Use of Electronic Learning and Teaching Resource Materials in Teaching Python Programming

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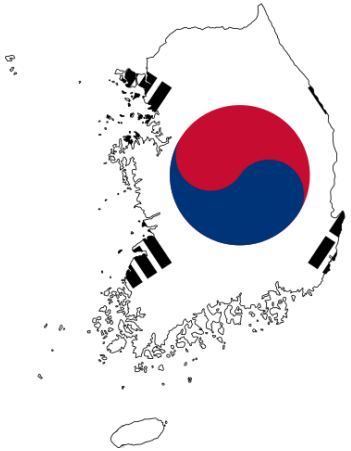
Importance of Programming - Global

- Many jobs require programming knowledge
- Even traditional jobs function, such as bankers
- Careers in computing make up most of STEM jobs opening

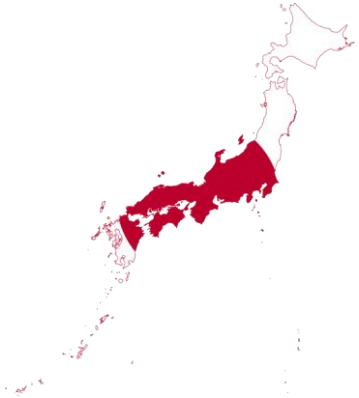
- https://www.usatoday.com/story/opinion/2013/02/26/computer-programming-coding-education/1947551/
- https://csedweek.org/resource_kit/blurbs

美國前總統奧巴馬在其國情咨文中提出「面向所有人的計算機科學」新計劃，美國多家知名互聯網企業參與其中，向全國中小學生提供包括編程在內的計算機課程，從而讓美國興起了一場全國中小學生計算機編程教育運動。

英國教育部於**2014**年9月啓用新的計算機教學大綱，強調學習更廣泛的「計算機素養」，而非簡單掌握如何運用電腦或操作軟件。新的大綱規定，孩子從5歲起就得學習使用算法公式編程，從11歲起學習程序設計語言。



韓國教育部決定，從**2018**年起將編程納入小學正規課程。



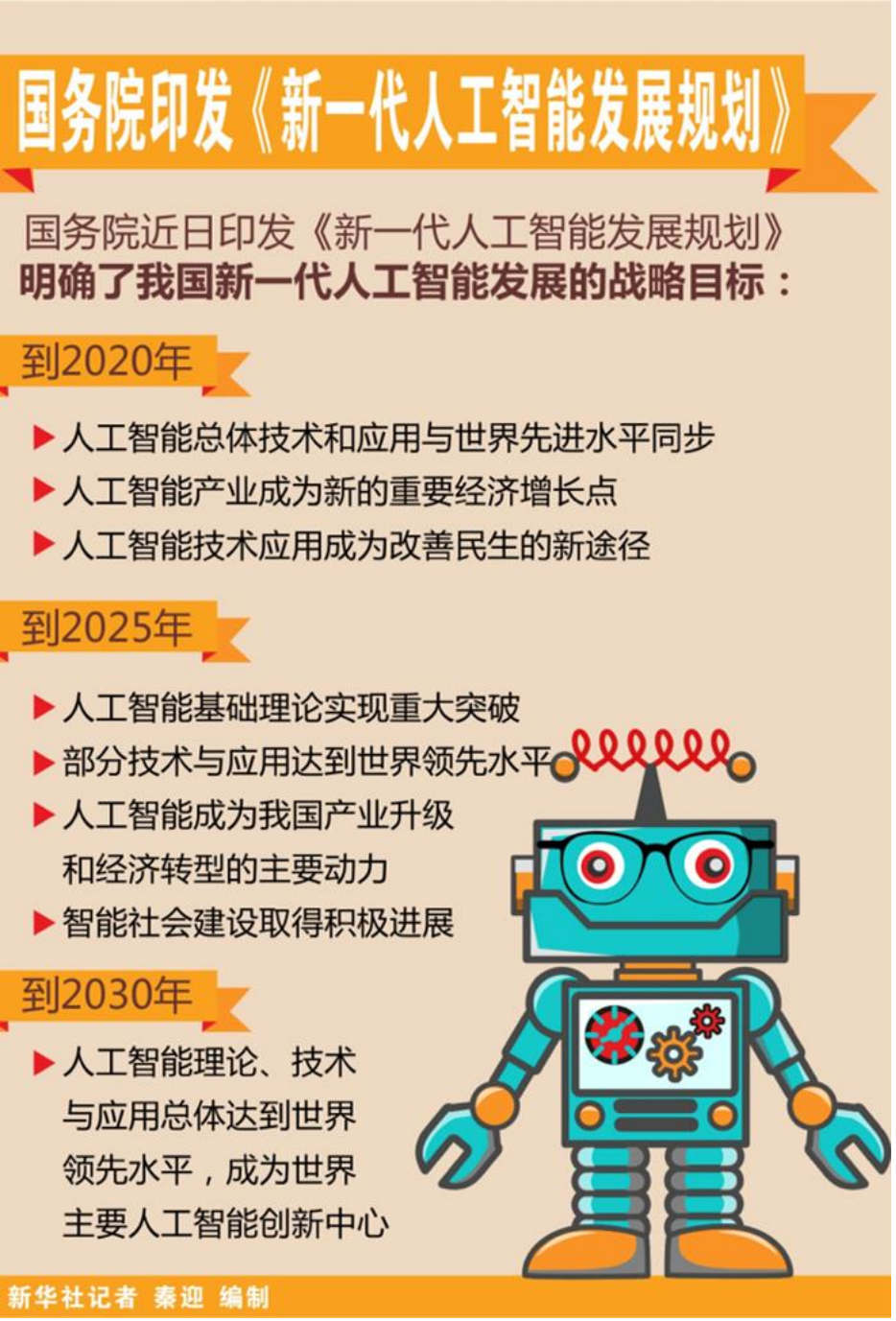
日本文部科學省已決定將程式編寫納為必修科，將於**2020** 年在小學推行，並分別在 2021 及 22 年把計劃拓展至中學和高校。中學課程會加入更豐富的內容；在高校程式編寫也會由選修科變成必修科。

Importance of Programming – Computational Thinking

- Computational Thinking started from primary education.
- Programming in secondary education can nurture the computational thinking of student
- Programming can prepare students to access higher education in different discipline , such as Engineering, Science , Business and more

- 製造計算製品
  - 儲存程式電腦的概念
  - 使用變量以便儲存及修改數據
  - 基本程序編寫的結構
    - 序列
    - 分支／選擇
    - 循環
  - 抽象的概念
    - 格局圖樣
    - 模組化
  - 開發程序／編碼
    - 程序編寫語言的語法和語義
    - 設計、重用、混合程序／編碼
    - 搜尋／排序算法
    - 使用綜合開發環境 (IDE)
  - 與實物進行互動

● 意識「序列」為設計算法中一個基本結構（組件） ● 明白「序列」中的每個步驟為一個指令，並在算法中按照次序逐一執行。例如：清潔牙齒的算法 ● 意識及明白任務次序中，正確指令或步驟必需依一正確序列，例如綁鞋帶、按照食譜烹調、使用計算機計算「a + b X c」算式、按照課業與考試的分數，計算已經加權後的分數 ● 意識有些次序並非重要，如寫郵寄地址的「常規次序」
● 意識「分支／選擇」為設計算法中一個基本結構（組件） ● 明白在算法中的某一步驟可能出現多於一個方法／路徑來處理，而發生的位置與時間需要作出「選擇」或「決策」，例如支付巴士車資 ● 意識及明白單一分支 IF（如果下雨我便使用傘子）及多個 IF（找出某一月份的日數）算法所涉及的步驟。例如識別及尋找康文署游泳池等的開放時間
● 意識「循環」為設計算法中一個基本結構（組件） ● 明白「循環」中的某些步驟需要重覆執行直至被命定或在特定條件成立下停止 ● 意識「循環」的重要性能令電腦進行重覆性的工作。「循環」有助簡化算法。例如：清潔牙齒的算法 ● 意識需要設定重覆的步驟及停止的條件。例如於圖書館尋找某本書，晚餐後清洗碗碟。認識「循環」的不同停止條件，例如，計數器控制、警戒值控制、與無終止



Source: [Xinhuanet]

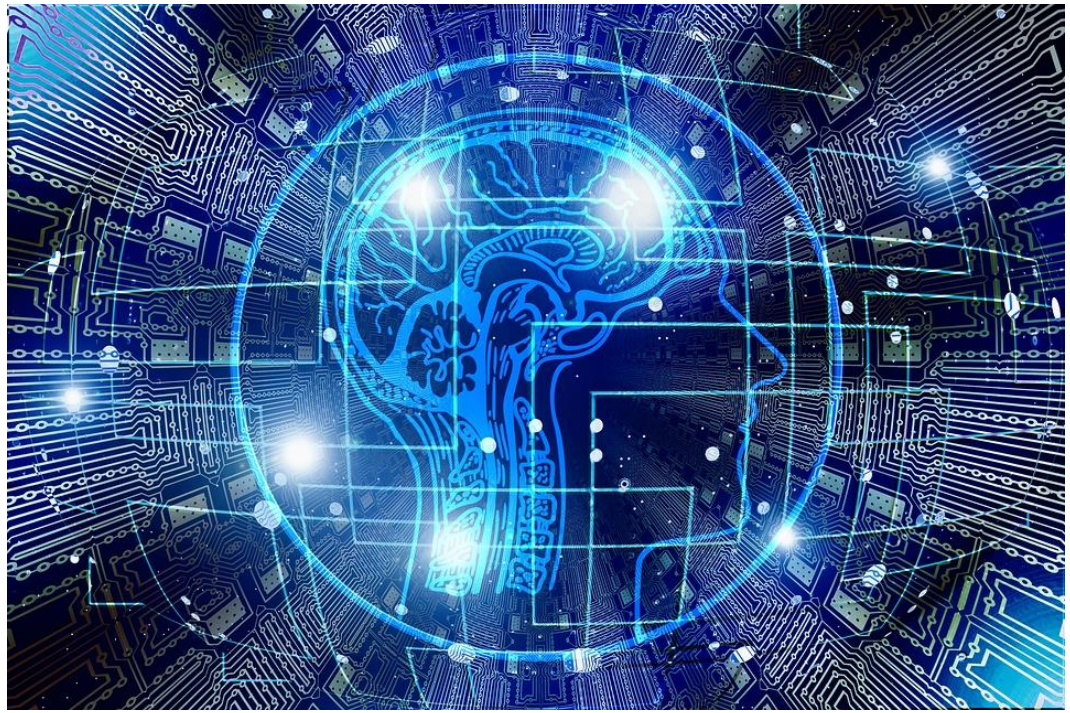
AI in China

- Lack of specialists in AI
- 2017年，《新一代人工智能发展规划》：「要完善人工智能教育体系，建设人工智能学科，在中小学阶段设置人工智能相关课程。」
- AI will contribute a lot to economic growth of China

Introduction

Importance of Programming – Python

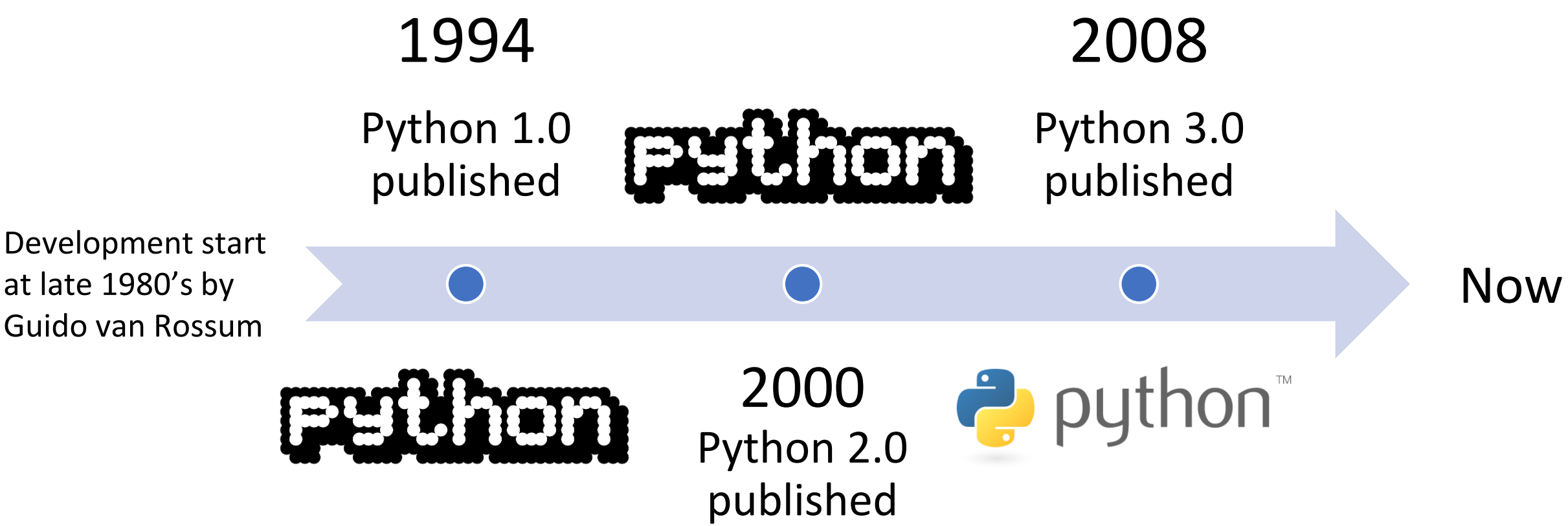
- Python is a popular choice in AI programming, there are many libraries for AI
  - Data visualization - Matplotlib
  - Mathematical modelling - Numpy
  - Remix and Reuse of data - Pandas
- Easy to learn



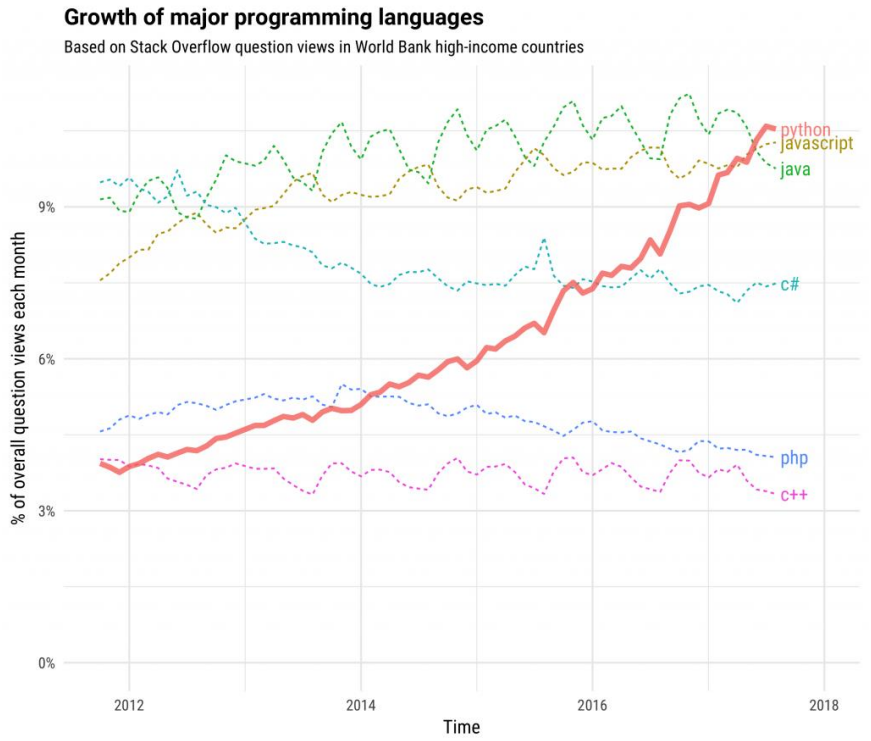
Introduction to Python (advantages)

- Python is a programing language that is easy to write and extend, powerful and cross – platform.
- Interpreted language, no need to compile before execution.
- Open Sources
- Can run in different OS
  - Windows, Linux, Unix, Mac

History of Python

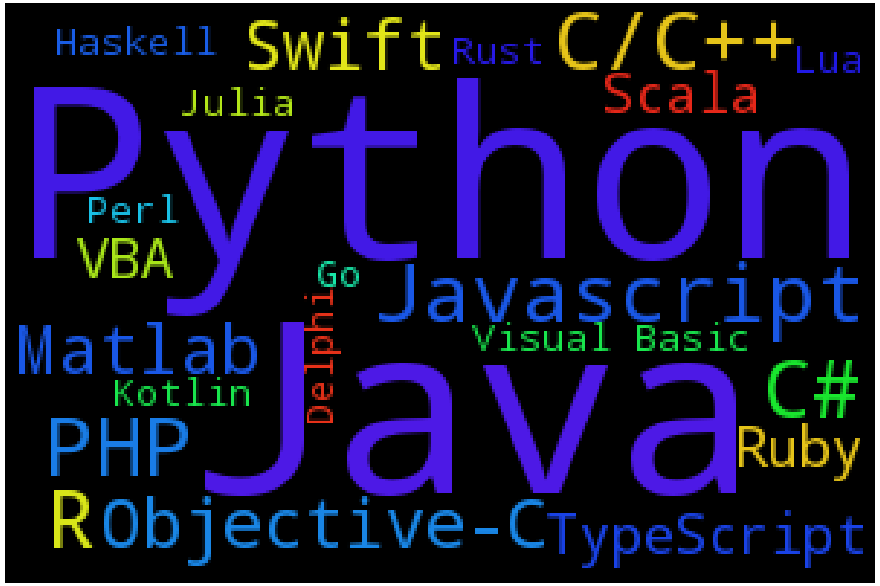


Statistics about Python



https://stackoverflow.blog/2017/09/06/incredible-growth-Python/

- Python is the most trending programming language
- The user base of Python is increasing continuously
- Many universities use Python to teach introductory computer science courses



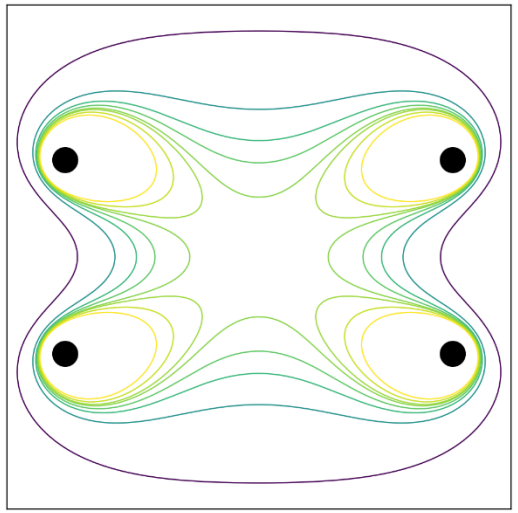
http://pypl.github.io/PYPL.html

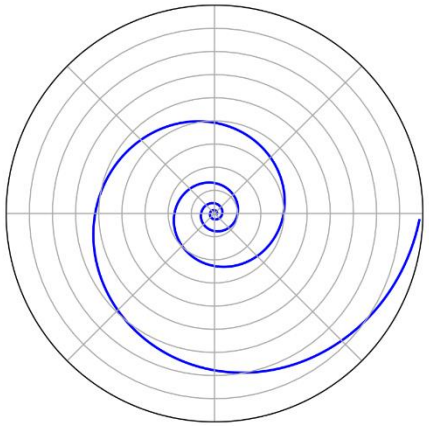
Python Applications - AI

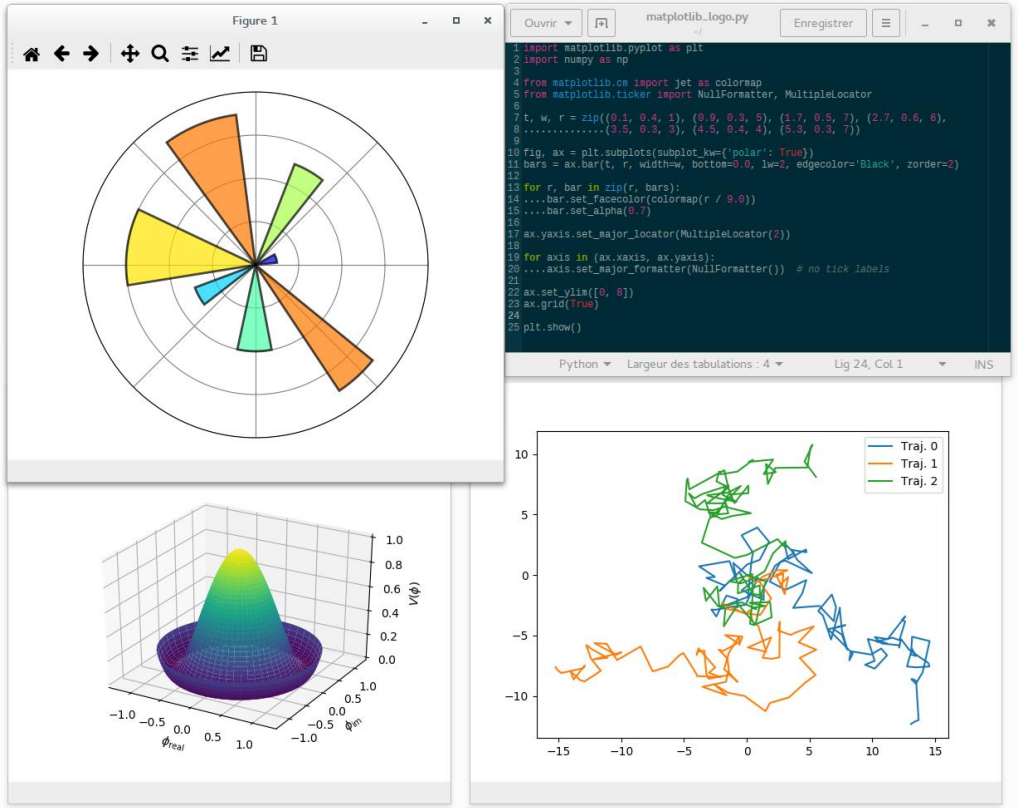
- Machine learning is an important part of AI
  - Machine learning can let the computer to optimize the algorithm used.
  - Google's Machine Learning project - Tensorflow
    - Which provides Python API

Python Applications – Data Visualization

- There are many libraries for data visualization by using Python
  - Matplotlib
  - Seaborn



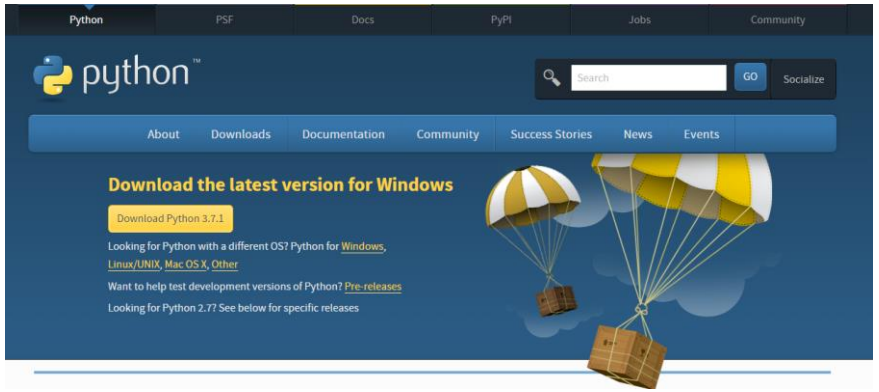


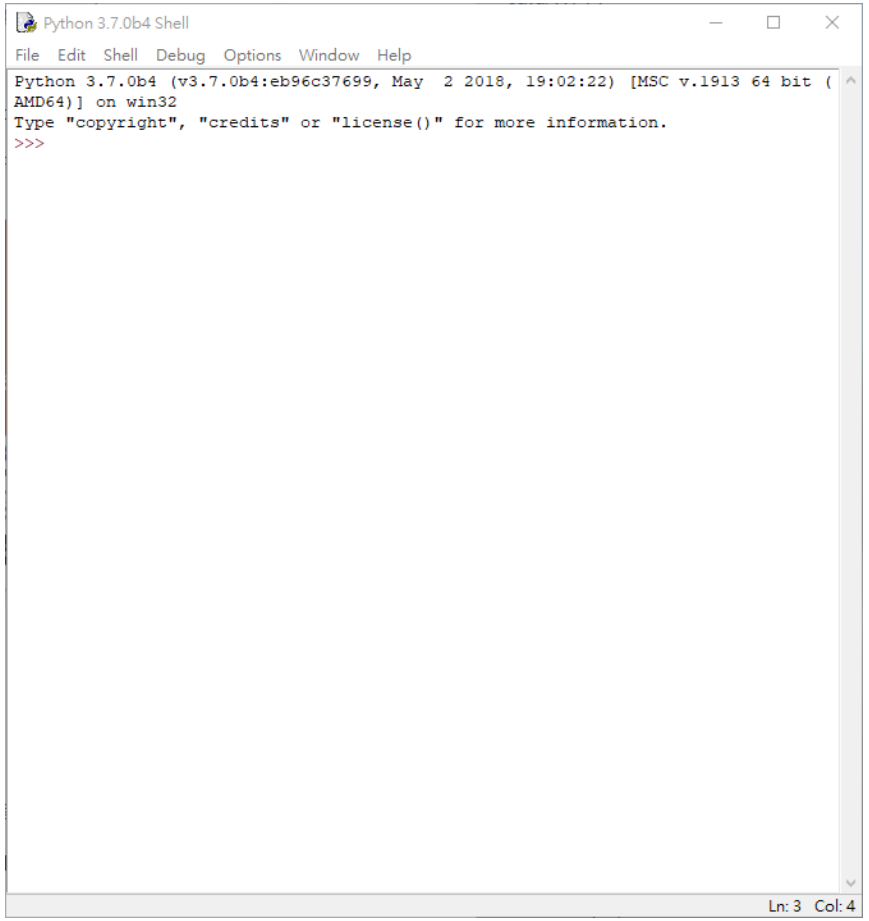


Matplotlib Screenshot from Wikipedia

Development Tools of Python - IDLE

IDLE (Integrated Development and Learning Environment)





https://www.Python.org/downloads/release/Python-370/

E-learning Materials for Python

Cover the basic concept in Python programming

Step-by-Step with examples

From basic to advanced

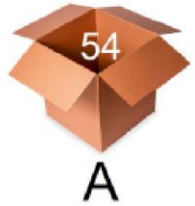
Bilingual, facilitate English and Chinese classes.

E-learning Materials for Python

- Covers the basic concept in Python programming

1. 變量與代數

數學與程式有很多共通之處，它們都是可用來分析和理解這個世界的工具。它們其中一個共同擁有的類似特性就是變量 (Variable)和代數 (Algebra)。



Python 的安裝:

Python 可在官網下載，網址：https://www.python.org/downloads/ ，官網上可以選擇不同操作系統的安裝程式。

E-learning Materials for Python

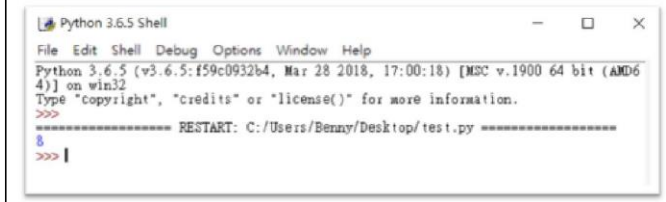
- Step-by-Step examples and exercises help students to learn and understand Python code
- Clipart are included for easier understanding

例子 1

列表的[0],[1]和[2]分別儲存 Peter 的中文、英文、數學考試成績，即中文 56 分，英文 98 分，數學 76 分。

Python 的程式碼	輸出會顯示
score_of_peter = [56, 98, 76] print(score_of_peter[0]) print(score_of_peter[1]) print(score_of_peter[2])	56 98 76

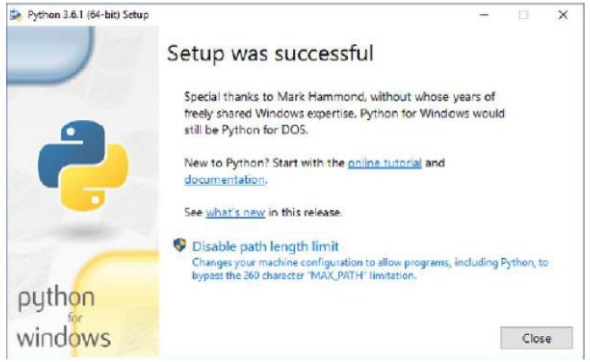
程式就會被執行。



E-learning Materials for Python

- From basic to advance

Background Information → Basic data structure → Operators → Loops → Modules → Practical Applications



6. 邏輯運算

and 而且/與

or 或者

not 相反

E. 計算符合準則的物件數目

例子 1

程式碼	輸出會顯示

a_list = [8,7,2,9,4,8]
 	
counter = 0
 	
for i in range(0,len(a_list)):
  if a_list[i] > 2:
  counter = counter + 1
 	
print(counter)
	5

以上程式能計算出在 list 內能大過 2 的元素(數字)的數量。

E-learning Materials for Python

- Bilingual, which facilitate English and Chinese classes

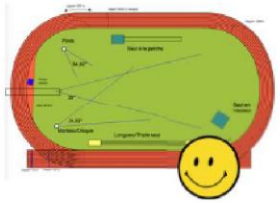
8. for loop (循環)

Loop 的概念有點像田徑賽中的運動員，他們會不斷重複圍著圈跑。

8. For loop (Looping)

The concept of loop is similar to athletes who run around the cycle repeatedly.

i	2	呼叫"Hello"

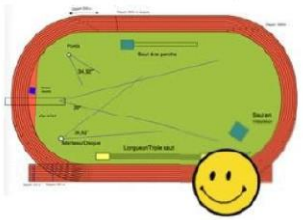


```
for i in range(0,2):
print ("hello")
```

Source: Ewan ar Born

如果我們想要求程式顯示兩次 hello，我們能利用 for loop 來完成。0 代表 i 由 0 開始累加。2 代表 i<2 的情況下，循環會繼續運作。

i	2	Call "Hello"



```
for i in range(0,2):
print ("hello")
```

Source: Ewan ar Born

We can use "for loop" if we want the program to show "hello" for two times. "0" represents that "i" starts to accumulate from 0. "2" represents that the loop will run continuously if **i** < 2.

Structure of the E-learning Material

A. Basic concept
B. Maximum value, Minimum value, Mean
C. Searching
D. Strings
E. Counting the number of objects which match criteria in list
F. Sequence test

Concepts and Prerequisites

Module A Topics	A	B	C	D	E	F
Variable and Algebra	✔	✔	✔	✔	✔	✔
Operators	✔	✔	✔	✔	✔	✔
List	✔	✔	✔			✔
Conditionals (If then)	✔	✔	✔		✔	✔
Conditionals (If then else)	✔		✔			
Logical operation	✔				✔	
Cumulative Addition and Subtraction	✔	✔				
for loop	✔	✔	✔		✔	✔
while loop	✔		✔			

Basic knowledge with ✔ are suggested to be covered before teaching Module B to F.

Module A. Basic concept

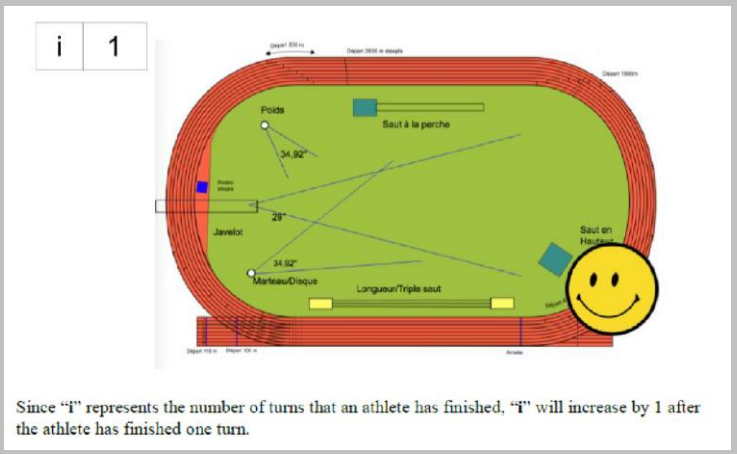
What is “Python”	Variables and Algebra	Operator	List	If ... (conditional statement)
... Else (conditional statement)	Logical operation	Addition / Subtraction	For loop (loop)	While loop (loop)
		Functions and Modules		

A. Basic concept
    0. What is “Python”
    1. Variables and Algebra
    2. Operator
    3. List
    4. If ... (conditional statement)
    5. ... Else (conditional statement)
    6. Logical operation
    7. Addition / Subtraction
    8. For loop (loop)
    9. While loop (loop)
    10. Modules
B. Maximum value, Minimum value, Mean
C. Searching
D. Strings
E. Counting the number of objects which match criteria in list
F. Sequence test

Module A - Basic concept

Learning Objectives:

- Understanding what is Python
- Installing Python
- Understanding the use of fundamental objects in Python (Variable and Algebra, Operators, List)



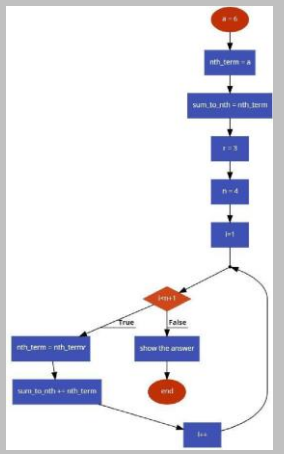
Since "i" represents the number of turns that an athlete has finished, "i" will increase by 1 after the athlete has finished one turn.

Example 1

Code	Output
for i in range(0,5): print(i)	0 1 2 3 4

Module A - Basic concept

- This module consists of 4 lessons and covers basic concepts of Python programming, such as prerequisite step before writing a program, basic data structure and syntax.



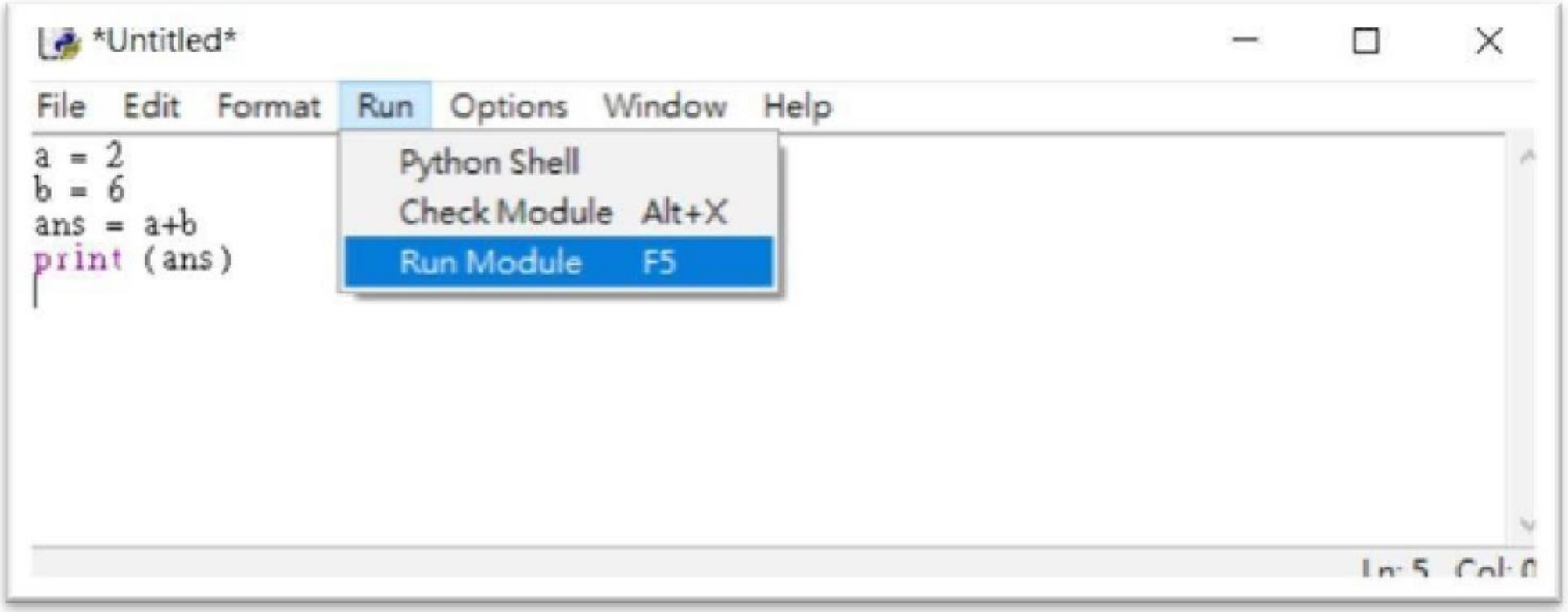
9. While loop (Looping)

In addition, "**while loop**" can make a program run repeatedly.

Example 1

Code	Output
i=0 while(i<2): print("hello") i = i + 1	hello hello

Click “Run” and choose “Run Module”.



Teaching Strategy

- Mapping the symbol of Pseudocode and Python code

Pseudocode	Python
<-	=
<>	!=
^	**
Output x	print(x)

Teaching Strategy

- Dry-run the Python program

Python Code
a = float(2) b = float(8) c = float(a**b) ans = float(c-1) print(ans)

Dry-run table

	a	b	c	ans
1	2			
2		8		
3			256	
4				**255**
5				

Teaching Strategy

- Guide to solve problem in daily life
  - Such as BMI calculator

Python Code

```
a = float(input('Please input your weight: '))
b = float(input('Please input your height: '))
c = float(b**2)
ans = float(a/c)
print(ans)
```

$$\text{BMI} = \frac{\text{Weight (kg)}}{\text{Height}^2\ (\text{m}^2)}$$

Module B - Maximum, Minimum, Mean (Average)

Learning Objectives:

- Applying all the basic concepts flexibly;
- Using fundamental concept to write a practical application program – Maximum, Minimum, Mean;
- Applying programming techniques to calculate through mathematical formulas.

This module consists of 1 lesson and covers basic statistical functions of Python.

B. Maximum, Minimum, Mean(Average)

Maximum

Code	Output
a_list = [8, 2, 0, – 5, 9] ans = max(a_list) print(ans)	9

Python provides a built – in function to find the maximum value in a list.

Mean (Average)

Code	Output
a_list = [8, 2, 0, – 5, 9] ans = sum(a_list)/len(a_list) print(ans)	2.8

"**Sum**" is a built – in function in Python. It can find out the sum of a list. "**Len**" is another built – in function in Python. It can find out the numbers of value in a list. Lastly, **mean** equals to the sum of list divided by the number of value in the list. (A bit confusing)

Module C - Searching

Learning Objectives:

- Applying all the basic concepts flexibly;
- Using fundamental concepts to write a practical application program – Searching.

This module consists of 1 lesson and covers practical usage of Python programming.

C. Searching

Example 1
We can find a certain value in a list by “searching” function.

Code	Output

a_list = [8, 2, 0, – 5, 9]
 	
search_num = 9
found = 0
 	
for i in range(0,len(a_list)):
  if a_list[i] == search_num:
  found = 1
 	
if found:
  print(search_num," is in the list.")
else:
  print(search_num," is not in the list.")
	9 is in the list.

Module D - Strings

Learning Objectives:

- Understanding string;
- Demonstrating and applying basic operation of string – sampling.

This module consists of 1 lesson and covers some functions that can be used on strings.

D. String

"**String**" is a sequence combined by zero or multiple characters.

Character: 2, T, o, 3
String: "apple", "hello", "hello world"

Character can be a symbol, letter or other single unit. Characters can form a string.

Number of words

Code	Output
a_string = "hello world" len_of_str = len(a_string) print(len_of_str)	11

Characters in " " are defined as a string. "**Len**" is used to find the number of characters in a string.

Module E - Counting the number of objects which meet criteria in list

Learning Objectives:

- Applying all the basic concepts flexibly;
- Using fundamental concepts (loop and conditional statement) to write a practical application program

E. Counting the number of objects which meet the criteria in list

Example 1

Code	Output

a_list = [8,7,2,9,4,8]
 	
counter = 0
 	
for i in range(0,len(a_list)):
  if a_list[i] > 2:
  counter = counter + 1
print(counter)
	5

The above program can be used to find the number of elements (numbers) that are larger than 2 in the list.

Exercise 1

Design a program to count the number of elements (numbers) which are equal to 5 in the list

Code	Output

a_list = [8,5,2,9,4,5]
 	
counter = 0
 	
for i in range(0,len(a_list)):
  if a_list[i] == 5:
  counter = counter + 1
print(counter)
	2

Module F - Sequence test

Learning Objectives:

- Applying all the basic concepts flexibly;
- Using basic concepts (loop and conditional statement) to write a practical application program

This module consists of 1 lesson and covers advance use of Python programming.

F. Sequence Test

Example 1

Code	Output

a_list = [1,2,4,4,6,6,7,7]
is_sorted = True
for i in range(1,len(a_list)):
  if a_list[i] < a_list[i – 1]:
  is_sorted = False
print(is_sorted)
	True

“True and False” is a Boolean, it represents whether the logic is correct or not. For example:

1==1 is True(Correct)

1>2 is False (Not correct)

Other online resources

- https://www.Python.org/
- https://docs.Python.org/3/tutorial/
- https://www.w3schools.com/Python/Python_intro.asp
- https://stackoverflow.com/
- https://elearning.eee.hku.hk/