Python 101

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Outline

How to use Jupyter Lab ?

1 What is Python

Python is a high-level general-purpose programming language created by Guido van Rossum in 1989. It is one of the most popular programming languages in the world

與家人朋友度過一年

一度溫馨的聖誕節

創造一個程式語言

1.1 Why Python ?

- Works on different OS
- Simple syntax
- Runs on interpreter systems
- Hundreds of libraries
- Can be applied to various fields

1.2 What can Python do ?

- Statistical analysis
- Backend (server) of web applications
- AI and machine learning
- Software applications

2 Variables and `print()`

Variables and `print()`

2.1 Variables

As a coder, we need “variables” to store some data for further use.
Here are some basic data types :

- Integers (We will focus on this !)
- Floating-Point Numbers
- Strings
- Boolean Type

Variables and `print()`

2.2 `print()`

`print()` is a function helping us to display the value of a variable.

Variables and `print()`

2.2.1 Example

```
a = int(3)
b = int(5)
print(b)
print(a)
```

2.3 Formatted `print`

We can print a formatted string (A string inside `f''` or `f""`)
You can refer to Python variables between { and }

Variables and `print()`

```
a = int(3)
b = str('Michael')
print(f'The value of a is {a}')
print(f'my name is {b}')
```

3. Arithmetic and Bitwise Operators

Arithmetic and Bitwise Operators

3.1 Arithmetic Operators

- `+`
- `-`
- `*`
- `//`
- `**`

Arithmetic and Bitwise Operators

Example

```
a = 987
print(a)
a = a - 87
print(a)
print(a // 5)
print(3 ** 3)
```

Arithmetic and Bitwise Operators

3.2 Bitwise Operators

Before going into this subsection, we need to understand what binary representation is.

Arithmetic and Bitwise Operators

Binary Representation

In decimal representation, 7050 is actually

$$7 \times 10^3 + 0 \times 10^2 + 5 \times 10^1 + 0 \times 10^0$$

What if the base is not 10 ?

Arithmetic and Bitwise Operators

Exercise 1

What is the binary representation of 32 ?

Arithmetic and Bitwise Operators

$$1 \times 2^5 + 0 \times 2^4 + 0 \times 2^3 + 0 \times 2^2 + 0 \times 2^1 + 0 \times 2^0 = 32$$

$$100000$$

Arithmetic and Bitwise Operators

Exercise 2

What is the binary representation of 102 ?

Arithmetic and Bitwise Operators

$$1 \times 2^6 + 1 \times 2^5 + 0 \times 2^4 + 0 \times 2^3 + 1 \times 2^2 + 1 \times 2^1 + 0 \times 2^0 = 102$$

$$1100110$$

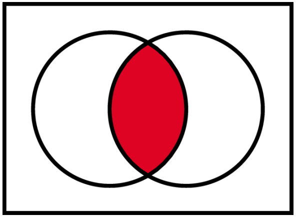
Arithmetic and Bitwise Operators

List of Bitwise Operators

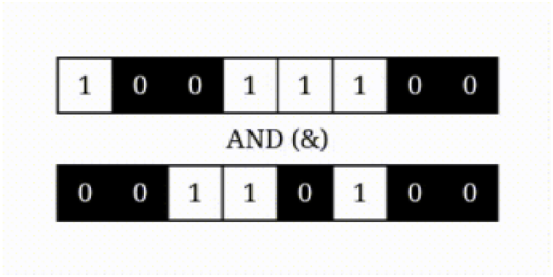
- `&`
- `|`
- `^`
- `>>`
- `<<`

Arithmetic and Bitwise Operators

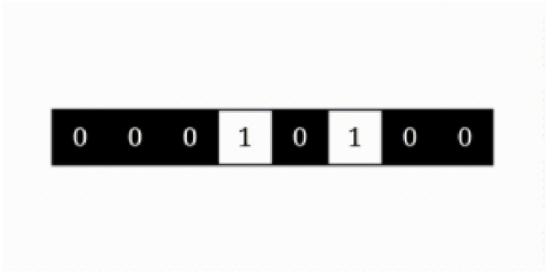
Bitwise AND



Arithmetic and Bitwise Operators

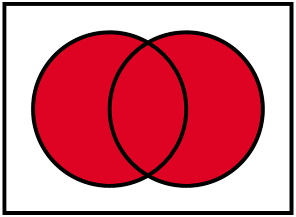


Arithmetic and Bitwise Operators

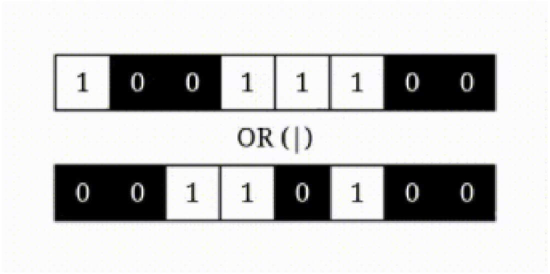


Arithmetic and Bitwise Operators

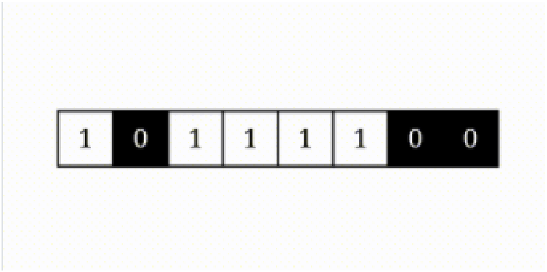
Bitwise OR



Arithmetic and Bitwise Operators

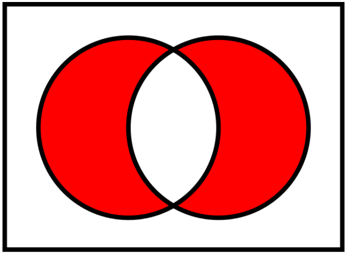


Arithmetic and Bitwise Operators

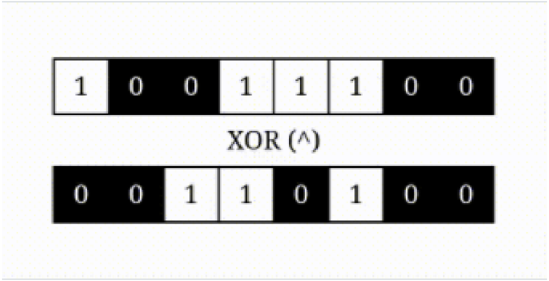


Arithmetic and Bitwise Operators

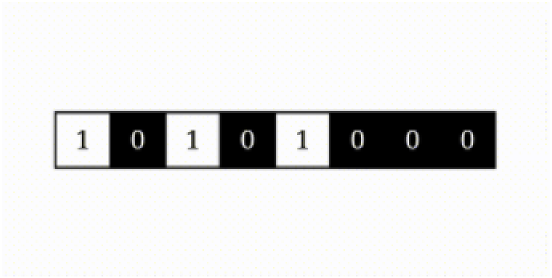
Bitwise XOR



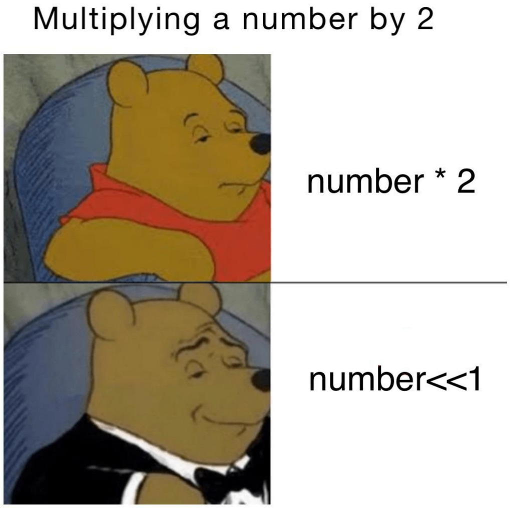
Arithmetic and Bitwise Operators



Arithmetic and Bitwise Operators



Arithmetic and Bitwise Operators



Arithmetic and Bitwise Operators

Assignment Operators

- `=`
- `+=`
- $\vdots$
- `//=`
- `&=`
- $\vdots$
- `<<=`

Arithmetic and Bitwise Operators

Example

```
a = 5
a = a + 5
print(a)
a += 5
print(a)
a *= 2
print(a)
```

4 Statement and Conditions

Statement and Conditions

Sometimes, we may want our program do different things based on different conditions.

- `if`
- `else`
- `elif`

Statement and Conditions

Example

```
a = 529
if (a % 2 == 0):
    print("Even")
else :
    print("Odd")
```

Statement and Conditions

Moreover, things are usually complicated so we need some “conjunctions”.

- `and`
- `or`

Statement and Conditions

Example

```
a = 200
b = 33
c = 500
if (a > b and c > a) :
    print("Both conditions are True")
if (b < a or c < a) :
    print("At least one of the conditions is True")
```

Statement and Conditions

Exercise

Write a program to check whether a number is between 1500 and 2700, then check if it's divisible by 7 or 5. If not, your program need to output whether the number is "Out of range" or "Not divisible".

Statement and Conditions

Hints

1. Store the number in a variable
2. Write a if statement to check whether the number is in range
3. Write a if statement inside the previous one and check if the number is divisible by 7 or 5
4. print anything you want if both statement is true
5. Figure out the rest by yourself !

Statement and Conditions

Answer

```
a = 438
if (a >= 1500 and a <= 2700) :
    if (a % 7 == 0 or a % 5 == 0):
        print("Test successful")
    else :
        print("Not divisible")
else:
    print("Out of range!")
```

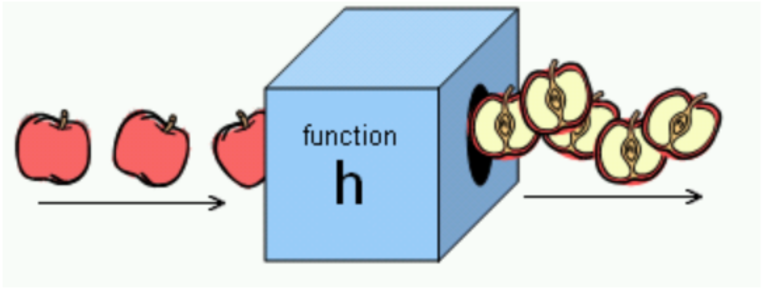
5 Functions

Functions

What are Functions

A function is a block of code that does certain calculations and return the result to you.

Functions



Functions

Example

```
def myFunction(num1, num2) :
    return num1**2 + num2**2
```

Functions

Why Functions?

- Don't have to copy and paste your code everywhere
- Prevent inconsistency
- Easy to manage

Functions

If we dont use functions...

```
print("Cherry, Happy New year !")
print("Brian, Happy New Year !")
print("Hubert, Happy New Year !")
print("Tommy, Happy New Year !")
```

Functions

With functions

```
def greetings(name):
    print(f"{name}, Happy New Year !")
greetings("Cherry")
greetings("Brian")
greetings("Hubert")
greetings("Tommy")
```

收到罐頭祝福的朋友
你：Function讚啦

Functions

Exercise

We define $A \oplus B = A \times B + A$,
write a Python code to calculate $(10 \oplus 4) * (5 \oplus 8) - (2^8)$
(Requirement : Define a function `oplus` to do $\oplus$ operation)

Functions

Answer

```
def oplus (A, B):
    return (A * B + A)
print (oplus(10, 4) * oplus(5, 8) - 2**8)
# 1994
```

6 Lists

Lists

Motivation

Suppose that we have 5 numbers
How do we store it ?

```
num1 = 3
num2 = 6
num3 = 23
num4 = 97
num5 = 7414
```

Lists

What if there are 1000 numbers ?

We can put them inside a `list` !

Lists

Constructing a List

Lists can be created using square brackets.

`my_list = [5, 60, 95, 33, 83]`

Or you could use `list()` :

- `list()` ⇒ []
- `list([1, 2, 3])` ⇒ [1, 2, 3]
- `list(range(5))` ⇒ [0, 1, 2, 3, 4]
- `list(range(0, 10, 2))` ⇒ [0, 2, 4, 6, 8]

List

List

Range Functions !

It creates a sequence of numbers

- `range(6)` $\rightarrow$ `[0, 1, 2, 3, 4, 5]`
- `range(1, 7, 2)` $\rightarrow$ `[1, 3, 5]` (No 7 !)

Lists

We use "index" to access elements in a list.
The first item in lists has index 0, the second item has index 1, etc.
For example, we can use `my_list[2]` to access the third element in the list.

Lists

Examples

L = [5, 10, 15, 20, 25, 30, 35, 40, 45, 50]

$$\begin{aligned}
\texttt{L[2]} &\Rightarrow 15 \\
\texttt{L[-2]} &\Rightarrow 45 \\
\texttt{L[2:5]} &\Rightarrow [15, 20, 25] \\
\texttt{L[:3]} &\Rightarrow [5, 10, 15] \\
\texttt{L[6:]} &\Rightarrow [35, 40, 45, 50]
\end{aligned}$$

Lists

Add or Remove Elements

- Use `append()` to add element to the end of the list.
  e.g. `my_list.append(50)`
- Use `insert()` to add element to a specific index of the list.
  e.g. `my_list.insert(i, elem)`
- Use `remove()` to remove an element in the list.
  e.g. `my_list.remove(60)`
- Use `pop()` to remove an element in a specific index.
  e.g. `my_list.pop(1)`

Lists

Some Functions of Lists

$$\begin{aligned}
\texttt{len([5, 3, 1])} &\Rightarrow 3 \\
\texttt{max([1, 2, 3, 4, 5])} &\Rightarrow 5 \\
\texttt{min([0, 55, 3, 75])} &\Rightarrow 0 \\
\texttt{sum([1, 2, 3, 4, 5])} &\Rightarrow 15
\end{aligned}$$

Lists

Exercise

Write a python program to find and remove the largest number in a list, and insert the sum of the list at the end.

Lists

Answer

```
numbers = [15, 67, 23, 99, 25, 44, 73]
maximum = max(numbers)
numbers.remove(maximum)
numbers.append(sum(numbers))
print(numbers)
```

7 For Loop and While Loop

For Loop and While Loop

For Loop

We can use for loops to make our program do repetitive things
e.g. add from 1 to 5

```
num = 0
for i in range (1, 6):
   num += i
print (num)
```

For Loop and While Loop

You could also use it to iterate through a list

```
L = [5, 2, 88]
for i in L :
   print (i)
```

For Loop and While Loop

While Loop

Execute a set of statements as long as a condition is true.

```
i = 0
while (i < 5):
   print (i)
   i += 1
```

For Loop and While Loop

Break

We use `break` to get out of a loop.

For Loop and While Loop

Continue

We use `continue` to skip rest of the code and start a new iteration.

For Loop and While Loop

Example

```
for i in range(10):
    if (i == 5):
        continue
    print(i)
```

For Loop and While Loop

Exercise

Write a python code to print from 1×1 to 9×9

For Loop and While Loop

Answer

```
for i in range (1, 10):
    for j in range (1, 10):
        print(f'{i} x {j} = {i*j}')
    print('\n')
```

Dictionary

Dictionary

Suppose we have a list that stores informations about a person.

```
["Michael","Chen","NTU","IM","Clown","2001-4-19"]
```

Dictionary

What attribute does each index represents ?

Dictionary can help you !

Dictionary

```
thisDict = {
    "First_name": "Michael",
    "Last_name": "Chen",
    "School": "NTU",
    "Department": "IM",
    "Job": "Clown",
    "Birthday": "2001-4-19"
}
```

Conclusion

Conclusion

Now that you've learned the basic syntax for Python,
you can explore various packages for Python !
For example, `numpy`, `pandas`, `matplotlib`, `scipy`...

Assignment

Assignment

Palindrome Number (100 points)

An integer is a palindrome when it reads the same backward as forward.
Given an integer `x`, return `True` if `x` is palindrome integer.

Advanced: try doing it without turning `x` into a `string`

Submit your code here

Assignment

Single Number (Extra 50 points)

Given a non-empty array of integers nums, every element appears twice except for one. Find that single one.

Advanced: Make it run in linear time! (hint: XOR)

Submit your code here

Thank You For Listening !