程式設計概論
Programming 101

—程式數值變數的操作
(Numerical operations)

授課老師：邱淑怡

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Outline

1. Types of numerical value
   - int: integer without decimals
   - float: integer containing one or more decimals
   - bool(boolean): False/True
2. Operator precedence
3. How to import modules
   - math module
   - random module
4. The built-in function: type() function

The arithmetic operations on numbers

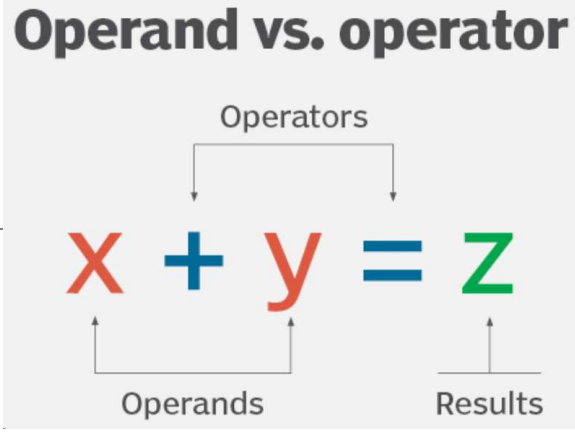
- Addition(+)
- Substation(-)
- Multiplication(*)
- Division(/)
- Integer division: divides one number by another and gives the result as an integer, calculate quotient(//)
- Remainder(%)
- Exponent(**): raises a number to a power

Examples

- print(6+3)
- print(6-2)
- print(6*2)
- print(10/3)
- print(10//3)
- print(10%3)
- print(3**2)

➢ float and int operations are the same

Numerical operations



- Operator(運算子，運算符號)
- Operand(運算元)
- **The order of operations:**
  A. Parentheses (parentheses come in pairs) **(the highest)**
  B. Exponent (**)
  C. Multiplication(*), division(/), calculate quotient(//),remainder(%)
  D. Addition, substation **(the lowest)**

  For operations with the same priority, operations are performed from left to right.

float

- Scientific number with an “e” to indicate the power of 10

```
print(35e3)
print(12E3)
print(-87.7e100)
```

practise

basic

- a=3
- print(a+7)
- print(a**2)
- print(100/3)
- print(100//3)
- print(100%3)

advanced

- x1= 2*(3+4)
- x2= 2**3+4
- x3= 3**2*4
- x4= 2*3/4
- x5 = 2**2**3
- print(x1,x2,x3,x4,x5)

Built-in function

1. abs(x): Returns the absolute value of x

2. min(x1,x2 [, x3…]): Returns the minimum value in the parameter list
   - min(5,1)
   - min(-1,3,-5,7,10)

3. max(x1,x2 [, x3…]): Returns the maximum value in the parameter list

4. pow(x,y): return the value of x raised to the power of y, pow(3,4); pow(3,4,5)

pow(x,y,z)=pow(x,y) %z

5. int(x): return the integer part of x, discarding the decimal

6. round(x [, precision]): returns a floating point number that is a rounded version of the specified number (x), with the specified number of decimals. Precision: Optional. The number of decimals to use when rounding the number. Default is 0.

Numeric processing function _math module

標準函式庫(standard library) 或是內建函式庫(built-in library)

- Module is some Python files. Example: the math module includes some mathematical constants and mathematical functions.
- Such modules need to be imported

import math (要執行以下函式需先下達該敘述)

✓ Constants: math.pi, math.e(自然對數的底數e)

math. factorial(n): return n factorial as an integer (ex:5!)

math.gcd(x,y): returns the greatest common divisor of x and y (傳回參數x, y的最大公因數)

math.exp(x): return e raised to the power x (傳回自然對數之底數e的數值的x次方)

math.log10(x): return the base-10 logarithm of *x.*

math.log(x[,base]): return the logarithm of *x* to the given *base* (傳回數值參數x的自然對數值，預設的底數是e，base可以設定底數)，ex: math.log(2,2)

math.sqrt(x): return the square root of *x*

Practice

1. Find the maximum value from 0, 98,29, -56, 38, 27.
2. Find the minimum value from 0, 98,29, -56, 38, 27.
3. Find the area of a circle with a radius of 10 using the pi defined by math.pi.
4. The value of $\sqrt{7}$
5. The greatest common factor of 616 and 1331.
6. Given that x=log2, y=log3, please calculate $10^{2x+3y+1}$ and print the result. Round the answer to an integer.

Compound operator (複合運算子)

Operator	Expression	meaning
=	a=b	The b value is assigned to the a variable (將b值指派給a變數, a變數的值設定為b)
+=	a += b	a = a + b
-=	a -= b	a = a – b
*=	a *= b	a = a * b
/=	a /= b	a = a / b
//=	a //= b	a = a // b
%=	a %= b	a = a % b
**=	a **= b	a = a ** b

Boolean

Boolean value(布林值)

- Boolean for conditions
  - Boolean type: True/ False
  - Comparison operator(比較運算子)
    - Equal: x == y (x等於y)
    - Not equal: x != y (x不等於y)
    - Greater than: x > y (x大於y)
    - Greater than or equal to: x >= y (x大於等於y)
    - Less than: x < y (x小於y)
    - Less than or equal to: x <= y (x小於等於y)

'=' 表示指派指令(右邊值給左邊的變數)
'==' 表示判斷兩邊是否相等或一致

Example code

- 5==5
- 5 !=2+4
- a=8
- a>=7+3
- a < 7+3

Example

```
num1=34   #int
num2=67.5  # float
flag=True
num3=34.0
num4=9+True
```

Multiple conditions

- Logical operator: and, or, not

Truth table

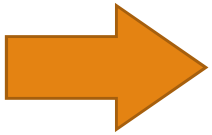
A	B	A and B	A or B
True	True	True	True
True	False	False	True
False	True	False	True
False	False	False	False

A and B respectively represent a condition

A	not A
True	False
False	True

Boolean practics

- Use print() function to show True/False
  - x = 7
  - y = 8
  - 0<x and x<10
  - 0<x <10
  - not(y<6)
  - x%2==0 or y%3==0
  - not (x%2==0 and y%3==0)



```
x = 7
y=8
print(0<x and x<10)
print(0<x <10)
print(not(y<6))
print(x%2==0 or y%3==0)
print(not (x%2==0 and y%3==0))
```

The priority level of Boolean + Numeric

Priority (由高至低)	meaning	Operators
8 (the highest)	Parentheses	( )
7	Exponent	**
6	Multiplication, division	*, /, //(quotient), %(remainder)
5	Addition, substation	+, -
4	Comparison	==, !=, <, >, <=, >=
3	logic	not
2	logic	and
1 (the lowest)	logic	or

- Example code
  - x=3
  - y=10
    - print(10<x*5 and y-6<2)
      - # 1. compute x*5, y-6
      - # 2. relation 10<15, 4<2
      - # 3. logical True and False
      - # Finally, result: False

The functions of the random module

import random

random.randint(x,y): returns a random number between the given range (傳回數值x,y之間的數值包含x,y)

random.random(): returns a random float number between 0 and 1

x = [1,2,6,4,8, 13] # list is a sequence

random.shuffle(x) # Takes a sequence (x) and returns the sequence in a random order (將變數x中的元素隨機重排後再把結果給x)

print(x)

print(random.choice(x)): return a random element from the given sequence(x) (將變數x中的元素隨機選出一個)

type() function

- type(x): What data type is x?
- Example:
  - a1=10
  - a2=20.55
  - a3= a1+a2
  - print(type(a1))
  - print(type(a2))
  - print(type(a3))

References

keyword

False	await	else	import	pass
None	break	except	in	raise
True	class	finally	is	return
and	continue	for	lambda	try
as	def	from	nonlocal	while
assert	del	global	not	with
async	elif	if	or	yield

Uppercase and lowercase characters are different.

Source: http://yltang.net/tutorial/python/3/

built-in function

內建函式

A
abs()
aiter()
all()
any()
anext()
ascii()

B
bin()
bool()
breakpoint()
bytearray()
bytes()

C
callable()
chr()
classmethod()
compile()
complex()

D
delattr()
dict()
dir()
divmod()

E
enumerate()
eval()
exec()

F
filter()
float()
format()
frozenset()

G
getattr()
globals()

H
hasattr()
hash()
help()
hex()

I
id()
input()
int()
isinstance()
issubclass()
iter()

L
len()
list()
locals()

M
map()
max()
memoryview()
min()

N
next()

O
object()
oct()
open()
ord()

P
pow()
print()
property()

R
range()
repr()
reversed()
round()

S
set()
setattr()
slice()
sorted()
staticmethod()
str()
sum()
super()

T
tuple()
type()

V
vars()

Z
zip()

_
__import__()

Exercise 1

Q1

1. i=12, j=3, print result False/True (請用程式及你個人判斷是否相同)
   - (1) 10<i*2 or j-6<2**(-1)
   - (2) 1<i%5 and i//4<j
   - (3) not i//7>j and i%2==0

2.請用Python設計一個程式，有4個學生人數及25個蘋果，將蘋果平均分給學生，每個學生分到的蘋果數量必須相同且能得到最多蘋果數量，印出”每個學生分到的蘋果數量及剩下未被分給學生的蘋果數量”

3. A company has determined that its annual profit is typically 23 percent of total sales. Write a program that the projected amount of total sales is 5000, and then displays the profit that will be made from that amount.

Q1(cont.)

4. define x1="python programming" (course name), x2=2023(year), x3=1900.98765 (amount of consumption), data type: x1 is string, x2 is int, x3 is float
print:

(1) "你消費金額是:?元"(?為x3,請顯示到小數點後四位數字並四捨五入)

(2) "你在??年這學期修???課程!"(??為x2, ???為x1)

(3) "你在??年購買?元的商品"(??為x2, ?為x3,請顯示到小數點後一位數字並四捨五入)

Review

Chapter 2: 2.7 (number) and Chapter 4: 4.5, 4.6 (Boolean)