Chapter 7
迴圈設計

7.1 基本 for 迴圈

- 計算 1 加到 10 的總和：

```
1    sum = 1 + 2 + 3 + 4 + 5 + 6 + 7 + 8 + 9 + 10
2    print(f"sum of 1 to 10 is {sum}")
```

```
sum of 1 to 10 is 55
```

- 計算 1 加到 100 的總和：？？？
- for 迴圈可以讓程式將整個物件內的元素遍歷（也可稱為迭代）。在迭代期間可以紀錄或輸出當下的狀態或稱為軌跡。

  for var in 可迭代物件:

  　　程式碼區塊

  - 可迭代物件(iterable object)可以是串列(list)、元組(Tuple)、字典(Dct)與集合(Set)或 range( ) 函數產生的區間。

```
1    sum = 0
2    for val in range(1,101):     # 1 to <101
3        sum += val
4    print(f"sum of 1 to 100 is {sum}")
```

```
sum of 1 to 100 is 5050
```

7.1 基本 for 迴圈

- for 的基本運作：

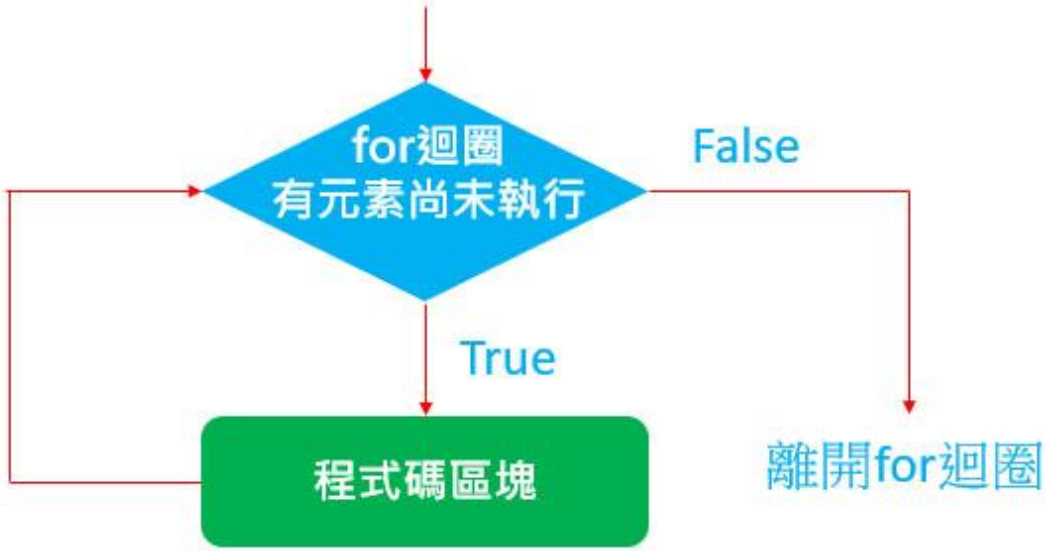
```
1   actresses = ["Nicole Kidman","Angelina Jolie", "Gal Gadot", "Meryl Streep", "Emily Blunt"]
2   for actress in actresses:
3       print(actress)
```

```
Nicole Kidman
Angelina Jolie
Gal Gadot
Meryl Streep
Emily Blunt
```

- 若 for 的程式碼區塊只有一行：

  for var in 可迭代物件: 程式碼區塊

```
1   actresses = ["Nicole Kidman","Angelina Jolie
2   for actress in actresses: print(actress)
```



7.1 基本 for 迴圈

- for 的基本運作：
  - 迭代整個串列：

```
1   actresses = ["Nicole Kidman","Angelina Jolie", "Gal Gadot", "Meryl Streep", "Emily Blunt"]
2   for actress in actresses:
3       print(f'What a great show {actress.split(" ")[0]}')
4       print(f"I can't wait to see your next show!!!")
```

```
What a great show Nicole
I can't wait to see your next show!!!
What a great show Angelina
I can't wait to see your next show!!!
What a great show Gal
I can't wait to see your next show!!!
What a great show Meryl
I can't wait to see your next show!!!
What a great show Emily
I can't wait to see your next show!!!
```

  - 迭代部份串列：

```
1   actresses = ["Nicole Kidman","Angelina Jolie", "Gal Gadot", "Meryl Streep", "Emily Blunt"]
2   for actress in actresses[1:4]:
3       print(f"{actress.split(' ')}")
```

```
['Angelina', 'Jolie']
['Gal', 'Gadot']
['Meryl', 'Streep']
```

7.1 基本 for 迴圈

- for 的基本運作：
  - 搭配 if 做篩選

```
actresses = ["Nicole Kidman","Angelina Jolie", "Gal Gadot", "Meryl Streep", "Emily Blunt"]
for actress in actresses:
    if actress.endswith('t'):
        print(f"{actress}")
```

```
Gal Gadot
Emily Blunt
```

```
sum = 0
for val in range(1,101):    # 1 to <101
    if (val % 3 == 0) and (val % 5 == 0) :  # val % 15 == 0
        sum += val
print(f"Conditional sum is {sum}")
```

```
Conditional sum is 315
```

7.1 基本 for 迴圈

- for 的基本運作：
  - 兩個串列的比較

```
1   fruits1 = ["Banana", "Apple", "Pineapple", "Papaya", "Peach"]
2   fruits2 = ["Pineapple", "Papaya", "Watermelon", "Passion Fruit"]
3   print(f"Befort: {fruits2 = }")
4   for fruit in fruits1:
5       if fruit in fruits2:
6           fruits2.remove(fruit)
7           print(f"Remove {fruit} in fruits2")
8   print(f"After: {fruits2 = }")
```

```
Befort: fruits2 = ['Pineapple', 'Papaya', 'Watermelon', 'Passion Fruit']
Remove Pineapple in fruits2
Remove Papaya in fruits2
After: fruits2 = ['Watermelon', 'Passion Fruit']
```

7.2 range() 函數

- 可產生一個 range 物件，內容為一等差數列，也是個可迭代物件 (iterable object)。
- range(start, stop, step)：
  - start, stop, step 與串列的 slice 用法類似。
  - 若 step 為 1，會產生 start ~ stop - 1 的遞增數列（stop > start）。
  - 若 step 為 -1，會產生 start ~ stop + 1 的遞減數列（start > stop）。
  - range(n) = range(0, n) = range(0, n, 1) = 0~n-1 的遞增數列。

```
1  for x in range(3):
2      print(x)
```

```
0
1
2
```

```
1  for x in range(3, 0, -1):
2      print(x)
```

```
3
2
1
```

```
1  for x in range(0, 6, 2):
2      print(x)
```

```
0
2
4
```

7.2 range() 函數

- 跟 if 搭配：

```
print(f"{'-'*5}{'*'*5}{'-'*5}{'*'*5}{'-'*5}")
```

```
-----*****-----*****-----
```

```
for x in range(5):
    for y in range(5):
        if x % 2:
            print("*", end="")
        else:
            print("-", end="")
```

- 將每次迭代的結果取出來：

```
money = 50000
rate = 0.005
years = 5
for year in range(years):
    money *= (1 + rate)
    print(f"第 {year + 1} 年本金和為 {int(money)}")
```

```
第 1 年本金和為 50249
第 2 年本金和為 50501
第 3 年本金和為 50753
第 4 年本金和為 51007
第 5 年本金和為 51262
```

7.2 range() 函數

- 活用 range() 函數：

```
1   start, end = eval(input("請輸入起始與結束數字："))
2   sum = 0
3   for val in range(start, end+1):
4       sum += val
5   print(f"Sum from {start} to {end} is {sum}")
```

```
請輸入起始與結束數字：5, 20
Sum from 5 to 20 is 200
```

```
1   start, end = eval(input("請輸入起始與結束數字："))
2   sum = sum(range(start, end+1))
3   print(f"Sum from {start} to {end} is {sum}")
```

  - range 會產生一個<class 'range'> 的物件，而不是串列
  - 用這個方法，並不會預留出 start ~ end 的記憶體空間，而是只用一個記憶體空間，將每次迭代的結果放在這個空間中，然後執行 sum()。可以增加工作效率與節省記憶體空間。

7.2 range() 函數

- 用 range() 照一定規則新增串列特定元素：

```
1   squares = []
2   count = eval(input("請輸入一個數值："))
3   for idx in range(1,count+1):
4       squares.append(idx * idx)   # squares.append(idx ** 2)
5   print(f"{squares = }")
```

```
請輸入一個數值：6
squares = [1, 4, 9, 16, 25, 36]
```

```
1   count = eval(input("請輸入一個數值："))
2   squares = [None] * count
3   for idx in range(1,count+1):
4       squares[idx - 1] = (idx * idx)   # squares[idx - 1](idx ** 2)
5   print(f"{squares = }")
```

7.2 range() 函數

- 用 range() 刪除串列所有元素：
  - 串列沒有提供刪除整個串列元素的方法。list.clear()???

```
1  fruits1 = ["Banana", "Apple", "Pineapple", "Papaya", "Peach"]
2  print(f"Fruits in list are: {fruits1}")
3  for fruit in fruits1[:]:
4      fruits1.remove(fruit)
5      print(f"Remove {fruit}.\nFruits left in list are:{fruits1}")
```

```
Fruits in list are: ['Banana', 'Apple', 'Pineapple', 'Papaya', 'Peach']
Remove Banana.
Fruits left in list are:['Apple', 'Pineapple', 'Papaya', 'Peach']
Remove Apple.
Fruits left in list are:['Pineapple', 'Papaya', 'Peach']
Remove Pineapple.
Fruits left in list are:['Papaya', 'Peach']
Remove Papaya.
Fruits left in list are:['Peach']
Remove Peach.
Fruits left in list are:[]
```

```
1  fruits1 = ["Banana", "Apple", "Pineapple", "Papaya", "Peach"]
2  print(fruits1)
3  fruits1.clear()
4  print(fruits1)
```

```
['Banana', 'Apple', 'Pineapple', 'Papaya', 'Peach']
[]
```

```
1  fruits1 = ["Banana", "Apple", "Pineapple", "Papaya", "Peach"]
2  print(f"Fruits in list are: {fruits1}")
3  for fruit in fruits1:
4      fruits1.remove(fruit)
5      print(f"Remove {fruit}.\nFruits left in list are:{fruits1}")
```

輸出會是什麼？

7.2 range() 函數

- 產生一個內容有規則的串列：

```
1   xList = []
2   xList.append(0)
3   xList.append(1)
4   xList.append(2)
5   xList.append(3)
6   xList.append(4)
7   xList.append(5)
8
9   print(xList)
```

```
[0, 1, 2, 3, 4, 5]
```

```
1   xList = []
2   for n in range(6):
3       xList.append(n)
4
5   print(xList)
```

```
1   xList = list(range(6))
2
3   print(xList)
```

7.2 range() 函數

- List generator: 用迭代方式產生串列資料的方法。

  新串列 = [運算式 for 項目 in 可迭代物件]

```
xList = [ n for n in range(6)]

print(xList)
```

```
[0, 1, 2, 3, 4, 5]
```

```
count = eval(input("請輸入一個數值："))
squares = []
for idx in range(1,count+1):
    squares.append(idx * idx)   # squares.append(idx ** 2)
print(f"{squares = }")

newSquares = [idx ** 2 for idx in range(1, count+1)]
print(f"{newSquares = }")
```

```
請輸入一個數值：6
squares = [1, 4, 9, 16, 25, 36]
newSquares = [1, 4, 9, 16, 25, 36]
```

  - 攝氏轉華氏：

```
celsius = [21, 25, 30]
fahrenheit = [(x *9 / 5 + 32) for x in celsius]
print(f"{fahrenheit = }")
```

```
fahrenheit = [69.8, 77.0, 86.0]
```

7.2 range() 函數

- List generator: 用迭代方式產生串列資料的方法。

  搭配 if：

```
1   count = eval(input("請輸入一個數值："))
2   squares = []
3   for idx in range(1,count+1):
4       if count <= 7:
5           squares.append(idx * idx)   # squares.append(idx ** 2)
6   print(f"{squares = }")
7
8   newSquares = [idx ** 2 for idx in range(1, count+1) if count <= 7]
9   print(f"{newSquares = }")
```

```
squares = [1, 4, 9, 16, 25, 36, 49]
newSquares = [1, 4, 9, 16, 25, 36, 49]
```

7.2 range() 函數

- List generator: 用迭代方式產生串列資料的方法。
  - 搭配多重指定與 if：列出邊長小於16的直角三角形的三邊長：

```
1   len = 16
2   tri90 = []
3   for a in range(1, len):
4       for b in range(1, len):
5           for c in range(1, len):
6               if a ** 2 + b ** 2 == c ** 2:
7                   tri90.append([a, b, c])
8   print(tri90)
9
10  tri90 = [[a, b, c] for a in range(1, len) for b in range(1, len) for c in range(1, len)
11           if a ** 2 + b ** 2 == c ** 2]
12  print(tri90)
```

```
[[3, 4, 5], [4, 3, 5], [5, 12, 13], [6, 8, 10], [8, 6, 10], [9, 12, 15], [12, 5, 13], [12, 9, 15]]
[[3, 4, 5], [4, 3, 5], [5, 12, 13], [6, 8, 10], [8, 6, 10], [9, 12, 15], [12, 5, 13], [12, 9, 15]]
```

7.2 range() 函數

- List generator: 用迭代方式產生串列資料的方法。
  - 搭配多重指定與 if：列出邊長小於16的直角三角形的三邊長。

```
1   len = 16
2   tri90 = [[a, b, c] for a in range(1, len) for b in range(1, len) for c in range(1, len)
3            if a ** 2 + b ** 2 == c ** 2]
4   print(tri90)
5
6   tri90 = [[a, b, c] for a in range(1, len) for b in range(a, len) for c in range(b, len)
7            if a ** 2 + b ** 2 == c ** 2]
8   print(tri90)
9
10  tri90 = [[a, b, c] for a in range(1, len) for b in range(a, len) for c in range(b, len)
11           if a ** 2 + b ** 2 == c ** 2 and a % 2 == 0]
12  print(tri90)
```

```
[[3, 4, 5], [4, 3, 5], [5, 12, 13], [6, 8, 10], [8, 6, 10], [9, 12, 15], [12, 5, 13], [12, 9, 15]]
[[3, 4, 5], [5, 12, 13], [6, 8, 10], [9, 12, 15]]
[[6, 8, 10]]
```

7.2 range() 函數

- List generator: 用迭代方式產生串列資料的方法。
  - 兩串列內容相乘。
  - A * B = {(a, b)}：a 屬於A元素，b屬於B元素

```
1   listColors = ["Red", "Green", "Blue"]
2   listShape = ["Circle", "Triangle", "Square"]
3   result = []
4   for color in listColors:
5       for shape in listShape:
6           result.append([color, shape])
7   print(result)
8
9   result = [[color, shape] for color in listColors for shape in listShape]
10  print(result)
```

```
[['Red', 'Circle'], ['Red', 'Triangle'], ['Red', 'Square'], ['Green', 'Circle'], ['Green', 'Triangle'], ['Gree
n', 'Square'], ['Blue', 'Circle'], ['Blue', 'Triangle'], ['Blue', 'Square']]
[['Red', 'Circle'], ['Red', 'Triangle'], ['Red', 'Square'], ['Green', 'Circle'], ['Green', 'Triangle'], ['Gree
n', 'Square'], ['Blue', 'Circle'], ['Blue', 'Triangle'], ['Blue', 'Square']]
```

7.2 range() 函數

- 列印含串列元素的串列：

```
1   listColors = ["Red", "Green", "Blue"]
2   listShape = ["Circle", "Triangle", "Square"]
3   result = [[color, shape] for color in listColors for shape in listShape]
4   for color, shape in result:
5       print(color, shape)
```

```
Red Circle
Red Triangle
Red Square
Green Circle
Green Triangle
Green Square
Blue Circle
Blue Triangle
Blue Square
```

7.3 進階的 for 迴圈應用

- 巢狀for迴圈：

```
for var1 in 可迭代物件:                    # 外層for迴圈
    ...外層程式區塊
        for var2 in 可迭代物件:            # 內層for迴圈
            ....內層程式區塊
```

7.3 進階的 for 迴圈應用

- 巢狀for迴圈：
  - 99乘法表：

```
for i in range(1, 10):
    for j in range(1, 10):
        res = i * j
        print(f"{j}*{i}={i*j:>2d}", end="   ")
    print("")   #換行
```

```
1*1= 1   2*1= 2   3*1= 3   4*1= 4   5*1= 5   6*1= 6   7*1= 7   8*1= 8   9*1= 9
1*2= 2   2*2= 4   3*2= 6   4*2= 8   5*2=10   6*2=12   7*2=14   8*2=16   9*2=18
1*3= 3   2*3= 6   3*3= 9   4*3=12   5*3=15   6*3=18   7*3=21   8*3=24   9*3=27
1*4= 4   2*4= 8   3*4=12   4*4=16   5*4=20   6*4=24   7*4=28   8*4=32   9*4=36
1*5= 5   2*5=10   3*5=15   4*5=20   5*5=25   6*5=30   7*5=35   8*5=40   9*5=45
1*6= 6   2*6=12   3*6=18   4*6=24   5*6=30   6*6=36   7*6=42   8*6=48   9*6=54
1*7= 7   2*7=14   3*7=21   4*7=28   5*7=35   6*7=42   7*7=49   8*7=56   9*7=63
1*8= 8   2*8=16   3*8=24   4*8=32   5*8=40   6*8=48   7*8=56   8*8=64   9*8=72
1*9= 9   2*9=18   3*9=27   4*9=36   5*9=45   6*9=54   7*9=63   8*9=72   9*9=81
```

7.3 進階的 for 迴圈應用

- 巢狀for迴圈：
  - 直角三角形：

```
1    for i in range(1, 10):
2        for j in range(1, 10):
3            if j <= i:
4                print("aa", end="")
5        print()
```

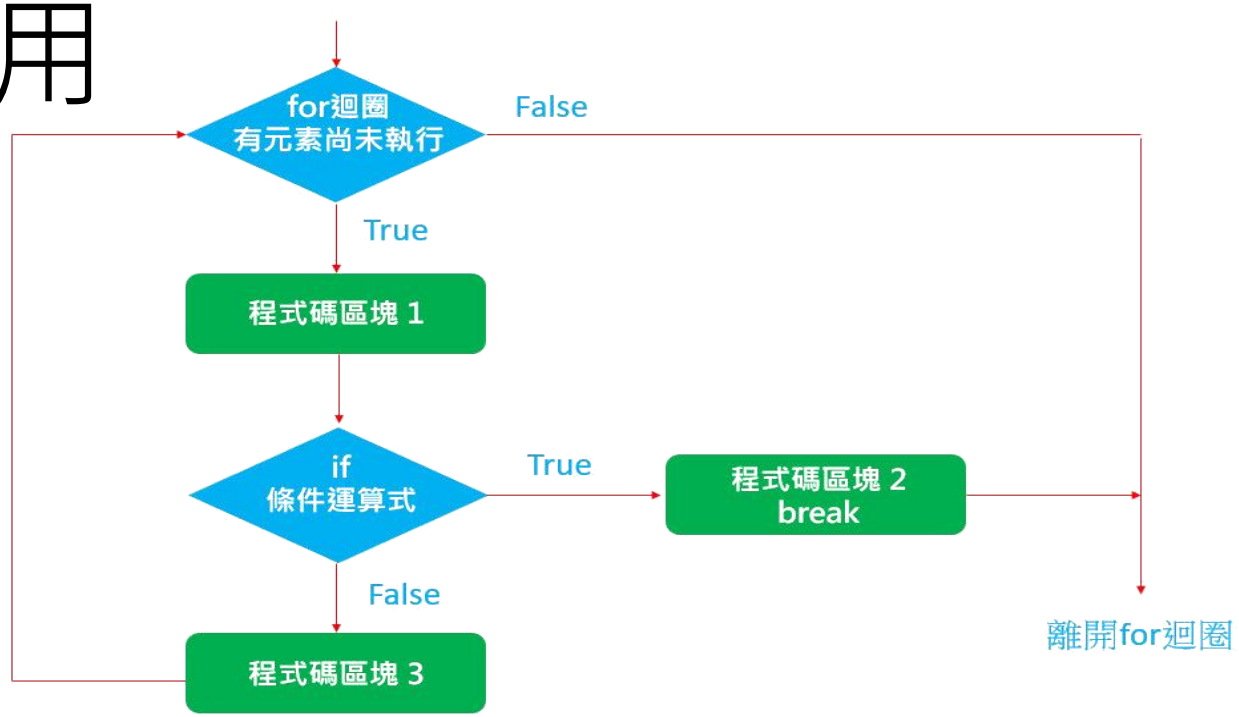
```
for j in range(1, i+1):
```

```
aa
aaaa
aaaaaa
aaaaaaaa
aaaaaaaaaa
aaaaaaaaaaaa
aaaaaaaaaaaaaa
aaaaaaaaaaaaaaaa
aaaaaaaaaaaaaaaaaa
```

```
1    for i in range(1, 10):
2        symbol = "aa" * i
3        print(symbol)
```

7.3 進階的 for 迴圈應用

- break 指令：
  - 強制離開 for 迴圈：




```
for var in 可迭代物件:
    程式碼區塊1
    if 條件運算式:  # 判斷條件運算式
        程式碼區塊2
        break       # 如果條件運算式是True則離開for迴圈
    程式碼區塊3
```

7.3 進階的 for 迴圈應用

- break 指令：

```
1   print("Test 1:")
2   for digit in range(1, 11):
3       if digit == 5:
4           break
5       print(digit, end=" ")
6   print()
7
8   print("Test 2:")
9   for digit in range(0, 11, 2):
10      if digit == 5:
11          break
12      print(digit, end=" ")
```

```
Test 1:
1 2 3 4
Test 2:
0 2 4 6 8 10
```

```
1   scores = [90, 83, 96, 92, 59, 88, 91]
2   scores.sort(reverse = True)
3   count = 0
4   for score in scores:
5       print(score, end = " ")
6       count += 1
7       if count == 5:
8           break
```

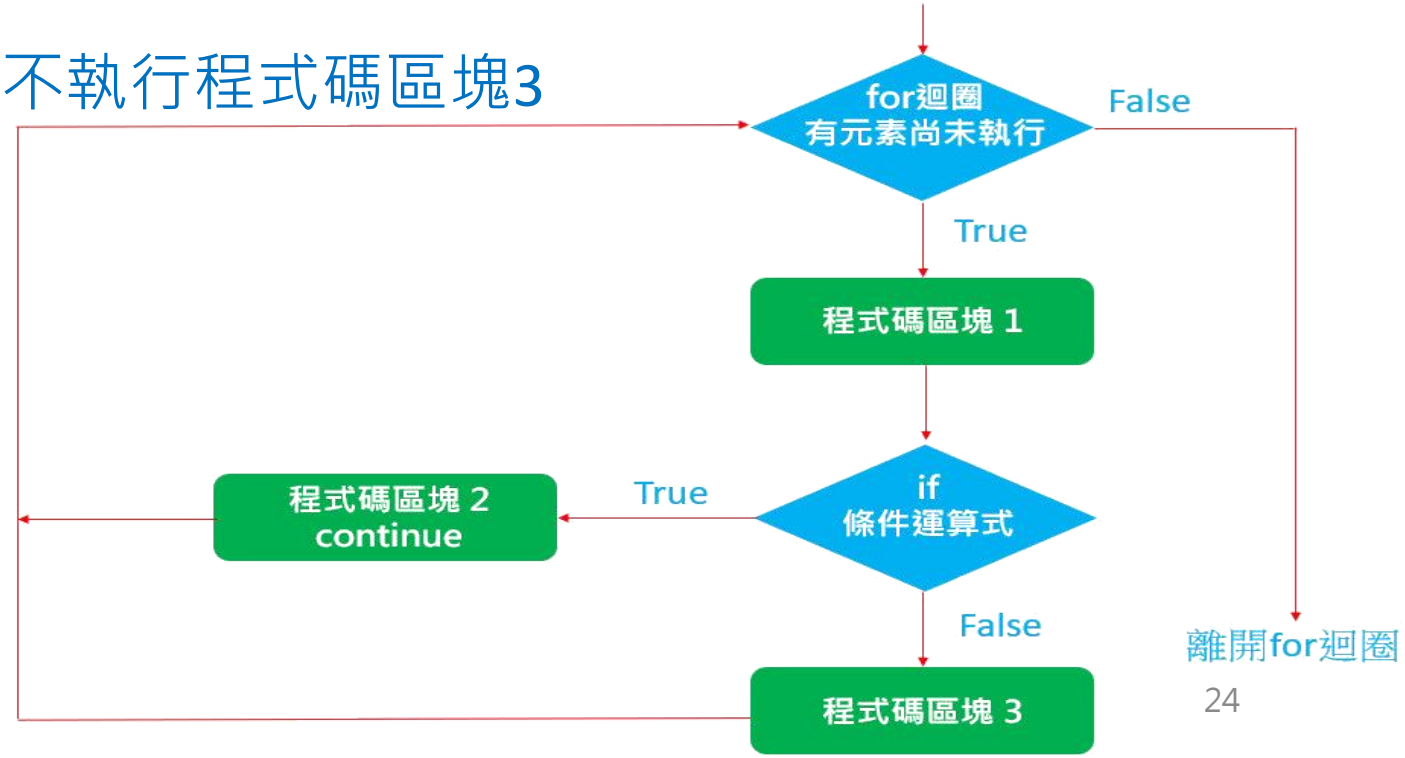
```
96 92 91 90 88
```

```
1   scores = [90, 83, 96, 92, 59, 88, 91]
2   scores.sort(reverse = True)
3   count = 0
4   for score in scores[:5]:
5       print(score, end = " ")
```

7.3 進階的 for 迴圈應用

- continue 指令：
  - 某些條件發生時，本次迴圈剩餘的程式碼區塊可以不繼續執行，直接進入下一次迭代：

```
for var in 可迭代物件:
    程式碼區塊1
    #如果條件運算式是True則不執行程式碼區塊3
    if 條件運算式:
        程式碼區塊2
        continue
    程式碼區塊3
```



7.3 進階的 for 迴圈應用

- continue 指令：

```
1   scores = [90, 83, 96, 92, 59, 88, 91]
2   count = 0
3   for score in scores:
4       if score < 90:
5           continue
6       print(score, end = " ")
7       count += 1
8   print(f"\nThere are {count} times that score >= 90")
```

```
90 96 92 91
There are 4 times that score > 90
```

```
1   scores = [90, 83, 96, 92, 59, 88, 91]
2   scores.sort(reverse = True)
3   count = 0
4   for score in scores:
5       if score < 90:
6           break
7       print(score, end=" ")
8       count += 1
9   print(f"\nThere are {count} times that score >= 90")
```

```
96 92 91 90
There are 4 times that score > 90
```

7.3 進階的 for 迴圈應用

- for … else … ：
  - 通常跟 if, break 一起使用。

```
for var in 可迭代物件
    if 條件運算式          #如果條件為 True 就離開迴圈，不執行 else 部份。
        程式碼區塊1
        break
else:
    程式碼區塊2            #如果迴圈沒有被 break 就執行
```

7.3 進階的 for 迴圈應用

- for … else … ：
  - 檢查一個數是否為質數：

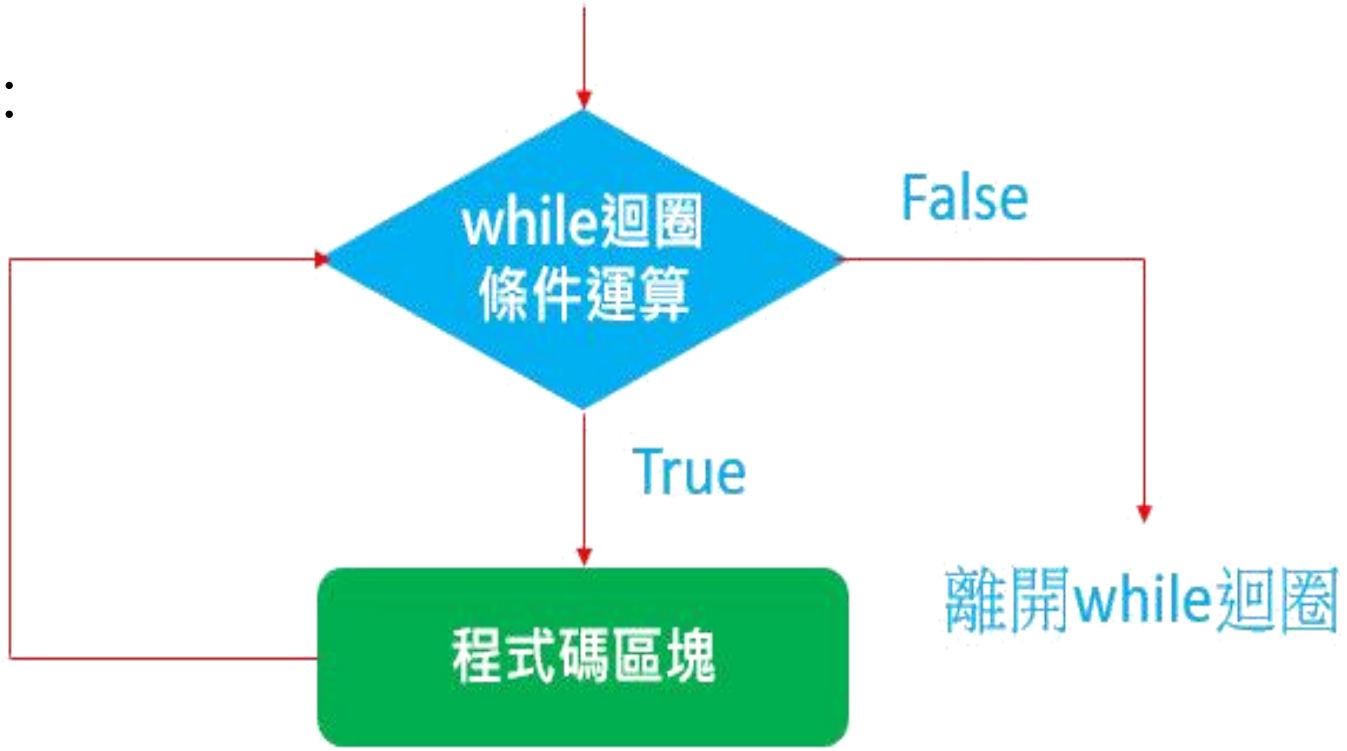
```
num = int(input("Input a integer larger than 1: "))
if num == 2:
    print("2 is a prime number.")
else:
    for n in range(2, num):
        if num % n == 0:
            print(f"{num} is not a prime number.")
            break
    else:
        print(f"{num} is a prime number.")
```

```
Input a integer larger than 1: 5
5 is a prime number.
```

7.4 while 迴圈

- for 迴圈是一種計數迴圈，會重複執行一定次數。
- while 迴圈是一種條件控制迴圈，會執行到條件滿足才結束。

while 條件運算：
　　程式區塊



7.4 while 迴圈

- 印出輸入的字串，直到輸入 q 結束 while 迴圈。
  - q 又稱作哨兵值(Sentinel value)

```
1   inputMsg = ""
2   while inputMsg != "q":
3       inputMsg = input("Input q to break loop: ")
4       print(inputMsg)
```

```
Input q to break loop: abc
abc
Input q to break loop: def
def
Input q to break loop: q
q
```

```
1   inputMsg = ""
2   while inputMsg != "q":
3       inputMsg = input("Input q to break loop: ")
4       if inputMsg != "q":
5           print(inputMsg)
```

```
Input q to break loop: abc
abc
Input q to break loop: def
def
Input q to break loop: q
```

```
1   inputMsg = ""
2   loopContinue = True
3   while loopContinue:
4       inputMsg = input("Input q to break loop: ")
5       if inputMsg == "q":
6           loopContinue = False
7       else:
8           print(inputMsg)
```

```
Input q to break loop: abc
abc
Input q to break loop: def
def
Input q to break loop: q
```

7.4 while 迴圈

- 猜一個 1 ~ 100 的數字：

```python
answer = 63
guessInt = -1
while guessInt != answer:
    guessInt = int(input("Choose a integer between 1 to 100: "))
    if guessInt < answer:
        print("Guess a \"LARGER\" ingeger.")
    elif guessInt > answer:
        print("Guess a \"SMALLER\" ingeger.")
    else:
        print("Right guess~~~~~~")
```

```
Choose a integer between 1 to 100: 50
Guess a "LARGER" ingeger.
Choose a integer between 1 to 100: 75
Guess a "SMALLER" ingeger.
Choose a integer between 1 to 100: 63
Right guess~~~~~~
```

- 預測學費：

```python
tuition = 50000
year = 0
while tuition < 60000:
    tuition = int(tuition * 1.05)
    year += 1
    print(f"經過 {year} 年，學費是 {tuition}")
print(f"經過 {year} 年，學費會超過60000")
```

```
經過 1 年，學費是 52500
經過 2 年，學費是 55125
經過 3 年，學費是 57881
經過 4 年，學費是 60775
經過 4 年，學費會超過60000
```

7.4 while 迴圈

- 巢狀 while 迴圈

```
while 條件運算：                    # 外層while迴圈
    …
    while 條件運算：                # 內層while迴圈
        …
```

  - 99乘法表

```
1   i = 1
2   while i <= 9:
3       j = 1
4       while j <= 9:
5           res = i * j
6           print(f"{j}*{i}={i*j:>2d}", end="   ")
7           j += 1
8       print()    #換行
9       i += 1
```

```
1*1= 1   2*1= 2   3*1= 3   4*1= 4   5*1= 5   6*1= 6   7*1= 7   8*1= 8   9*1= 9
1*2= 2   2*2= 4   3*2= 6   4*2= 8   5*2=10   6*2=12   7*2=14   8*2=16   9*2=18
1*3= 3   2*3= 6   3*3= 9   4*3=12   5*3=15   6*3=18   7*3=21   8*3=24   9*3=27
1*4= 4   2*4= 8   3*4=12   4*4=16   5*4=20   6*4=24   7*4=28   8*4=32   9*4=36
1*5= 5   2*5=10   3*5=15   4*5=20   5*5=25   6*5=30   7*5=35   8*5=40   9*5=45
1*6= 6   2*6=12   3*6=18   4*6=24   5*6=30   6*6=36   7*6=42   8*6=48   9*6=54
1*7= 7   2*7=14   3*7=21   4*7=28   5*7=35   6*7=42   7*7=49   8*7=56   9*7=63
1*8= 8   2*8=16   3*8=24   4*8=32   5*8=40   6*8=48   7*8=56   8*8=64   9*8=72
1*9= 9   2*9=18   3*9=27   4*9=36   5*9=45   6*9=54   7*9=63   8*9=72   9*9=81
```

7.4 while 迴圈

- break 指令：強制離開 while 迴圈

```
while 運算條件式 A:
    程式碼區塊 1
    if 運算條件式 B:
        程式碼區塊 2
        break
    程式碼區塊 3
```

- 猜一個 1 ~ 100 的數字：

```python
answer = 63

while True:
    inputInt = int(input("Choose a integer between 1 to 100: "))
    if inputInt < answer:
        print("Guess a \"LARGER\" ingeger.")
    elif inputInt > answer:
        print("Guess a \"SMALLER\" ingeger.")
    else:
        print("Right guess~~~~~~")
        break
```

```
Choose a integer between 1 to 100: 50
Guess a "LARGER" ingeger.
Choose a integer between 1 to 100: 75
Guess a "SMALLER" ingeger.
Choose a integer between 1 to 100: 63
Right guess~~~~~~
```

7.4 while 迴圈

- break 指令：強制離開 while 迴圈
  - 隨機產生一個1000 ~ 9999的數，其中每一個位數值都不相同。

```
1   import random
2
3   answer = -1
4   listDigit = []
5   while True:
6       breakFlag = True
7       answer = random.randint(1000, 9999)
8       listDigit = list(str(answer))
9       for iIdx1 in range(len(listDigit)):
10          for iIdx2 in range(iIdx1+1, len(listDigit)):
11              if listDigit[iIdx1] == listDigit[iIdx2]:
12                  breakFlag = False
13      if breakFlag:
14          break
15  print(f"{answer:04d}")
```

```
6238
5690
0586
```

7.4 while 迴圈

- continue 指令：某些條件發生時，本次迴圈剩餘的程式碼區塊可以不繼續執行，直接進入下一次迭代：

```
while 運算條件式 A:
    程式碼區塊1
    #如果條件運算式 B是True則不執行程式碼區塊3
    if 條件運算式 B:
        程式碼區塊2
            continue
    程式碼區塊3
```

- 印出 1~10 之間的偶數：

```
1   index = 0
2   while index <= 10:
3       index += 1
4       if index % 2 == 1:
5           continue
6       print(index, end = " ")
```

```
2 4 6 8 10
```

7.4 while 迴圈

- 條件運算式與可迭代物件：

while var in 可迭代物件:
    程式碼區塊

如果 var in可迭代物件是 True 就繼續

6.10 in 和 not in 運算式

- 用於判斷一個物件是否屬於另外一個物件。物件可以是字串(string)、串列(list)、元組(Tuple)、字典(Dict)。
  - boolValue = obj1 in obj2
  - boolValue = obj1 not in obj2

while 可迭代物件:
    程式碼區塊

如果可迭代物件空的才結束

- bool() 函數
  - 將資料轉換為 True 或 False。
  - 輸出為False，當
    - 布林值False
    - 整數0
    - 浮點數0.0
    - 空字串 "" or ''
    - 空串列 []
    - 空元組 ()
    - 空字典 {}
    - 空集合 set()
    - None
  - 其他狀況都會輸出 True。

7.4 while 迴圈

- 將串列中的 Apple 刪除：

```
1  fruits1 = ["Banana", "Apple", "Pineapple", "Apple", "Papaya", "Peach", "Apple"]
2  print(f"Fruits in list are: {fruits1}")
3  fruit = "Apple"
4  #for fruit in fruits1[:]:
5  while fruit in fruits1:
6      fruits1.remove(fruit)
7      print(f"Remove {fruit}.\nFruits left in list are:{fruits1}")
```

```
Fruits in list are: ['Banana', 'Apple', 'Pineapple', 'Apple', 'Papaya', 'Peach', 'Apple']
Remove Apple.
Fruits left in list are:['Banana', 'Pineapple', 'Apple', 'Papaya', 'Peach', 'Apple']
Remove Apple.
Fruits left in list are:['Banana', 'Pineapple', 'Papaya', 'Peach', 'Apple']
Remove Apple.
Fruits left in list are:['Banana', 'Pineapple', 'Papaya', 'Peach']
```

- 有一串列，請依消費金額將消費者分成 VIP 與 Golden 兩個串列。

```
1   allBuyers = [["James", 1030],
2                ["Curry", 2000],
3                ["Durant", 803],
4                ["Jordon", 3029],
5                ["David", 2502]]
6   goldenBuyer = []
7   vipBuyer = []
8   while allBuyers:
9       buyer = allBuyers.pop()
10      if buyer[1] > 2500:
11          vipBuyer.append(buyer)
12      else:
13          goldenBuyer.append(buyer)
14  print(f"VIP: {vipBuyer}")
15  print(f"Golden: {goldenBuyer}")
```

```
VIP: [['David', 2502], ['Jordon', 3029]]
Golden: [['Durant', 803], ['Curry', 2000], ['James', 1030]]
```

7.4 while 迴圈

- 無限迴圈：

```
while True:          #while 1
    程式碼區塊
```

- pass 指令是什麼也不做。

```
While True:
    pass
```

- 不過不建議這麼做。這個有時候會用在設計一個迴圈或函數，在尚未完成時，先放 pass，等未來再用完整的程式碼取代。

7.5 enumerate 物件使用 for 迴圈解析

- enumerate 物件是由索引值與元素值配對出現。
- 可以將串列用 enumerate 建立成 enumerate 物件，再搭配 for 迴圈將每個物件的索引值與元素值解析出來。

```
1   drinks = ["coffee", "milk", "tea"]
2   for drink in enumerate(drinks):
3       print(drink)
4   for count, drink in enumerate(drinks):
5       print(count, drink)
6   print("***************")
7   for drink in enumerate(drinks, 10):
8       print(drink)
9   for count, drink in enumerate(drinks, 10):
10      print(count, drink)
```

```
(0, 'coffee')
(1, 'milk')
(2, 'tea')
0 coffee
1 milk
2 tea
***************
(10, 'coffee')
(11, 'milk')
(12, 'tea')
10 coffee
11 milk
12 tea
```

7.5 enumerate 物件使用 for 迴圈解析

- 傳統寫法：

```
1   scores = [21, 29, 18, 33, 12, 17, 26]
2   gameIdx = 1
3   for score in scores:
4       if score >= 20:
5           print(f"Game {gameIdx}, scores: {score}")
6       gameIdx += 1
```

```
Game 1, scores: 21
Game 2, scores: 29
Game 4, scores: 33
Game 7, scores: 26
```

- 符合 Python 精神寫法：

```
1   scores = [21, 29, 18, 33, 12, 17, 26]
2   for gameIdx, score in enumerate(scores, 1):
3       if score >= 20:
4           print(f"Game {gameIdx}, scores: {score}")
```

```
Game 1, scores: 21
Game 2, scores: 29
Game 4, scores: 33
Game 7, scores: 26
```

7.6 動手練習

- 使用迴圈計算成績的總分、平均與排名：

座號	姓名	國文	英文	數學	總分	平均	名次
1	王小明	80	95	88			
2	蘇小花	98	97	96			
3	謝大樹	94	93	85			
4	李大呆	91	94	95			
5	陳小比	92	97	90			

```python
scoreTable = [["王小明", 80, 95, 88, 0],
              ["蘇小花", 98, 97, 96, 0],
              ["謝大樹", 94, 93, 85, 0],
              ["李大呆", 91, 94, 95, 0],
              ["陳小比", 92, 97, 90, 0],
             ]

scoreTable[0][4] = sum(scoreTable[0][1:4])
scoreTable[1][4] = sum(scoreTable[1][1:4])
scoreTable[2][4] = sum(scoreTable[2][1:4])
scoreTable[3][4] = sum(scoreTable[3][1:4])
scoreTable[4][4] = sum(scoreTable[4][1:4])

print(f"  姓名   , 國文, 英文, 數學, 總分")
print(f"{scoreTable[0]}")
print(f"{scoreTable[1]}")
print(f"{scoreTable[2]}")
print(f"{scoreTable[3]}")
print(f"{scoreTable[4]}")
```

```
  姓名   , 國文, 英文, 數學, 總分
['王小明', 80, 95, 88, 263]
['蘇小花', 98, 97, 96, 291]
['謝大樹', 94, 93, 85, 272]
['李大呆', 91, 94, 95, 280]
['陳小比', 92, 97, 90, 279]
```

7.6 動手練習

- 使用迴圈計算成績的總分、平均與排名：
  - 可能會用到二維串列的 sort： 二維串列.sort(key=lambda x:x[n], reverse=True)
    - 對二維陣列中第n 個元素做升冪（ reverse=False, 小到大）/降冪（ reverse=True,大到小）的排序

```
1   scoreTable = [[1, "王小明", 80, 95, 88, 0],
2                 [2, "蘇小花", 98, 97, 96, 0],
3                 [3, "謝大樹", 94, 93, 85, 0],
4                 [4, "李大呆", 91, 94, 95, 0],
5                 [5, "陳小比", 92, 97, 90, 0],
6                ]
7   print("BeforeSort:")
8   for idx in range(len(scoreTable)):
9       print(scoreTable[idx])
10  scTable = scoreTable[:]
11  scTable.sort(key=lambda x: x[2], reverse=True)
12  print("After Sort:")
13  for idx in range(len(scTable)):
14      print(scTable[idx])
```

```
BeforeSort:
[1, '王小明', 80, 95, 88, 0]
[2, '蘇小花', 98, 97, 96, 0]
[3, '謝大樹', 94, 93, 85, 0]
[4, '李大呆', 91, 94, 95, 0]
[5, '陳小比', 92, 97, 90, 0]
After Sort:
[2, '蘇小花', 98, 97, 96, 0]
[3, '謝大樹', 94, 93, 85, 0]
[5, '陳小比', 92, 97, 90, 0]
[4, '李大呆', 91, 94, 95, 0]
[1, '王小明', 80, 95, 88, 0]
```

7.6 動手練習

- 使用迴圈計算雞兔同籠的問題：
  - 雞兔同籠，共有100隻腳，請列出所有可能的雞兔隻數的結果？

- 計算圓周率：使用萊布尼茲公式計算圓週率，使 i = 1 to 100萬，每計算20萬次就輸出一次當前 pi 值。

$$\text{pi} = 4(1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \cdots + \frac{(-1)^{i+1}}{2i-1})$$

```
When i =  200000, Pi = 3.1415876535897618
When i =  400000, Pi = 3.141590153589744
When i =  600000, Pi = 3.1415909869230147
When i =  800000, Pi = 3.1415914035897172
When i = 1000000, Pi = 3.1415916535897743
```