple spectral analysis". The notebook contains the following text and code:

An illustration of the [Discrete Fourier Transform](#) using windowing, to reveal the frequency content of a sound signal.

$$X_k = \sum_{n=0}^{N-1} x_n e^{-\frac{j\pi}{N} kn} \quad k = 0, \dots, N-1$$

We begin by loading a datatype using SciPy's audio file support:

```
In [1]: from scipy.io import wavfile  
rate, x = wavfile.read('test_wav.wav')
```

And we can easily view its spectral structure using matplotlib's builtin specgram routine:

```
In [2]: %matplotlib inline  
from matplotlib import pyplot as plt  
fig, (ax1, ax2) = plt.subplots(2, figsize=(12, 4))  
ax1.plot(x); ax1.set_title('Raw audio signal')  
ax2.specgram(x); ax2.set_title('Spectrogram')
```

Two plots are displayed: a line plot titled "Raw audio signal" showing a waveform, and a spectrogram titled "Spectrogram" showing frequency over time.



How To Do Data Mining: Machine Learning Techniques

Artificial Intelligence

Artificial Intelligence (AI) is the science of making things smart. Can be defined as:

“Human intelligence exhibited by machines”

A broad term for getting computers to perform human tasks. The scope of AI is disputed and constantly changing over time. Let's go deeper...

How To Do Data Mining: Machine Learning Techniques

Machine Learning

An approach to achieve artificial intelligence through ‘software’ systems that can **learn** from **experience** to find **patterns** in a **set of data**.

Write a computer program
with **explicit rules** to follow

```
if email contains V!agra  
  then mark is-spam;  
if email contains ...  
if email contains ...
```

Write a computer program
to **learn from examples**

```
try to classify some emails;  
change self to reduce errors;  
repeat;
```

Traditional Programming

Machine Learning Programs

How To Do Data Mining: Machine Learning Techniques

Gathering Data



Inspiring Your Future

上環/中環/金鐘 寶泰大廈 [室內相]
售 \$530 萬 月供 \$13,711 按揭計算機»

單位詳情

成交紀錄

屋苑資訊

附近學校



樓盤	上環/中環/金鐘 寶泰大廈
樓盤編號	LCX458-34676
地址	水坑口街9號 <small>中原地圖»</small>
價格	售 \$530 萬
實用面積	357呎 (\$14,845/呎)
建築面積	519呎 (\$10,211/呎)
實用率	69%
樓層	低層 (B室)
樓齡	33年
單位類型	分層單位
輟學特色	<small>小學: 11» 中學: 中西區»</small>

Data Processing & Analysis

Practise 2

Which Data Type is Structured/Unstructured,
Discrete/Continuous?

E-mails

Digital Images

Stock Market Logs

Historical Gold Prices

Credit Approval Records

Social Media Friend Relationships

Tweets & Trending Topics

Sales Records

Source: Practical Data Analysis - Second Edition Hector Cuesta, Dr. Sampath Kumar OACKT Publishing BIRMINGHAM - MUMBAI

Business Process Automation with Python

Sequential Data Types

- **Motivation**

- How to represent the ordering of schools?
 - e.g., HKU > CUHK > HKUST

+ Rank	- University	- Overall Score
21	 The University of Hong Kong Hong Kong, Hong Kong SAR	87
38	 The Chinese University of Hong Kong (CUHK) Hong Kong SAR, Hong Kong SAR	80.6
40	 The Hong Kong University of Science and Technology Hong Kong SAR, Hong Kong SAR	79.8

* QS Rankings 2023

Business Process Automation with Python

Sequential Data Types

- Motivation

- How to represent the ordering of schools?
 - e.g., HKU > CUHK > HKUST
 - Preferably with 1 variable...

+ Rank	University	Overall Score
21	The University of Hong Kong Hong Kong, Hong Kong SAR	87
38	The Chinese University of Hong Kong (CUHK) Hong Kong SAR, Hong Kong SAR	80.6
40	The Hong Kong University of Science and Technology Hong Kong SAR, Hong Kong SAR	79.8

* QS Rankings 2023

```
▶ school_1 = 'hku'  
school_2 = 'cuhk'  
school_3 = 'hkust'  
print(school_1)  
print(school_2)  
print(school_3)
```

⇨ hku
cuhk
hkust

Sequential Data Types

- Tuple
 - Representation

```
[55] school_tuple = ('hku', 'cuhk', 'hkust')
      print(school_tuple)
      print(type(school_tuple))

('hku', 'cuhk', 'hkust')
<class 'tuple'>
```

- Indexing (zero-based)

```
▶ print(school_tuple[0])
print(school_tuple[1])
print(school_tuple[2])

↪ hku
cuhk
hkust
```

Sequential Data Types

- **Tuple**

```
school_tuple = ('hku', 'cuhk', 'hkust')
```

- Useful functions
 - Get the first occurrence

```
▶ school_tuple.index('cuhk')
```

```
▷ 1
```

- Number of items

```
▶ len(school_tuple)
```

```
▷ 3
```

- Number of specific element

```
▶ ('male', 'male', 'female').count('male')
```

```
▷ 2
```

Sequential Data Types

- **List**

- “Mutable” object (something you can change)
- Representation

```
▶ school_list = ['hku', 'cuhk', 'hkust']
    print(school_list)
    print(type(school_list))

◀ ['hku', 'cuhk', 'hkust']
<class 'list'>
```

- Indexing

```
▶ print(school_list[0])      # First 1 item
    print(school_list[0:2])    # First 2 items
    print(school_list[-1])     # Last one

◀ hku
['hku', 'cuhk']
polyu
```

Business Process Automation with Python

Sequential Data Types

- **List**

- Adding items

```
➊ school_list = ['hku', 'cuhk', 'hkust'] + ['cityu', 'polyu']
school_list
```

```
➋ ['hku', 'cuhk', 'hkust', 'cityu', 'polyu']
```

```
➊ school_list = ['hku', 'cuhk', 'hkust', 'cityu']
school_list.append('polyu')
school_list
```

```
➋ ['hku', 'cuhk', 'hkust', 'cityu', 'polyu']
```

Sequential Data Types

- **List**

- Removing an item
 - By index → `pop()`

```
▶ school_list.pop(1)
school_list
[ 'hku', 'hkust', 'cityu', 'polyu' ]
```

- By element → `remove()`

```
▶ school_list.remove('cityu')
school_list
[ 'hku', 'hkust', 'polyu' ]
```

Sequential Data Types

- Common operations

- Membership Check → “in”

```
▶ # Membership check
    school_list = ['hku', 'cuhk', 'hkust', 'cityu', 'polyu']
    print('hku' in school_list)
    print('hkbu' in school_list)

◀ True
False
```

Sequential Data Types

- Common operations

- Ordering → max() / min() / reversed() / sorted()

```
▶ number_list = [1, 5, 6, 2, 3]
    print(max(number_list))                      # Max
    print(min(number_list))                      # Min
    print(list(reversed(number_list)))          # Reverse order
    print(sorted(number_list))                  # Sort by ascending order

▷ 6
1
[3, 2, 6, 5, 1]
[1, 2, 3, 5, 6]
```

Sequential Data Types

- String (again)
 - string = sequential!



```
# Index:          0123456789
school_name = 'HKU School of Professional and Continuing Education'

print(len(school_name))      # There is a total of 51 letters
print(school_name.index('c')) # First c is the 6th letter (counting 1 space)
print(school_name.count('o')) # There are 7 O's
print('HKU' in school_name)  # Substring matching
print(school_name[4:10])     # Substring extraction
```

```
51
5
7
True
School
```

Sequential Data Types

- String (again)
 - Conversions

```
▶ # Conversion: String -> list
  print(list('hello'))
```

▷ ['h', 'e', 'l', 'l', 'o']

```
▶ # Conversion: List -> String
  print(''.join(['h', 'e', 'l', 'l', 'o']))
  print(','.join(['Welcome', 'Jackie!']))
```

▷ hello
Welcome,Jackie!

```
▶ # Conversion: String <-> int?
  print(ord('a'))
  print(chr(98))
```

▷ 97
b

Business Process Automation with Python

Practice 2 – Word Count

- Given an input text → Show below 3 fields
 - Reference: <https://charcounter.com/en/>

Charcounter
Character, Letter and Word Counter 

356 Characters	50 Words	307 Without White Space
----------------	----------	-------------------------

The programme aims to impart the essential knowledge of process automation to students and equip them with automation techniques in the business. It adopts a contemporary project management approach to business process automation. It also examines the emerging business opportunities and challenges in its planning and implementation of process automation.

- Starting notebook:**

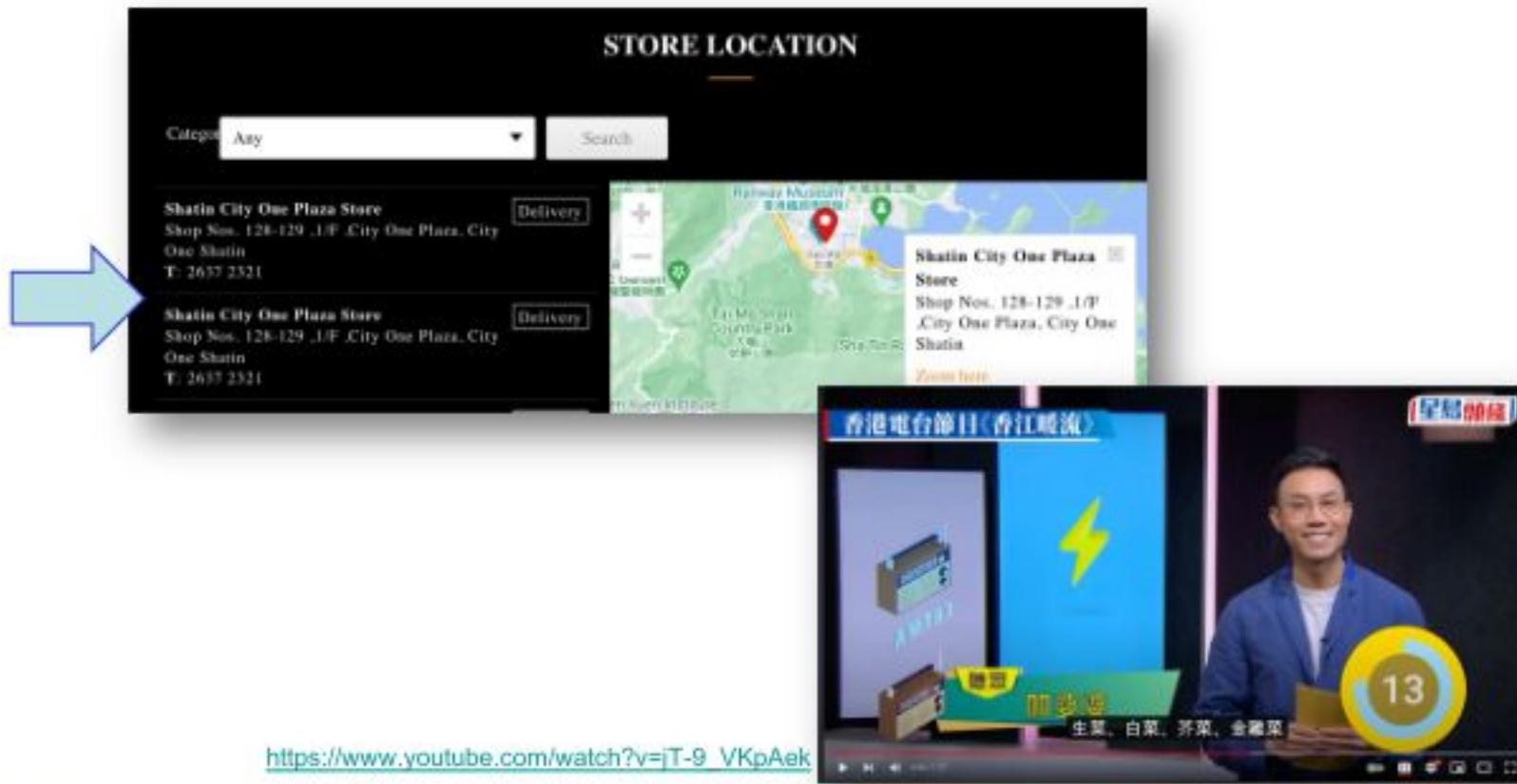
https://github.com/innoviai/ipa_courses/blob/main/Lecture%202/practice2_word_count_202409.ipynb

Business Process Automation with Python

Data Type - Set

- Motivation

- Problem → Duplicate data are everywhere



Data Type - Set

- **Set**
 - A way to maintain unique values

```
▶ duplicate_list = ['Shatin City One', 'Shatin City One', 'TKO Gateway']
      set(duplicate_list)
[▶ ('Shatin City One', 'TKO Gateway')
```

Business Process Automation with Python

Data Type - Set

- Set
 - Representation

```
▶ school_set = {'A', 'B', 'B', 'C'}  
print(school_set)  
print(type(school_set))  
  
⇒ {'B', 'C', 'A'}  
<class 'set'>
```

- Can be converted between sequential data types

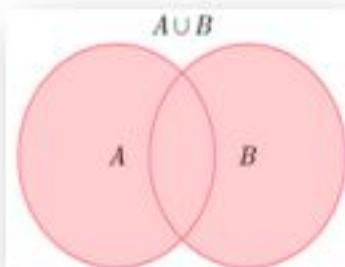
```
▶ print(set(['A', 'B', 'B', 'C'])) # List -> Set  
print(list({'A', 'B', 'C'})) # Set -> List  
  
⇒ {'C', 'B', 'A'}  
['B', 'C', 'A']
```

Business Process Automation with Python

Data Type - Set

- Set operations

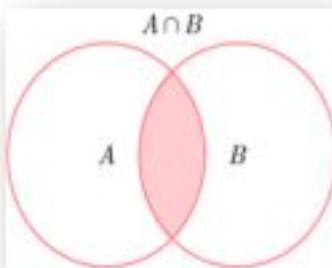
- Union



```
❶ # Set operations
school_set_2022 = {'A', 'B', 'C'}
school_set_2023 = {      'B', 'C', 'D'}
```

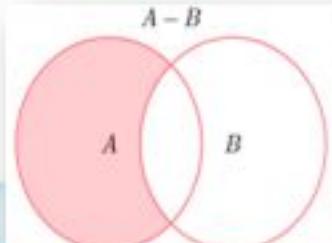
```
❶ # Union: items in any one of the sets
school_set_2022 | school_set_2023
[] ('A', 'B', 'C', 'D')
```

- Intersection



```
❶ # Intersection: items in both of the sets
school_set_2022 & school_set_2023
[] ('B', 'C')
```

- Difference



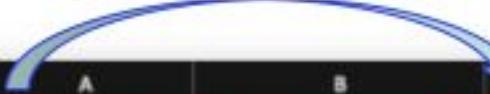
```
❶ # Difference: Items in 1 set but not in the other
school_set_2023 - school_set_2022
[] ('D')
```

Business Process Automation with Python

Data Type - Dictionary

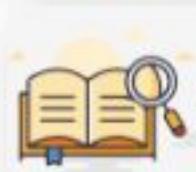
- Motivation

- Business problems often involve key-value pairs
- e.g., Employee ID → Full Name / Job Title



A	B	C	D
Employee ID	Full Name	Job Title	Department
E02002	Kai Le	Controls Engineer	Engineering
E02003	Robert Patel	Analyst	Sales
E02004	Cameron Lo	Network Administrator	IT
E02005	Harper Castillo	IT Systems Architect	IT
E02006	Harper Dominguez	Director	Engineering
E02007	Ezra Vu	Network Administrator	IT
E02008	Jade Hu	Sr. Analyst	Accounting
E02009	Miles Chang	Analyst II	Finance
E02010	Gianna Holmes	System Administrator	IT
E02011	Jameson Thomas	Manager	Finance
E02012	Jameson Pena	Systems Analyst	IT
E02013	Bella Wu	Sr. Analyst	Finance

- Looking up a keyword
→ like finding words in **ictionaries**



Business Process Automation with Python

Data Type - Dictionary

- Representation

```
# Representation: option 1
school_rank_dict = {'hku': 21, 'cuhk': 38, 'hkust': 40}
print(type(school_rank_dict))

# Representation: option 2
school_rank_dict = dict(hku=21, cuhk=38, hkust=40)
print(school_rank_dict)

<class 'dict'>
{'hku': 21, 'cuhk': 38, 'hkust': 40}
```

+ Rank	- University
21	 The University of Hong Kong Hong Kong, Hong Kong SAR
38	 The Chinese University of Hong Kong (CUHK) Hong Kong SAR, Hong Kong SAR
40	 The Hong Kong University of Science and Technology Hong Kong SAR, Hong Kong SAR

- Lookup → get()

```
# Lookup
print(school_rank_dict['cuhk'])          # Direct lookup
print(school_rank_dict.get('hkust'))       # get(): Success
print(school_rank_dict.get('test'))        # get(): Failed
print(school_rank_dict.get('test', 'N/A'))  # get(): Error handling
```

38
40
None
N/A

Data Type - Dictionary

- Adding an item

```
▶ # Adding an item
school_rank_dict = {'hku': 21, 'cuhk': 38, 'hkust': 40}
school_rank_dict['cityu'] = 54
print(school_rank_dict)

▶ {'hku': 21, 'cuhk': 38, 'hkust': 40, 'cityu': 54}
```

- Removing an item

```
▶ # Removing an item
school_rank_dict = {'hku': 21, 'cuhk': 38, 'hkust': 40, 'cityu': 54}
school_rank_dict.pop('cityu')
print(school_rank_dict)

▶ {'hku': 21, 'cuhk': 38, 'hkust': 40}
```

Business Process Automation with Python

Data Type - Dictionary

- Listing out the details

```
▶ # Show all the keys
print(f'keys: {list(school_rank_dict.keys())}')
```



```
▶ # Show all the values
print(f'velues: {list(school_rank_dict.values())}')
```



```
▶ # Show all the items
print(f'items: {list(school_rank_dict.items())}')
```



```
▶ keys: ['hku', 'cuhk', 'hkust']
values: [21, 38, 40]
items: [('hku', 21), ('cuhk', 38), ('hkust', 40)]
```

- Membership Check

```
▶ # Membership Check
print('hku' in school_rank_dict)
```



```
▶ True
```

Data Type - Dictionary

- Conversion

- Cast from a list of tuples

	A	B	C
1	Employee ID	Full Name	Job Title
2	E02002	Kai Le	Controls Engineer
3	E02003	Robert Patel	Analyst
4	E02004	Cameron Lo	Network Administrator

```
# Conversion: list => dict
employee_name_list = [('E02002', 'Kai Le'), ('E02003', 'Robert Patel')]
print(dict(employee_name_list))

{'E02002': 'Kai Le', 'E02003': 'Robert Patel'}
```

Business Process Automation with Python

Data Type - Dictionary

- Conversion
 - zip() can be used to create tuples

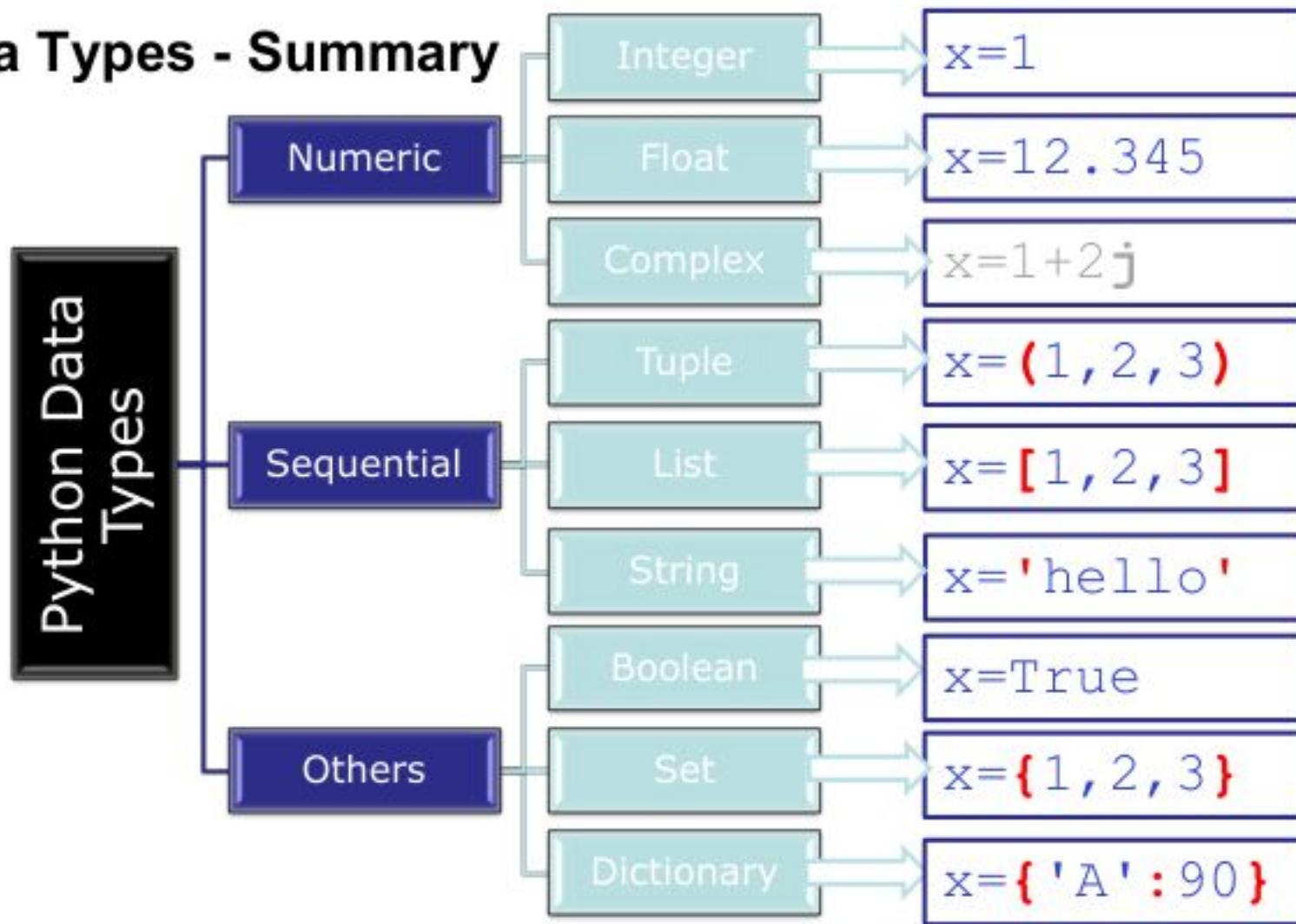
	A	B	C
1	Employee ID	Full Name	Job Title
2	E02002	Kai Le	Controls Engineer
3	E02003	Robert Patel	Analyst
4	E02004	Cameron Lo	Network Administrator

```
employee_ids = ['E02002', 'E02003']
full_names = ['Kai Le', 'Robert Patel']
job_titles = ['Controls Engineer', 'Analyst']

print( list(zip(employee_ids, full_names)) )
print( dict(zip(employee_ids, full_names)) )
print( dict(zip(employee_ids, job_titles)) )

[('E02002', 'Kai Le'), ('E02003', 'Robert Patel')]
{'E02002': 'Kai Le', 'E02003': 'Robert Patel'}
{'E02002': 'Controls Engineer', 'E02003': 'Analyst'}
```

Data Types - Summary



Business Process Automation with Python

Conditional Statements

- If-else
 - Python tracks the scope using **indentation** (spaces)

VBA

```
Dim speed As Integer  
speed = 70  
  
If speed > 50 Then  
    Debug.Print ("Exceeded limit")  
Else  
    Debug.Print ("OK")  
End If
```

Python

```
speed = 70  
  
if speed > 50:  
    print('Exceeded limit')  
else:  
    print('OK')
```



Business Process Automation with Python

Conditional Statements

- If-else
 - Value assignment can be conditional too!

Multiline

```
speed = 70

if speed > 50:
    print('Exceeded limit')
else:
    print('OK')
```

1 line

```
speed = 70

print ('Exceeded limit' if speed > 50 else 'OK')
```

Conditional Statements

- If-elif-else
 - elif → “Else If”

```
mark = 89
grade = None

if mark >= 90:
    grade = 'A'
elif mark >= 80:
    grade = 'B'
elif mark >= 70:
    grade = 'C'
else:
    grade = 'F'

print(grade)
```

D. B

Conditional Statements

- If-elif-else
 - elif → “Else If”
 - May be broken down to if-else

```
mark = 89
grade = None

if mark >= 90:
    grade = 'A'
elif mark >= 80:
    grade = 'B'
elif mark >= 70:
    grade = 'C'
else:
    grade = 'F'

print(grade)
```

D B

```
mark = 89
grade = None

grade = 'A' if mark >= 90 else ('B' if mark >= 80 else ('C' if mark >= 70 else 'F'))

print(grade)
```

D B

Business Process Automation with Python

Conditional Statements

- If
 - “else” is optional

```
▶ salary = 10000
    salary_growth = 1.2
    years_of_service = 3

    # No increment for first year
    if years_of_service > 1:
        salary = salary * salary_growth
    print(salary)

□ 12000.0
```

Business Process Automation with Python

Conditional Statements

- If-elif-else
 - Unlike VBA, scope is NOT defined with “If → End If”
 - Python tracks the scope using **indentation** (spaces)

VBA

```
Dim speed As Integer  
speed = 70  
  
If speed > 50 Then  
    Debug.Print ("Exceeded limit")  
Else  
    Debug.Print ("Speed is okay")  
End If
```

Python

```
speed = 70  
  
if speed > 50:  
    print('Exceeded limit')  
else:  
    print('Speed is okay')
```

Business Process Automation with Python

Loops – Using “for”

- Iterating through a range



	A	B	C
1		1	
2		2	
3		3	
4		4	
5		5	
6		6	
7		7	
8		8	
9		9	
10		10	

VBA

```
For i = 1 To 10  
    Debug.Print (i)  
Next i
```

Python

```
for i in range(1, 11):  
    print(i)
```

Loops – Using “for”

- Different ways to specify ranges



	A	B	C
1		1	
2		2	
3		3	
4		4	
5		5	
6		6	
7		7	
8		8	
9		9	
10		10	

```
[11] for i in range(1, 11):
    print(i) # 1, 2, ..., 10
1
2
3
4
5
6
7
8
9
10
```



```
[1] for i in range(10):
    print(i + 1) # i = 0, 1, ..., 9
1
2
3
4
5
6
7
8
9
10
```

Business Process Automation with Python

Loops – Using “for”

- Under the hood
 - Iterating through a sequence object

```
[21] print(range(10))  
range(0, 10)
```



	A	B	C
1	1		
2	2		
3	3		
4	4		
5	5		
6	6		
7	7		
8	8		
9	9		
10	10		

```
▶ list(range(10)) # In Python2, range() returns a list directly  
⇒ [0, 1, 2, 3, 4, 5, 6, 7, 8, 9]
```



Business Process Automation with Python

Loops – Using “for”

- Be careful...

```
▶ item_prices = [200, 100]
    total = 0
    # Case 1: Apply $50 discount once
    for price in item_prices:
        total = total + price
        if total >= 200:
            total = total - 50
    print(total)
```

✉ 250

```
▶ item_prices = [200, 100]
    total = 0
    # Case 2: Apply $50 discount twice (accidentally..)
    for price in item_prices:
        total = total + price
        if total >= 200:
            total = total - 50
    print(total)
```

✉ 200

Business Process Automation with Python

Loops – Using “for”

- Looping through a list

```
▶ school_list = ['hku', 'cuhk', 'hkust']

for school in school_list:
    print(f'{school} is a good school in Hong Kong')

▶ hku is a good school in Hong Kong
    cuhk is a good school in Hong Kong
        hkust is a good school in Hong Kong
```

Business Process Automation with Python

Loops – Using “for”

- Looping through a dictionary

```
➊ school_rank_dict = {'hku': 21, 'cuhk': 38, 'hkust': 40}

➋ for school, rank in school_rank_dict.items():
    | print(f'{school} is ranked {rank} in the world!')

➌ hku is ranked 21 in the world!
    cuhk is ranked 38 in the world!
        hkust is ranked 40 in the world!
```

Loops – Using “for”

- Looping through a string
- Q: Why use “elif” instead of “else”?

```
▶ # looping through a string
    uppercase_letter_count = 0
    lowercase_letter_count = 0

    for letter in 'See you in Hong Kong':
        if letter.isupper():
            uppercase_letter_count = uppercase_letter_count + 1
        elif letter.islower():
            lowercase_letter_count = lowercase_letter_count + 1

    print(f'Uppercase letters: {uppercase_letter_count}')
    print(f'Lowercase letters: {lowercase_letter_count}')

□ Uppercase letters: 3
Lowercase letters: 13
```

Business Process Automation with Python

Loops – Using “for”

- List comprehension
→ compressing a loop in 1 line

```
▶ print(f'8 % 2 = {8%2}')
print(f'9 % 2 = {9%2}')

⇒ 8 % 2 = 0
9 % 2 = 1
```

```
▶ # Traditional way
even_number_list = []
for i in range(11):
    # Use the modulus operator to check for even number (Can be divided by 2)
    if i % 2 == 0:
        even_number_list.append(i)
print(even_number_list)

⇒ [0, 2, 4, 6, 8, 10]
```

```
▶ # List comprehension
even_number_list = [i for i in range(11) if i % 2 == 0]
print(even_number_list)

⇒ [0, 2, 4, 6, 8, 10]
```

Business Process Automation with Python

Loops – Using “for”

- List comprehension + Filtering

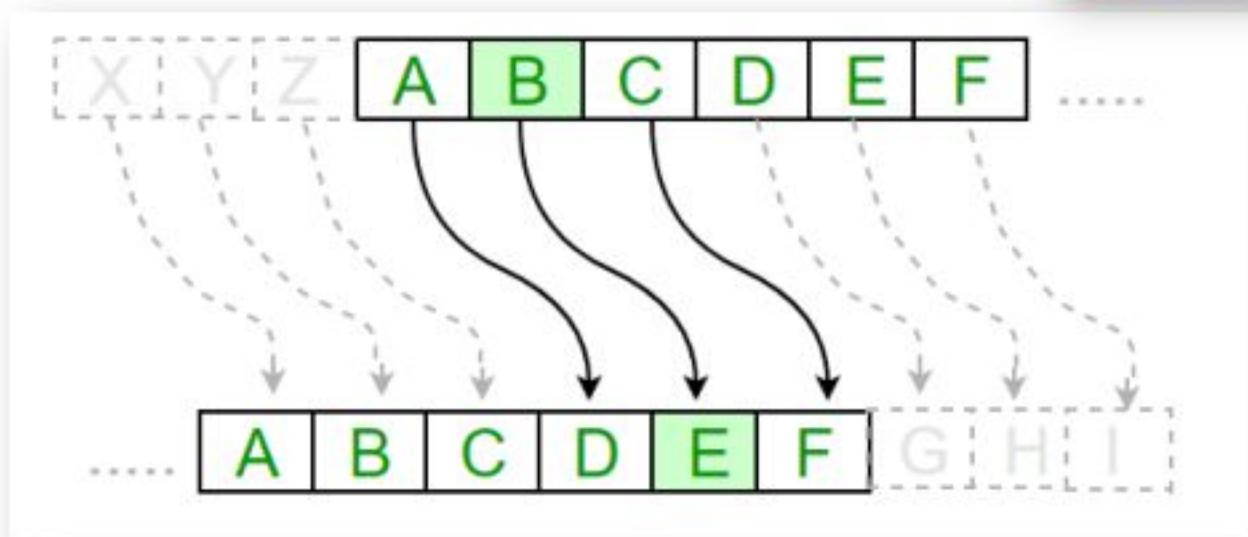
```
▶ print(bool(''))  
print(bool(None))
```

```
▶ item_list = ['123', '456', '']  
  
▶ print([item for item in item_list])  
print([item for item in item_list if bool(item)])  
print([item for item in item_list if item])  
  
◀ ['123', '456', '']  
['123', '456']  
['123', '456']
```

Practice 3 – Caesar Cipher

- Encryption: Shift each letter by 3

- Reference: <https://cryptii.com/pipes/caesar-cipher>



- Starting notebook:

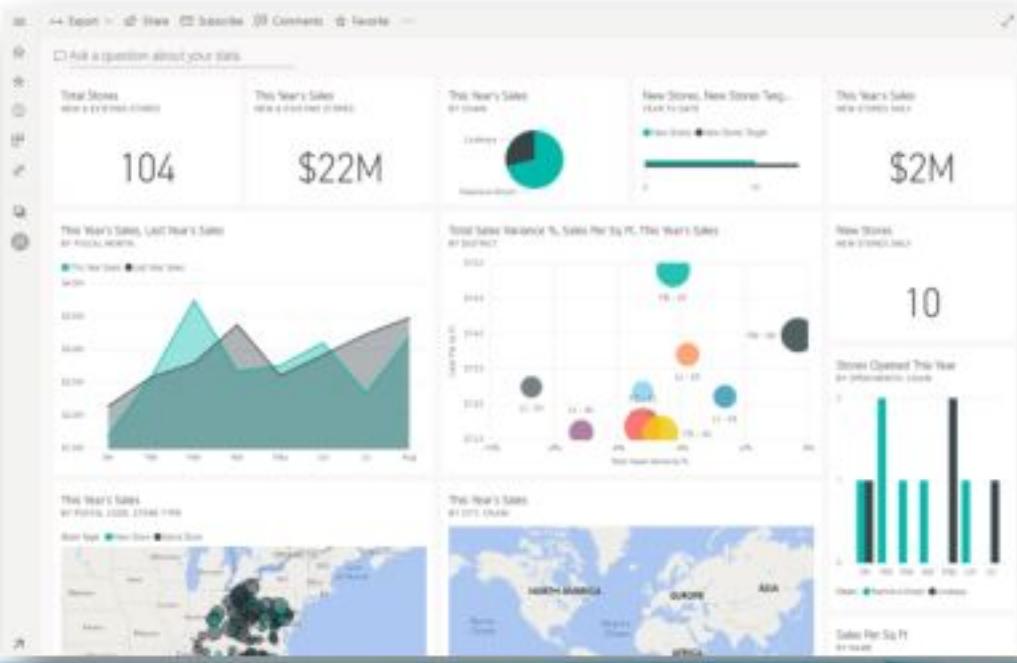
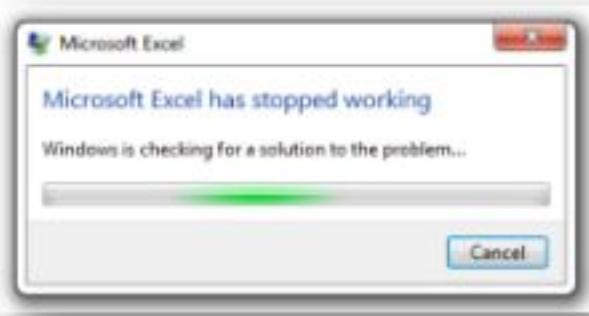
https://github.com/innoviai/ipa_courses/blob/main/Lecture%202/practice2_word_count_202409.ipynb

Business Process Automation with Python

File Input / Output

- Motivation

- Storage → Saving progress
- Interaction with other systems



File Input / Output

- **Creating a file object**

- `open(file_name, file_mode)`
- **file_mode**
 - **r** → read (read an existing file)
 - **w** → write (create a new file)
 - **a** → append (add to an existing file)
 - **b** → binary mode
 - e.g., Chinese characters / PDF files
 - adds to another mode (e.g., 'rb' instead 'r')

File Input / Output

- **Writing a text file**

- `open()` → with 'w' mode
- `write()` → insert a string
- `close()` → save the file (as a last step)

```
▶ # Create a handler
    output_file_stream = open('test.txt', 'w')

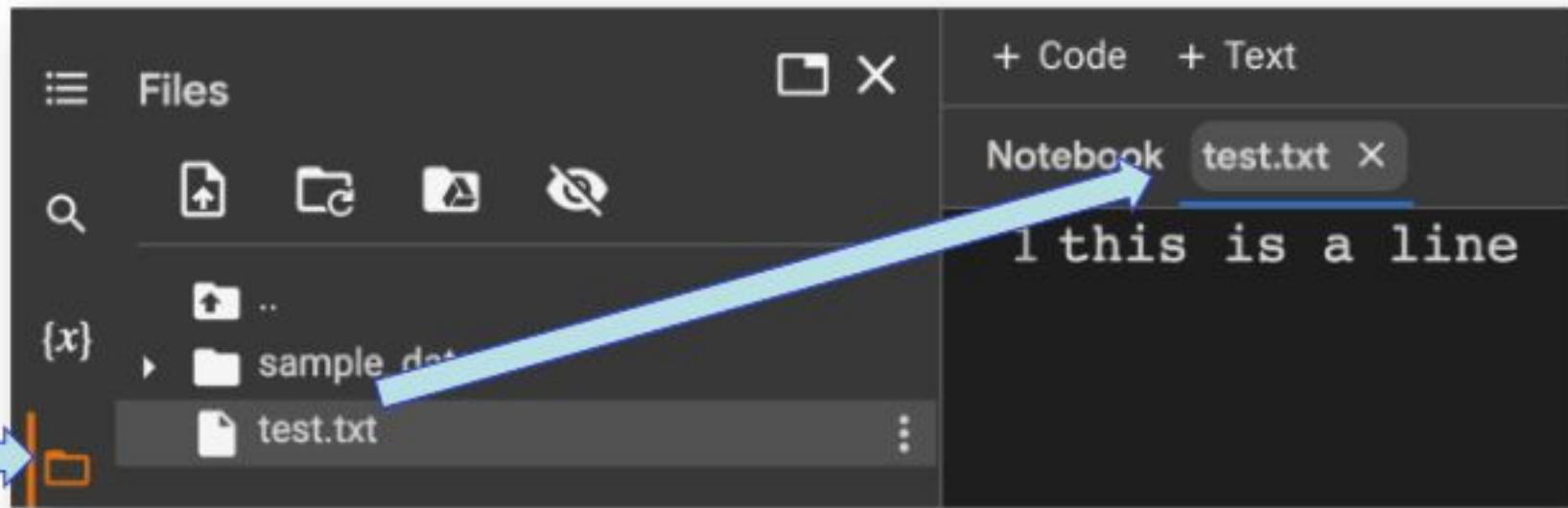
    # Write a string into it
    output_file_stream.write('this is a line')

    # Save the file
    output_file_stream.close()
```

Business Process Automation with Python

File Input / Output

- Writing a text file
 - Viewing the result



Business Process Automation with Python

File Input / Output

- Writing a text file
 - Multiple lines – the problem

```
▶ # Create a handler
    output_file_stream = open('test.txt', 'w')

    # Write a string
    output_file_stream.write('this is a line')
    # Write another one
    output_file_stream.write('this is another line')

    # Save the file
    output_file_stream.close()
```

Notebook test.txt X



1 this is a linethis is another line

File Input / Output

- **Writing a text file**

- Multiple lines – the solution
- → The next-line character “\n”

Notebook test.txt X
1 this is a line
2 this is another line

```
❶ # Create a handler
output_file_stream = open('test.txt', 'w')

# Write a string
output_file_stream.write('this is a line\n') ←
# Write another one
output_file_stream.write('this is another line')

# Save the file
output_file_stream.close()
```

File Input / Output

- **The “With” statement**

- Better readability (in terms of scoping)
- Automatically calling close() at the end

```
▶ # Create a handler
    with open('test.txt', 'w') as output_file_stream:
        # Write a string
        output_file_stream.write('this is a line')
```

File Input / Output

- **Reading a text file**

- `open()` with 'r' mode
- `read()` → extract all the content from the file

```
➊ file_text = None
    # Create a handler
    with open('test.txt', 'r') as input_file_stream:
        # Read the file
        file_text = input_file_stream.read()
file_text

➋ 'this is a line\nthis is another line'
```

File Input / Output

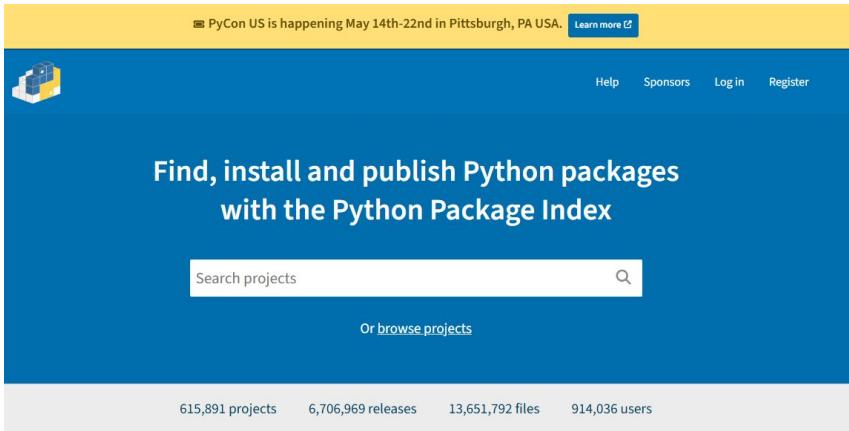
- **Reading a text file**

- Handling separators
 - `splitlines()` → useful against line separators '\n'
 - `split()` → flexible, can handle commas in CSV files

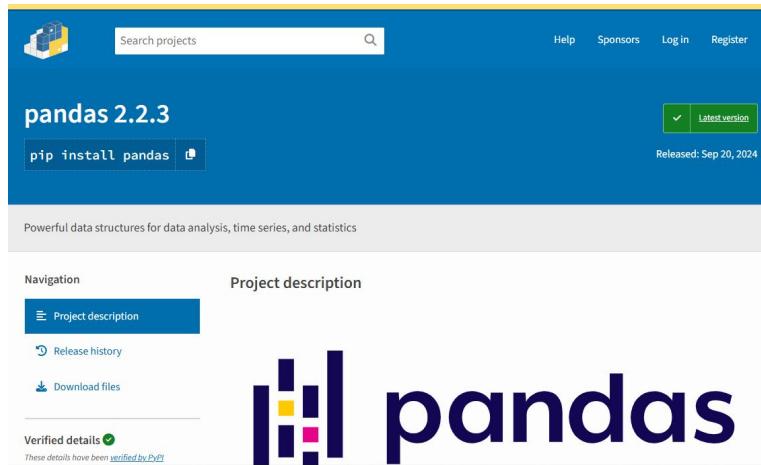
```
▶ print( file_text.split('\n') )  
print( file_text.splitlines() )  
  
↳ ['this is a line', 'this is another line']  
['this is a line', 'this is another line']
```

Library Installation in Python

Most of the python library can be founded in <https://pypi.org/>



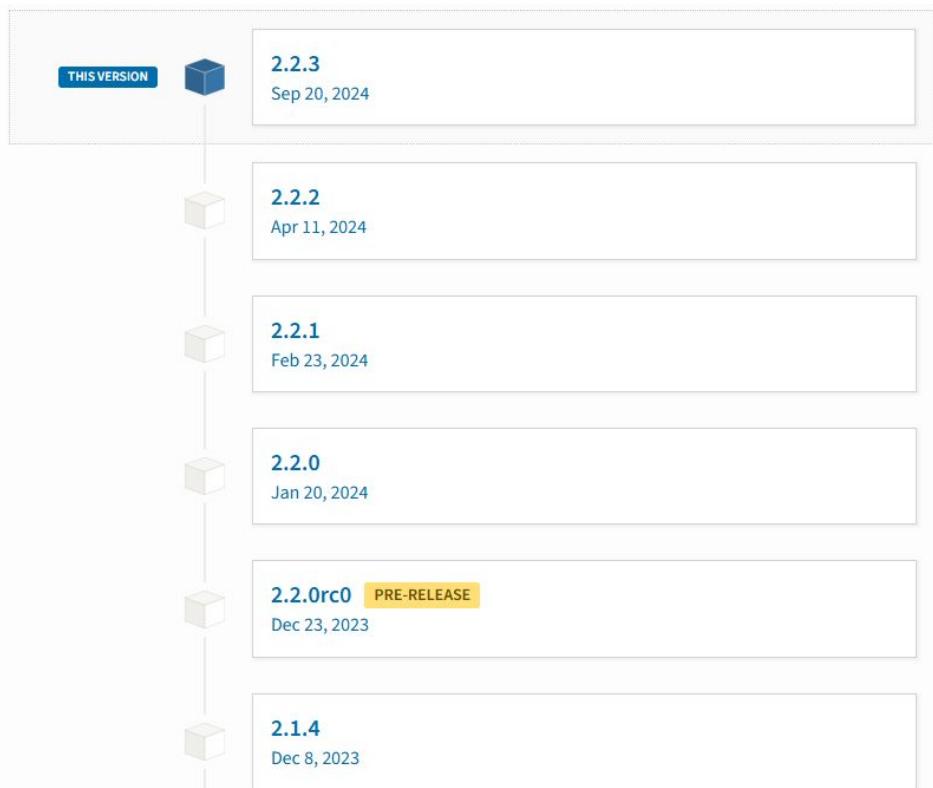
You can enter pandas to search or type <https://pypi.org/project/pandas/>



Library Installation in Python

Same library name have different version like 2.2.3, 2.1.0, ...

The default page show the newest version.



If you use python 3.7 or 3.8, you better install the version 2.1.0



For library installation, you can go to anaconda prompt and enter
“pip install pandas” or “pip install pandas==2.1.0”

Library Installation in Python

1. Open tools “Anaconda Prompt” which will direct you to the command prompt.



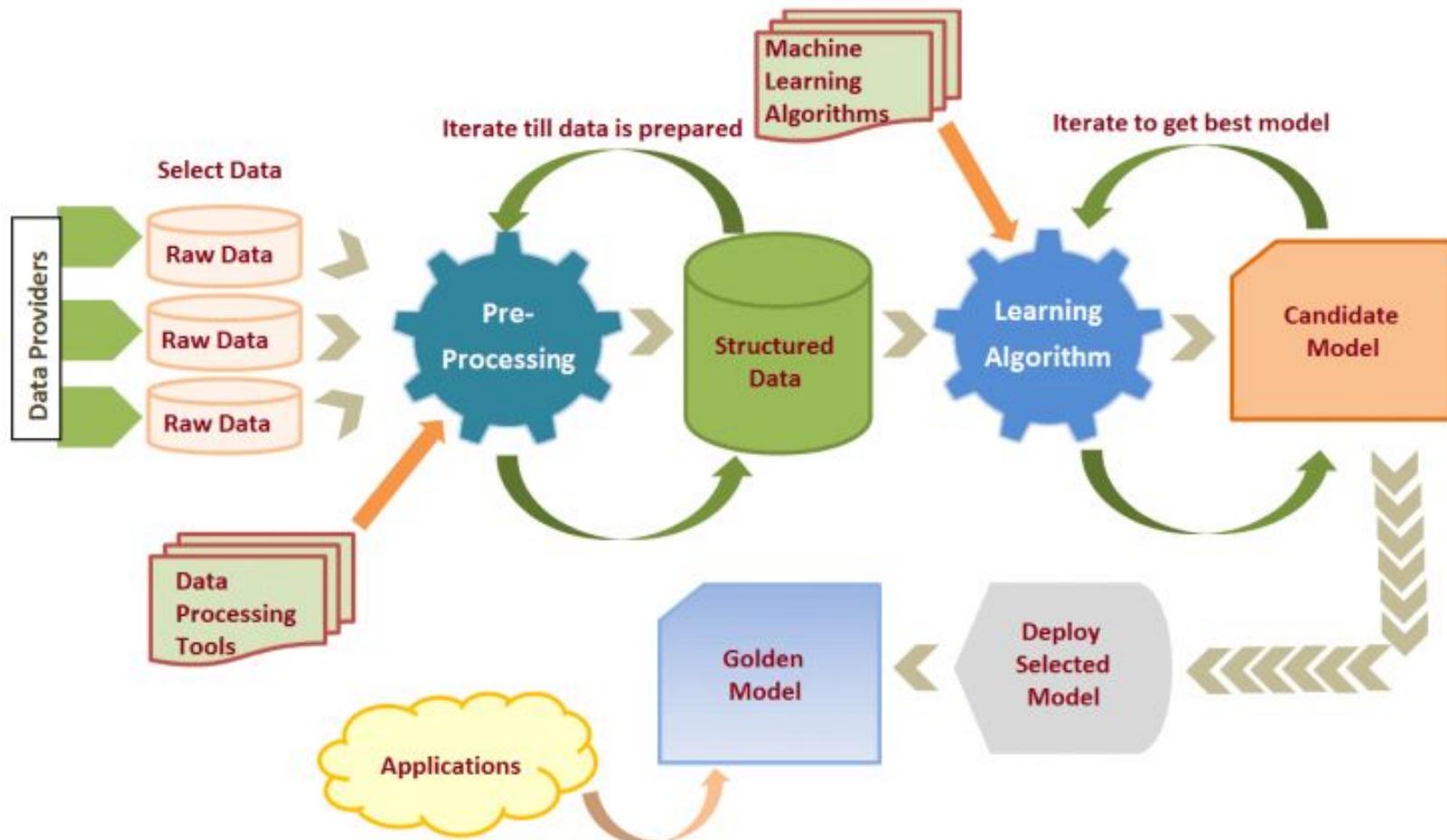
2. Install python package requests by entering “pip install pandas”

```
(base) C:\Users\user>pip install pandas
WARNING: Ignoring invalid distribution - (c:\programdata\miniconda3\lib\site-packages)
WARNING: Ignoring invalid distribution -harsent-normalizer (c:\programdata\miniconda3\lib\site-packages)
WARNING: Ignoring invalid distribution -heel (c:\programdata\miniconda3\lib\site-packages)
WARNING: Ignoring invalid distribution -pencv-python-headless (c:\programdata\miniconda3\lib\site-packages)
WARNING: Ignoring invalid distribution -qdm (c:\programdata\miniconda3\lib\site-packages)
Requirement already satisfied: pandas in c:\programdata\miniconda3\lib\site-packages (from pandas) (1.26.4)
Requirement already satisfied: numpy==1.22.4 in c:\programdata\miniconda3\lib\site-packages (from pandas) (1.26.4)
Requirement already satisfied: python-dateutil>=2.8.2 in c:\programdata\miniconda3\lib\site-packages (from pandas) (2.8.2)
Requirement already satisfied: pytz>=2020.1 in c:\programdata\miniconda3\lib\site-packages (from pandas) (2022.7.1)
Requirement already satisfied: tzdata>=2022.7 in c:\programdata\miniconda3\lib\site-packages (from pandas) (2023.3)
Requirement already satisfied: six>=1.5 in c:\programdata\miniconda3\lib\site-packages (from python-dateutil>=2.8.2->pandas) (1.16.0)
WARNING: Ignoring invalid distribution - (c:\programdata\miniconda3\lib\site-packages)
WARNING: Ignoring invalid distribution -harsent-normalizer (c:\programdata\miniconda3\lib\site-packages)
WARNING: Ignoring invalid distribution -heel (c:\programdata\miniconda3\lib\site-packages)
WARNING: Ignoring invalid distribution -pencv-python-headless (c:\programdata\miniconda3\lib\site-packages)
WARNING: Ignoring invalid distribution -qdm (c:\programdata\miniconda3\lib\site-packages)

[notice] A new release of pip is available: 24.1.1 -> 25.0.1
[notice] To update, run: python.exe -m pip install --upgrade pip
(base) C:\Users\user>
```

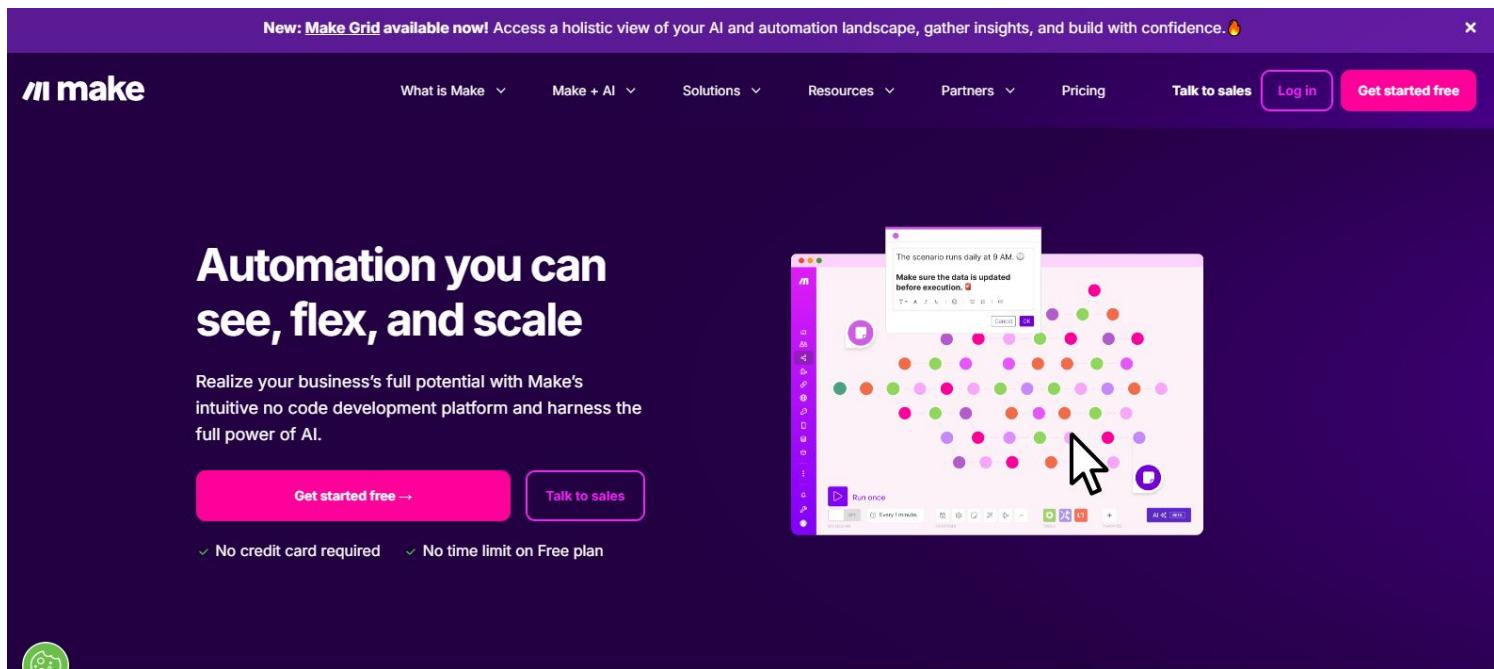
The screenshot shows the Anaconda Prompt window with the command "pip install pandas" entered and its output. The output indicates that the pandas package is already installed at version 1.26.4. It also lists other dependencies like numpy, pytz, and tzdata. At the bottom, there is a notice about a new pip release and instructions to upgrade it.

Applied Machine Learning Pipeline Overview



Preparing Weather Data using Make.com

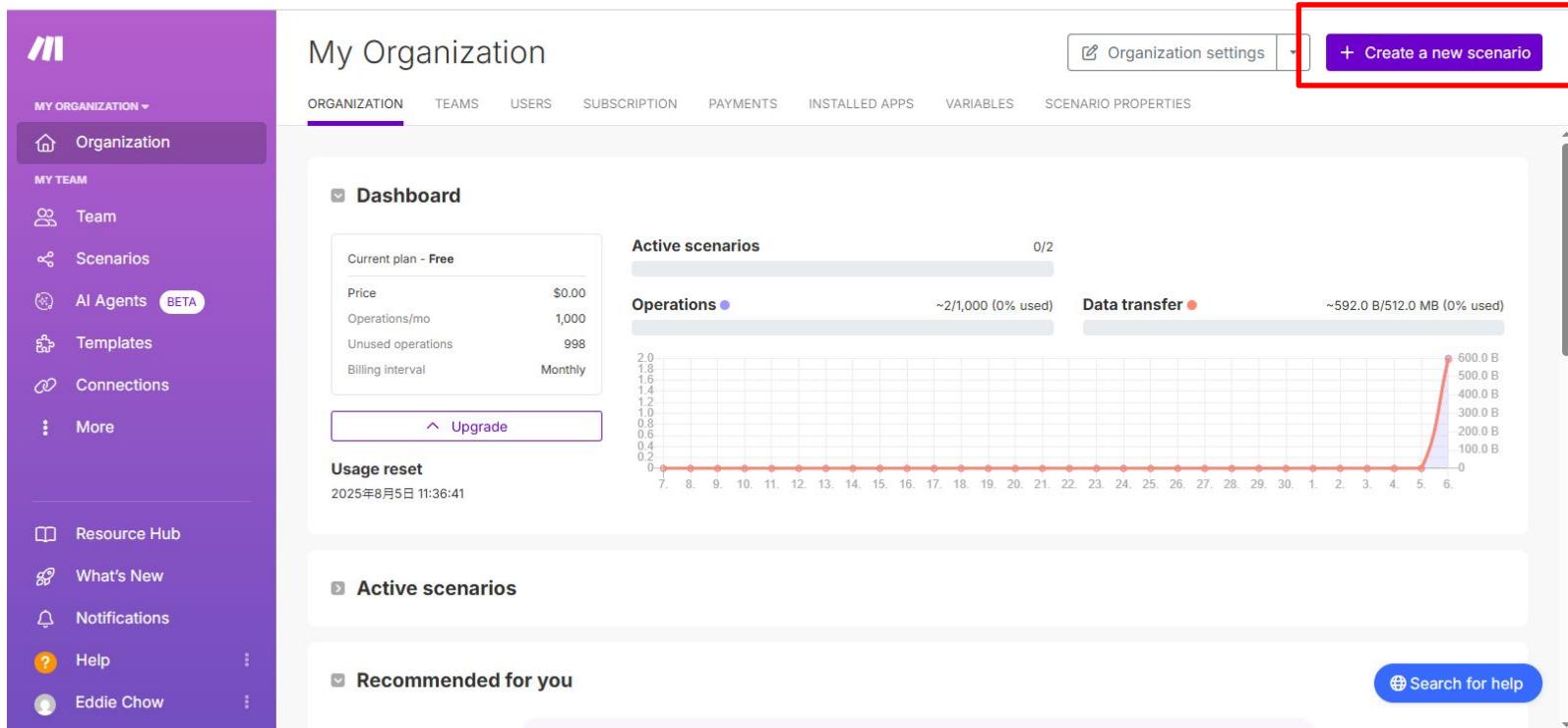
Go to <https://www.make.com/en>



Click “Get started free” or enter <https://www.make.com/en/login>

Preparing Weather Data using Make.com

Sign in with Google

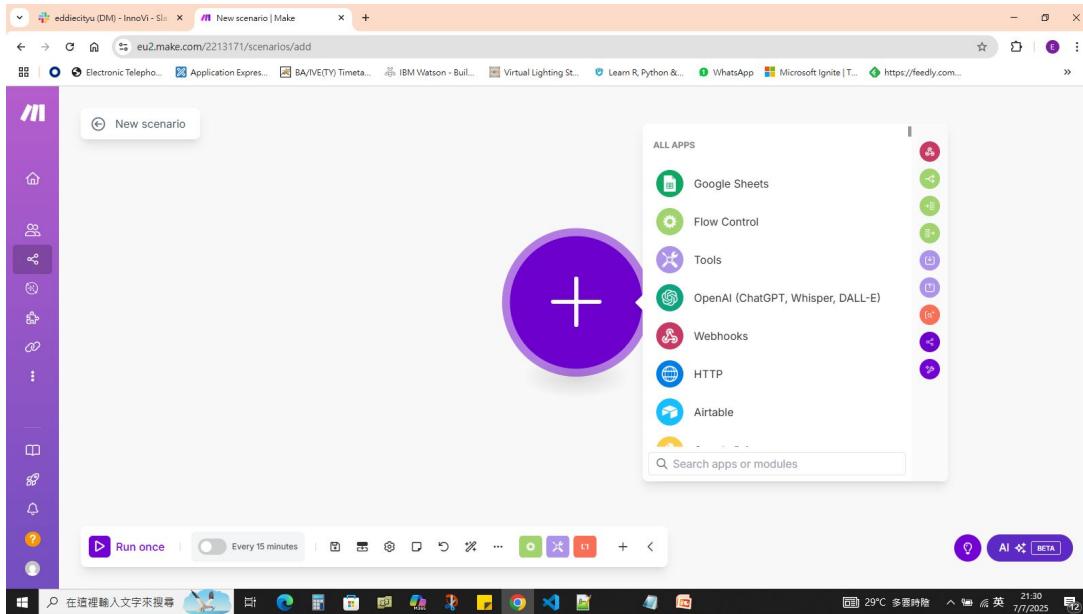


The screenshot shows the Make.com dashboard under the "My Organization" section. The left sidebar has a purple header "MY ORGANIZATION" with options like "Organization" (selected), "Team", "Scenarios", "AI Agents (BETA)", "Templates", "Connections", "More", "Resource Hub", "What's New", "Notifications", "Help", and "Eddie Chow". The main dashboard area has a title "My Organization" and tabs for "ORGANIZATION" (selected), "TEAMS", "USERS", "SUBSCRIPTION", "PAYMENTS", "INSTALLED APPS", "VARIABLES", and "SCENARIO PROPERTIES". A red box highlights the purple button "+ Create a new scenario" located in the top right corner of the dashboard area. The dashboard includes sections for "Dashboard", "Active scenarios" (0/2), "Operations (~2/1,000 (0% used))", "Data transfer (~592.0 B/512.0 MB (0% used))", "Usage reset" (2025年8月5日 11:36:41), "Active scenarios", and "Recommended for you". A search bar "Search for help" is also visible.

Click “Create a new scenario”

Preparing Weather Data using Make.com

An interface with module is displayed



Create Module “Weather” -> Click “Get daily weather forecast”

Preparing Weather Data using Make.com

Enter Days “9 days from today” and City “Hong Kong”
-> Click “Save”

Right-Click and select “Run this module only”

The screenshot shows the Make.com platform interface. On the left, there's a sidebar with various icons. In the center, there's a large orange "Weather" module icon with the subtext "Get current weather". A context menu is open over this module, listing options: Settings, Run this module only, Add a module, Add error handler, Rename, Clone, Copy module, Add a note, and Delete module. Below the module, there are execution triggers: "Run once" and "Every 15 minutes", along with other standard UI elements like back/forward buttons and a search bar. To the right, a detailed view of the "Weather" module is shown. It has an orange header bar with the title "Weather" and a status message "Data size: 319.0 B". Under "INPUT", it shows a "Bundle 1" collection with "City: Hong Kong" and "Days: (empty)". A note says "I want to enter a location by: name". Under "OUTPUT", it shows a "Bundle 1" collection with a single item: "Date: 2025年7月16日 12:00", which includes "Temperature: (Collection)" with values "Atmospheric pressure: 997", "Air humidity: 80", "Cloudiness: 100", and "Wind: (Collection)" with values "Rain: 7.92", "Status: Rain", "Code: 500", and "Description: light rain". An "Icon:" field contains the URL "http://openweathermap.org/img/w/10d.png". At the bottom of the module view, there are buttons for "Commit" and "Finalization".

You can view an output file in JSON format

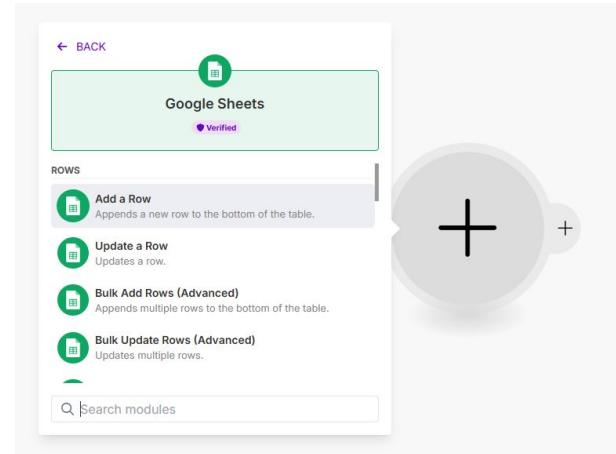
Preparing Weather Data using Make.com

Open drive.google.com -> create an google sheet named "Weather Data"

Create an header as follow:

Date	Temperature	Air humidity	Wind	Rain
------	-------------	--------------	------	------

Return to make interface, in the right side of Weather icon, Click “Add another module” -> create “Google Sheets” -> Select “Add a Row”



Automation for updating weather data in google sheet

In Spreadsheet ID, click button “Click here to choose file”

1. Select “Weather Data” -> Enter Sheet Name “Sheet1”
2. Click Date (A), select “3. Date” and other 4 columns
3. Click “Save”



In the button, click “Run once”

Automation for updating weather data in google sheet

Open the google sheet named “Weather Data”, the data is inserted in the second row as following:

Weather Data						
	A	B	C	D	E	F
1	Date	Temperature	Air humidity	Wind	Rain	
2	2025-07-16T04:1 ("day":30.57,"mi		80 {"speed":7.95,"d		7.92	
3						

HKO Weather Data Collection - Reading API

Study the Weather API data dict Documentation in

https://www.hko.gov.hk/en/weatherAPI/doc/files/HKO_Open_Data_API_Documentation.pdf

1. Weather Information API

Dataset

- 9-day Weather Forecast
- Current Weather Report
- Local Weather Forecast
- Weather Warning Information
- Weather Warning Summary
- Special Weather Tips

API URL

<https://data.weather.gov.hk/weatherAPI/opendata/weather.php>

Please include valid parameters in API request. For valid parameters, please refer to Request table in this section.

HTTP Request Method

GET

Return Type

JSON

Request Example

<https://data.weather.gov.hk/weatherAPI/opendata/weather.php?dataType=flw&lang=en>

Parameter

1. dataType
2. lang

Request

Parameter	Accepted values	Description
dataType	flw fnd rhrread warnsum warningInfo swt	flw: Local Weather Forecast fnd: 9-day Weather Forecast rhrread: Current Weather Report warnsum: Weather Warning Summary warningInfo: Weather Warning Information swt: Special Weather Tips
lang	en tc sc	en: English tc: Traditional Chinese sc: Simplified Chinese Default language: en

HKO Weather Data Collection - Reading API

When browser load <https://data.weather.gov.hk/weatherAPI/opendata/weather.php?dataType=flw&lang=en>



```
{"generalSituation":"The northeast monsoon is affecting the coast of Guangdong. Besides, a band of clouds is covering southern China.", "tcInfo": "", "fireDangerWarning": "", "forecastPeriod": "Weather forecast for this afternoon and tonight", "forecastDesc": "Mainly cloudy and dry. Bright periods in the afternoon. Moderate to fresh north to northeasterly winds.", "outlook": "Still cool in the morning in the next couple of days. The weather will improve gradually. Mainly fine in the middle and latter parts of this week to early next week. Warm and dry during the day. The temperature difference between day and night will be relatively large.", "updateTime": "2025-03-17T13:45:00+08:00"}
```

generalSituation	tcInfo	fireDangerWarning	forecastPeriod	forecastDesc	outlook	updateTime
:"The northeast monsoon is affecting the coast of Guangdong. Besides, a band of clouds is covering southern China			Weather forecast for this afternoon and tonight	Mainly cloudy and dry. Bright periods in the afternoon. Moderate to fresh north to northeasterly winds	Still cool in the morning in the next couple of days. The weather will improve gradually. Mainly fine in the middle and latter parts of this week to early next week. Warm and dry during the day. The temperature difference between day and night will be relatively large.	2025-03-17T13:45:00+08:00

HKO Weather Data Collection - Reading API

Case Study - Read Weather Forecasting from HKO API

Step 1. Import the required libraries:

```
#import necessary library  
import requests  
import pandas as pd
```

Step 2: Load the weather forecasting data from '<https://data.weather.gov.hk/weatherAPI/opendata/>'

```
# Initialize Parameters for the API  
datatype = 'fnd'  
lang = 'en'  
apiurl = f'https://data.weather.gov.hk/weatherAPI/opendata/weather.php?dataType={datatype}&lang={lang}'
```

Fetching the JSON data

```
response = requests.get(apiurl)  
response.raise_for_status() # Check for request errors
```

Converting JSON to a DataFrame

```
json_data = response.json()
```

Convert JSON data to DataFrame

```
weatherforecast_df = pd.DataFrame(json_data['weatherForecast'])
```

Display the DataFrame

```
print(weatherforecast_df.head())
```

```
forecastDate      week          forecastWind \  
0   20250115 Wednesday      North force 4 to 5.  
1   20250116 Thursday       North to northeast force 4, force 5 at first.  
2   20250117 Friday        Northeast force 4, east force 5 later.  
3   20250118 Saturday      East to northeast force 4 to 5, occasionally f...  
4   20250119 Sunday         East to northeast force 2 to 3.  
  
forecastWeather \  
0 Mainly cloudy with a few light rain patches at...  
1 Fine. Rather cool in the morning. Very dry dur...  
2 Fine. Rather cool in the morning. Very dry dur...  
3 Dry with sunny periods.  
4 Mainly fine and dry.  
  
forecastMaxtemp    forecastMinTemp \  
0 {'value': 20, 'unit': 'C'} {'value': 15, 'unit': 'C'}  
1 {'value': 19, 'unit': 'C'} {'value': 13, 'unit': 'C'}  
2 {'value': 19, 'unit': 'C'} {'value': 13, 'unit': 'C'}  
3 {'value': 20, 'unit': 'C'} {'value': 15, 'unit': 'C'}  
4 {'value': 21, 'unit': 'C'} {'value': 16, 'unit': 'C'}  
  
forecastMaxrh    forecastMinrh \  
0 {'value': 80, 'unit': 'percent'} {'value': 40, 'unit': 'percent'}  
1 {'value': 65, 'unit': 'percent'} {'value': 35, 'unit': 'percent'}  
2 {'value': 65, 'unit': 'percent'} {'value': 30, 'unit': 'percent'}  
3 {'value': 70, 'unit': 'percent'} {'value': 40, 'unit': 'percent'}  
4 {'value': 70, 'unit': 'percent'} {'value': 40, 'unit': 'percent'}  
  
ForecastIcon PSR  
0      51 Low  
1      92 Low  
2      50 Low  
3      51 Low  
4      50 Low
```

HKO Weather Data Collection - Reading API

#Continue from previous page

Step 3. Saving Weather Forecasting DataFrame to a CSV

```
csv_file = 'weatherForecast.csv' # Desired output CSV file
```

```
weatherforecast_df.to_csv(csv_file, index=False)
```

```
print(f'Data has been successfully saved to {csv_file}')
```

A	B	C	D	E	F	G	H	I	J
forecastDate	week	forecastWind	forecastWeather	forecastMaxtemp	forecastMintemp	forecastMaxrh	forecastMinrh	ForecastIcon	PSR
20250115	Wednesday	North force 4 to 5.	Mainly cloudy with a few showers.	{'value': 20, 'unit': 'C'}	{'value': 15, 'unit': 'C'}	{'value': 80, 'unit': '%'}	{'value': 40, 'unit': '%'}	51	Low
20250116	Thursday	North to northeast force 4.	Fine. Rather cool in the morning.	{'value': 19, 'unit': 'C'}	{'value': 13, 'unit': 'C'}	{'value': 65, 'unit': '%'}	{'value': 35, 'unit': '%'}	92	Low
20250117	Friday	Northeast force 4, east 5.	Fine. Rather cool in the morning.	{'value': 19, 'unit': 'C'}	{'value': 13, 'unit': 'C'}	{'value': 65, 'unit': '%'}	{'value': 30, 'unit': '%'}	50	Low
20250118	Saturday	East to northeast force 4.	Dry with sunny periods.	{'value': 20, 'unit': 'C'}	{'value': 15, 'unit': 'C'}	{'value': 70, 'unit': '%'}	{'value': 40, 'unit': '%'}	51	Low
20250119	Sunday	East to northeast force 4.	Mainly fine and dry.	{'value': 21, 'unit': 'C'}	{'value': 16, 'unit': 'C'}	{'value': 70, 'unit': '%'}	{'value': 40, 'unit': '%'}	50	Low
20250120	Monday	East to northeast force 4.	Fine and dry.	{'value': 22, 'unit': 'C'}	{'value': 16, 'unit': 'C'}	{'value': 70, 'unit': '%'}	{'value': 40, 'unit': '%'}	50	Low
20250121	Tuesday	East to northeast force 4.	Fine and dry.	{'value': 22, 'unit': 'C'}	{'value': 17, 'unit': 'C'}	{'value': 70, 'unit': '%'}	{'value': 40, 'unit': '%'}	50	Low
20250122	Wednesday	East force 4, occasional rain.	Sunny periods.	{'value': 21, 'unit': 'C'}	{'value': 17, 'unit': 'C'}	{'value': 75, 'unit': '%'}	{'value': 50, 'unit': '%'}	51	Low
20250123	Thursday	East force 4, occasional rain.	Sunny intervals.	{'value': 21, 'unit': 'C'}	{'value': 17, 'unit': 'C'}	{'value': 75, 'unit': '%'}	{'value': 50, 'unit': '%'}	52	Low

Definition

- a web crawler is a computer program that browses the World Wide Web in a methodical, automated manner. (Wikipedia)

Utilities:

- Gather pages from the Web.
- Support a search engine, perform data mining and so on.

Object:

- Text, video, image and so on.
- Link structure

Web Features of a Crawler

Should provide:

- Distributed
- Scalable
- Performance and efficiency
- Quality
- Freshness
- Extensible

Some scraping knowledge

1. HTTP: the communication protocol
2. HTML: the language in which web pages are defined
3. JS: javascript (code executing in the browser)
4. CSS: style sheets, how web pages are styled.
Important, but does not contain data.
5. JPG, PNG, BMP: images, usually not interesting
6. CSV / TXT / JSON / XML: data, interesting !!!

Obtaining Data

Data can come from:

- You curate it
- Someone else provides it, all pre-packaged for you
(e.g., files)
- Someone else provides an API
- Someone else has available content, and you try to take it (web scraping)

Obtaining Data – Web Scraping

Web Scraping

- Using programs to get data from online
- Often much faster than manually copying data!
- Transfer the data into a form that is compatible with your code

Obtaining Data – Web Scraping

Why scraping the web?

- Vast source of information; can combine with multiple datasets
- Companies have not provided APIs
- Automate tasks
- Keep up with sites / real-time data
- Fun!

Obtaining Data – Web Scraping

Robots.txt

- Specified by web site owner
- Gives instructions to web robots (e.g., your code)
- Located at the top-level directory of the web server
 - E.g., <http://google.com/robots.txt>

Robots.txt

- Protocol for giving spiders ("robots") limited access to a website

www.robotstxt.org/wc/norobots.html

- Website announced its request on what can(not) be crawled
 - For a server, create a file /robots.txt
 - This file specifies access restrictions

Robots.txt

- Protocol for giving spiders ("robots") limited access to a website

www.robotstxt.org/wc/norobots.html

- Website announced its request on what can(not) be crawled
 - For a server, create a file /robots.txt
 - This file specifies access restrictions

An example of robots.txt

- No rebot should visit any URL starting with "/yoursite/temp/", except the rebot called "searchengine":
- User-agent: *
- Disallow: /yoursite/temp/
- User-agent: searchengine
- Disallow:

Obtaining Data – Web Scraping

Web Servers

- A server maintains a long-running process (also called a daemon), which listens on a pre-specified port
- It responds to requests, which is sent using a protocol called HTTP (HTTPS is secure)
- Our browser sends these requests and downloads the content, then displays it
- 2 – request was successful, 4 – client error, often `page not found`; 5 – server error (often that your request was incorrectly formed)

Obtaining Data – Web Scraping

HTML

- Tags are denoted by angled brackets
- Almost all tags are in pairs e.g.,
`<p>Hello</p>`
- Some tags do not have a closing tag e.g.,
`
`

Example

```
<!DOCTYPE html>
<html>
  <head>
    <title>Title</title>
  </head>
  <body>
    <h1>Body Title</h1>
    <p>Body Content</p>
  </body>
</html>
```

Obtaining Data – Web Scraping

HTML

- <html>, indicates the start of an html page
- <body>, contains the items on the actual webpage (text, links, images, etc)
- <p>, the paragraph tag. Can contain text and links
- <a>, the link tag. Contains a link url, and possibly a description of the link
- <input>, a form input tag. Used for text boxes, and other user input
- <form>, a form start tag, to indicate the start of a form
- , an image tag containing the link to an image

Obtaining Data – Web Scraping

How to Web scrape:

1. Get the webpage content

- Requests (Python library) gets a webpage for you

2. Parse the webpage content

- (e.g., find all the text or all the links on a page)
- BeautifulSoup (Python library) helps you parse the webpage.
- Documentation:
<http://crummy.com/software/BeautifulSoup>

The Big Picture Recap

Data Sources	Files, APIs, Webpages (via Requests)
Data Parsing	Regular Expressions, Beautiful Soup
Data Structures/Storage	Traditional lists/dictionaries, PANDAS
Models	Linear Regression, Logistic Regression, kNN, etc

BeautifulSoup only concerns
webpage data

Obtaining Data – Web Scraping

1. Open tools “Anaconda Prompt” which will direct you to the command prompt.



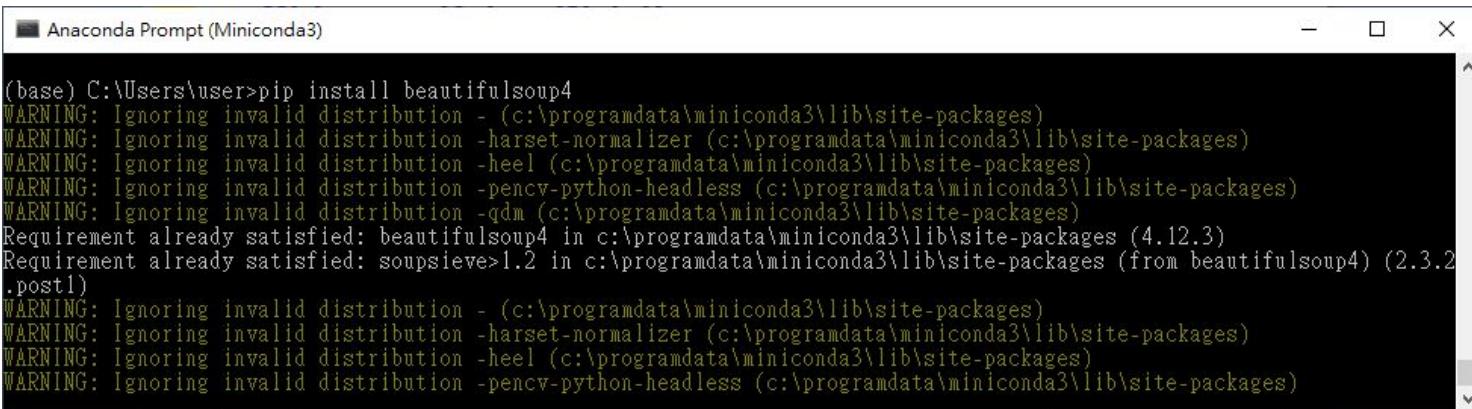
2. Install python package requests by entering “pip install requests”

```
(base) C:\Users\user>pip install requests
WARNING: Ignoring invalid distribution - (c:\programdata\miniconda3\lib\site-packages)
WARNING: Ignoring invalid distribution -harset-normalizer (c:\programdata\miniconda3\lib\site-packages)
WARNING: Ignoring invalid distribution -heel (c:\programdata\miniconda3\lib\site-packages)
WARNING: Ignoring invalid distribution -pencv-python-headless (c:\programdata\miniconda3\lib\site-packages)
WARNING: Ignoring invalid distribution -qdm (c:\programdata\miniconda3\lib\site-packages)
ERROR: Could not find a version that satisfies the requirement request (from versions: none)
ERROR: No matching distribution found for request

[notice] A new release of pip is available: 24.1.1 -> 24.3.1
[notice] To update, run: python.exe -m pip install --upgrade pip
(base) C:\Users\user>
```

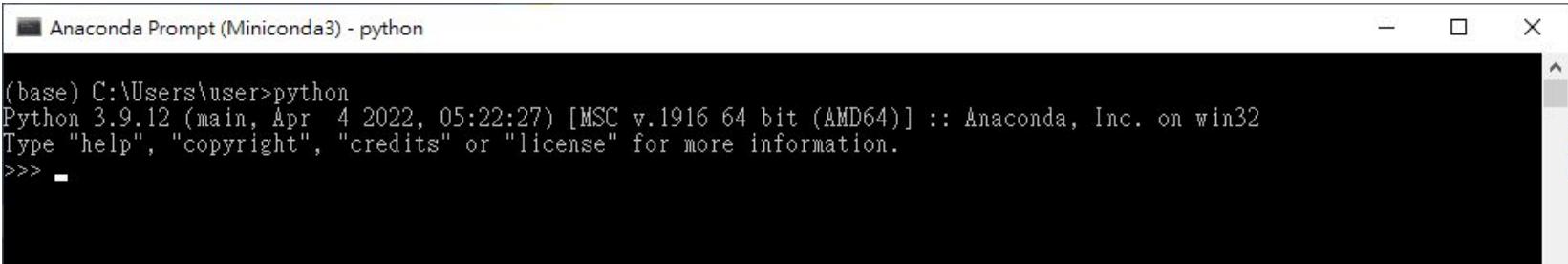
Obtaining Data – Web Scraping

3. Install python package beautifulsoup4 by entering “pip install beautifulsoup4”



```
(base) C:\Users\user>pip install beautifulsoup4
WARNING: Ignoring invalid distribution - (c:\programdata\miniconda3\lib\site-packages)
WARNING: Ignoring invalid distribution -harset-normalizer (c:\programdata\miniconda3\lib\site-packages)
WARNING: Ignoring invalid distribution -heel (c:\programdata\miniconda3\lib\site-packages)
WARNING: Ignoring invalid distribution -pencv-python-headless (c:\programdata\miniconda3\lib\site-packages)
WARNING: Ignoring invalid distribution -qdm (c:\programdata\miniconda3\lib\site-packages)
Requirement already satisfied: beautifulsoup4 in c:\programdata\miniconda3\lib\site-packages (4.12.3)
Requirement already satisfied: soupsieve>1.2 in c:\programdata\miniconda3\lib\site-packages (from beautifulsoup4) (2.3.2
.post1)
WARNING: Ignoring invalid distribution - (c:\programdata\miniconda3\lib\site-packages)
WARNING: Ignoring invalid distribution -harset-normalizer (c:\programdata\miniconda3\lib\site-packages)
WARNING: Ignoring invalid distribution -heel (c:\programdata\miniconda3\lib\site-packages)
WARNING: Ignoring invalid distribution -pencv-python-headless (c:\programdata\miniconda3\lib\site-packages)
```

4. Enter “python” in the command



```
(base) C:\Users\user>python
Python 3.9.12 (main, Apr  4 2022, 05:22:27) [MSC v.1916 64 bit (AMD64)] :: Anaconda, Inc. on win32
Type "help", "copyright", "credits" or "license" for more information.
>>> -
```

Obtaining Data – Web Scraping

1. Get the webpage content

Requests (Python library) gets a webpage for you

```
import requests  
  
url =  
"https://www.nytimes.com/internationa  
l/"  
  
page = requests.get(url)  
page.status_code  
page.content
```

Obtaining Data – Web Scraping

1. Get the webpage content

Requests (Python library) gets a webpage for you

```
import requests
```

```
url =  
"https://www.nytimes.com/  
1/"
```

```
page = requests.get(url)  
page.status_code  
page.content
```

Gets the status from the webpage request.
200 means success.
404 means page not found.

Obtaining Data – Web Scraping

1. Get the webpage content

Requests (Python library) gets a webpage for you

```
import requests
```

```
url =
```

```
"https://www.nytimes.com/internationa  
l/"
```

```
page = requests.get(url)
```

```
page.status_code
```

```
page.content
```

Returns the content of
the response, in
bytes.

Obtaining Data – Web Scraping

2. Parse the webpage content

BeautifulSoup (Python library) helps you parse a webpage

```
from bs4 import BeautifulSoup  
  
soup = BeautifulSoup(page.content ,  
"html.parser")  
  
soup.title  
  
soup.title.text
```

Obtaining Data – Web Scraping

2. Parse the webpage content

BeautifulSoup (Python library) helps you parse a webpage

```
from bs4 import BeautifulSoup
```

```
soup = BeautifulSoup(page.content,  
"html.parser")
```

```
soup.title
```

```
soup.title.text
```

Returns the full context, including
the title tag. e.g.,

```
<title data-rh="true">The New York  
Times - Breaking News</title>
```

Obtaining Data – Web Scraping

2. Parse the webpage content

BeautifulSoup (Python library) helps you parse a webpage

```
soup = BeautifulSoup(page.content,  
"html.parser")
```

```
soup.title
```

```
soup.title.text
```

Returns the text part of the title

tag. e.g.,

The New York Times – Breaking
News

Obtaining Data – Web Scraping

BeautifulSoup

- Helps make messy HTML digestible
- Provides functions for quickly accessing certain sections of HTML content

Example

```
import bs4
## get bs4 object
soup = bs4.BeautifulSoup(source)
## all a tags
soup.findAll('a')
## first a
soup.find('a')
## get all links in the page
link_list = [l.get('href') for l in soup.findAll('a')]
```

Obtaining Data – Web Scraping

HTML is a tree

- You don't have to access the HTML as a tree, though;
- Can immediately search for tags/content of interest (a la previous slide)

Example

```
tree = bs4.BeautifulSoup(source)

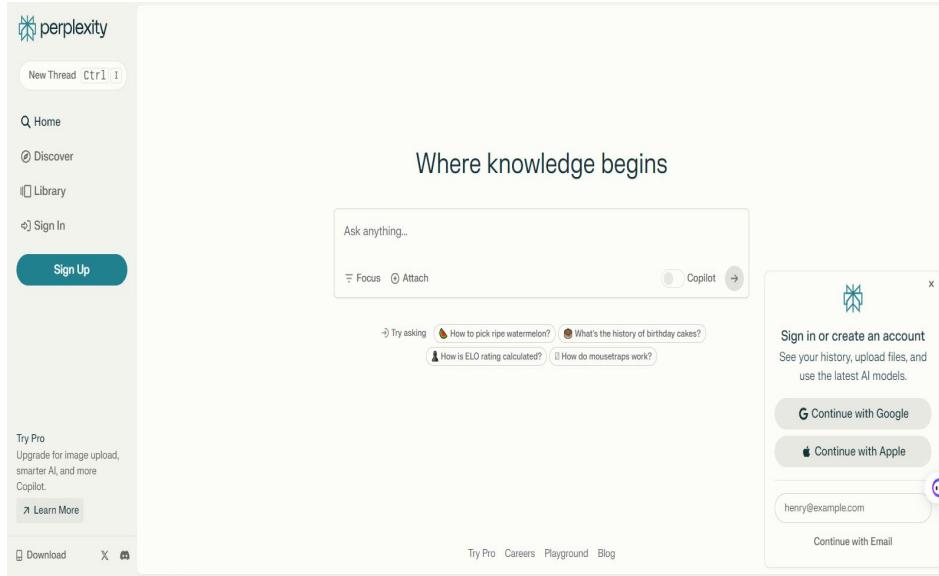
## get html root node
root_node = tree.html

## get head from root using contents
head = root_node.contents[0]

## get body from root
body = root_node.contents[1]

## could directly access body
tree.body
```

Generative AI Tools Introduction – Perplexity



```
python
def compound_interest(principal, rate, time, n):
    """
    Calculate compound interest.

    principal: initial amount (float)
    rate: annual interest rate in decimal (e.g., 5% as 0.05)
    time: time in years (float)
    n: number of compounding periods per year (int)

    Returns:
        tuple containing (final amount, compound interest)
    """
    amount = principal * (1 + rate / n) ** (n * time)
    interest = amount - principal
    return amount, interest

# Example usage:
principal = 1000 # $1000
rate = 0.05 # 5% interest rate
time = 10 # 10 years
n = 12 # compounded monthly
```

```
# Example usage:
principal = 1000 # $1000
rate = 0.05 # 5% interest rate
time = 10 # 10 years
n = 12 # compounded monthly

final_amount, interest = compound_interest(principal, rate, time, n)
print(f"Final Amount: ${final_amount:.2f}")
print(f"Compound Interest: ${interest:.2f}")
```

Output:

```
text
Final Amount: $1647.01
Compound Interest: $647.01
```

- Enter <https://www.perplexity.ai/>
- Input prompt "write python compound interest calculations"

Obtaining Data – Web Scraping

Open Browser and enter
<https://www.hk01.com/>

Right Click and Select “Inspect”



Select the Content that you want to extract

Obtaining Data – Web Scraping

Right Click and click "Edit As HTML"
Copy part of the code until "/div>

The screenshot shows a news article from the Hong Kong CI website. The article features a man presenting a medical device at an exhibition. Below the main image, there is a headline: '李嘉誠治肝癌新儀器料歸三私院 陸志聰：公院引入須顧人手及預算'. The sidebar contains links for '社會新聞', '會員資訊', '01空間', '01網購', and '01心意'. On the right, the browser's developer tools are open, specifically the 'Elements' tab. A context menu is displayed over some HTML code, with 'Edit as HTML' being the selected option. The code snippet shown is:

```
<!DOCTYPE html>
<html lang="zh-HK"> (scroll)
  <head> ... </head>
  <body aria-hidden="false" style="padding: 0px 0px 154px;">
    <div id="...">
      <div class="flex flex-wrap self-stretch">
        <div class="flex flex-grow"> ... </div>
      </div>
    </div>
  </body>
</html>
```

Obtaining Data – Web Scraping

Open Perplexity at <https://www.perplexity.ai/>

Enter prompt "write python beatifulsoap to extract data from website url <https://www.hk01.com/> with html code {htmlcode}"

Where {htmlcode} = "<div class="page__layout-navbar" data-testid="page-layout-navbar"><div class="flex flex-none items-center md:hidden"><button data-testid="hamburger-menu-button" class="box-border w-6 px-0 py-3 m-0 transition-all duration-[0.6s] ease-[cubic-bezier(0.19,1,0.22,1)] [transform:translateZ(0)] border-none outline-none rounded-none cursor-pointer shadow-none bg-transparent focus:shadow-none focus:outline-none" aria-label="mobile-menu"></button></div>"

Obtaining Data – Web Scraping

In original perplexity prompt, type the following prompt
“Add code that save it into csv file”

	A
1	text,url,class
2	,
3	港聞,/zone/1/%E6%B8%AF%E8%81%9E,
4	兩會焦點,/issue/10355/%E5%85%A9%E6%9C%832025-%E5%9C%8B%E9%9A%9B%E5%B1%80%
5	娛樂,/zone/2/%E5%A8%9B%E6%A8%82,
6	最平酒店,https://clk.omg13.com/?AID=2200313&PID=55029&uid=content&uid2=channel_旅遊_editor
7	國際,/zone/4/%E5%9C%8B%E9%9A%9B,
8	即時,/latest,
9	熱榜,/hot,
10	生活,/zone/8/%E7%94%9F%E6%B4%BB,
11	科技,/zone/11/%E7%A7%91%E6%8A%80%E7%8E%A9%E7%89%A9,
12	中國,/zone/5/%E4%B8%AD%E5%9C%8B,
13	體育,/zone/3/%E9%AB%94%E8%82%B2,
14	01深圳,/zone/25/01%E6%B7%B1%E5%9C%B3,
15	經濟,/zone/14/%E7%B6%93%E6%BF%9F,
16	觀點,/zone/12/%E8%A7%80%E9%BB%9E,
17	健康,/zone/24/%E5%81%A5%E5%BA%B7,
18	好食玩飛,/zone/19/%E5%A5%BD%E9%A3%9F%E7%8E%A9%E9%A3%9B,
19	女生,/zone/6/%E5%A5%B3%E7%94%9F,
20	熱話,/zone/7/%E7%86%B1%E8%A9%B1,
21	藝文格物,/zone/9/%E8%97%9D%E6%96%87%E6%A0%BC%E7%89%A9,
22	社區,/zone/10/%E7%A4%BE%E5%8D%80,
23	教育,/zone/23/%E6%95%99%E8%82%B2,
24	簡,,"font-light, pointer-events-none, !text-light-n5"
25	
26	
27	Mobile Menu Details:
28	Exists: True

How To Do Data Mining: Machine Learning Techniques

Features / Attributes

1. District
2. Floor

Outcome

1. Price Per Square

<https://www.28hse.com/en/rent/apartment/property-3496859>

Floor zone	Middle Floor
Saleable Area	807 ft ² Unit Price: @46.8

<https://www.28hse.com/en/rent/apartment>

The image displays three separate apartment listing cards from the website 28hse.com, each featuring a small thumbnail image, basic information, and a green "Lease HKD\$ [price]" button.

- Top Listing:** Located in Tsuen Wan, Ocean Pride, Unit C, Mid Floor, Tower 1. Saleable Area: 807 ft² @46.8. Features: Apartment, Good view, Sea view, Elegant, Air conditioner, Washing Machine, Water Heaters, Refrigerator, Induction Hob, Cooker Hood. Price: Lease HKD\$37,800.
- Middle Listing:** Located in Hung Hom, Upper East, High Floor, Tower 1A. Saleable Area: 375 ft² @49.3. Features: 1 Bedroom, 1 Bathroom, Western Style Bldg, Stand-alone Building, Good view, Sea view, Elegant, Microwave Oven, Air conditioner, Washing Machine, Water Heaters. Price: Lease HKD\$18,500.
- Bottom Listing:** Located in Kwun Tong, Hamden Court, High Floor, Block A. Saleable Area: 481 ft² @35.8. Features: 3 Bedrooms, 1 Bathroom, Western Style Bldg, Good view, Elegant. Price: Lease HKD\$17,200.

How To Do Data Mining: Machine Learning Techniques

In perplexity, enter the prompt “write python beautifulsoap to extract data from website url and save data into csv file using {pythoncode} from original html code {htmlcode}”

```
pythoncode = ""  
import csv  
import pandas as pd  
from bs4 import BeautifulSoup  
from selenium import webdriver  
from selenium.webdriver.common.by import By  
from selenium.webdriver.common.keys import Keys  
from selenium.webdriver.firefox.options import Options  
import requests  
import time  
  
from selenium.webdriver.support.ui import WebDriverWait  
from selenium.webdriver.support import expected_conditions as EC  
  
def main(url:str, per_page:int = 120, **kwargs):  
    options = kwargs.get('driver_options', Options())  
    # per_page = kwargs.get('per_page', 120)  
    # url = f'{url}?per_page={per_page}'  
    options.headless = True  
  
    firefox_options = Options()  
    firefox_options.set_preference("dom.webdriver.enabled", False)  
  
    driver = webdriver.Firefox(  
        options=firefox_options  
    )  
  
    driver.get(url)  
    # Get the page source  
    html = driver.page_source  
  
    # Create a BeautifulSoup object from the HTML  
    soup = BeautifulSoup(html, 'html.parser')
```

How To Do Data Mining: Machine Learning Techniques

```
htmlcode = ""  
<div class="ui segment search_results_div" id="search_results_div">    <div class="listItems ui divided items">  
    <div class="item property_item ">  
        <div class="image myimage desktop_myimage">  
            <a class="detail_page" href="https://www.28hse.com/en/rent/office/property-3445279"  
attr1="3445279" target="_blank">  
                  
  
                <div class="myimage_count_outer"><div class="ui labels myimage_count">  
                    <span class="ui label" style="">  
                        10  
  
                    </span></div></div>  
                    <div class="ui top left attached small label  
grade_label">Golden</div>  
                </a>  
            </div>  
            <div class="content">  
                <div class="right floated">  
                    <div class="fav" attr1="3445279" attr2="inactive"><i class="ui red heart  
large outline icon"></i></div>  
                </div>  
            </div>  
        </div>  
    </div>  
</div>
```

Data Collection – Fetching Data using Pandas

What / Why?

- Pandas is an *open-source* Python library (anyone can contribute)
- Allows for high-performance, easy-to-use data structures and data analysis
- Unlike NumPy library which provides multi-dimensional arrays, Pandas provides 2D table object called **DataFrame** (akin to a spreadsheet with column names and row labels).
- Used by *a lot* of people

Data Collection – Fetching Data using Pandas

How

- import `pandas` library (convenient to rename it)
- Use `read_csv()` function

```
import pandas as pd  
dataframe = pd.read_csv("yourfile.csv")
```

Data Collection – Fetching Data using Pandas

Common Panda functions

High-level viewing:

- `head()` – first N observations
- `tail()` – last N observations
- `columns()` – names of the columns
- `describe()` – statistics of the quantitative data
- `dtypes()` – the data types of the columns

Data Collection – Fetching Data using Pandas

Common Panda functions

Accessing/processing:

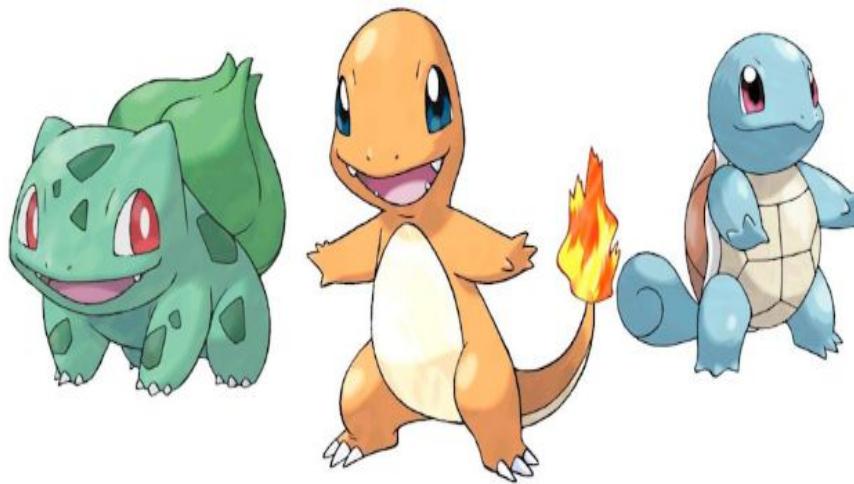
- `df["column_name"]`
- `Df.column_name`
- `.max(), .min(), .idxmax(), .idxmin()`
- `<dataframe> <conditional statement>`
- `.loc[]` – label-based accessing
- `.iloc[]` – index-based accessing
- `.sort_values()`
- `.isnull(), .notnull()`

Download the data

Download the Pokemon dataset from:

https://github.com/innoviai/ipa_courses/blob/main/Lecture%203/pokemon_dataset.csv

Save the pokemon dataset file in a location you'll remember.



Reading in the data

First we import the Python packages we are going to use.
Then we use Pandas to load in the dataset as a data frame.

```
import numpy as np  
import pandas as pd  
from matplotlib import pyplot as plt  
import seaborn as sns  
  
df1 = pd.read_csv("filepath/to/where/data/is/stored/pokemon_dataset.csv",  
index_col=0, encoding="ISO-8859-1")
```

NOTE: The argument `index_col` argument states that we'll treat the first column of the dataset as the ID column.
NOTE: The `encoding` argument allows us to bypass an input error created by special characters in the data set.

Examine the data set

```
print(df1.head())
```

#	Name	Type 1	Type 2	Total	...	Sp. Def	Speed	Stage	Legendary
1	Bulbasaur	Grass	Poison	318	...	65	45	1	False
2	Ivysaur	Grass	Poison	405	...	80	60	2	False
3	Venusaur	Grass	Poison	525	...	100	80	3	False
4	Charmander	Fire		309	...	50	65	1	False
5	Charmeleon	Fire		405	...	65	80	2	False

```
print(df1.describe())
```

	Total	HP	Attack	...	Sp. Def	Speed	Stage
count	151.00000	151.00000	151.00000	...	151.00000	151.00000	151.00000
mean	407.07947	64.211921	72.549669	...	66.019868	68.933775	1.582781
std	99.74384	28.590117	26.596162	...	24.197926	26.746880	0.676832
min	195.00000	10.00000	5.00000	...	20.00000	15.00000	1.000000
25%	320.00000	45.00000	51.00000	...	49.00000	46.50000	1.000000
50%	405.00000	60.00000	70.00000	...	65.00000	70.00000	1.000000
75%	490.00000	80.00000	90.00000	...	80.00000	90.00000	2.000000
max	680.00000	250.00000	134.00000	...	125.00000	140.00000	3.000000



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THANK YOU

