Python / R 資料處理

Python 資料結構

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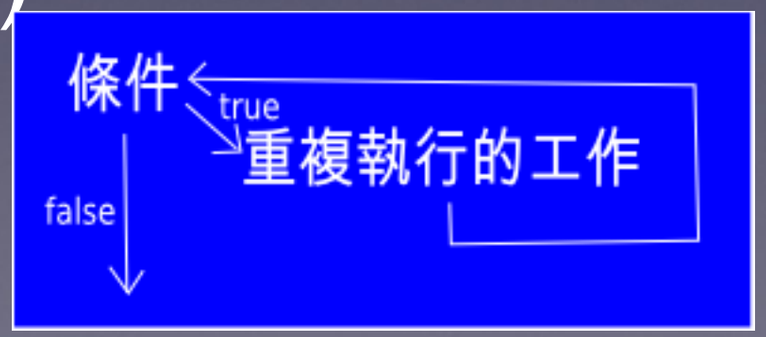
- 當有工作需要重複執行時，重複的條件為真，此工作就重複執行一次，執行完畢再行測試條件，條件為真，繼續重複執行此工作，直到條件為假時，結束工作的執行

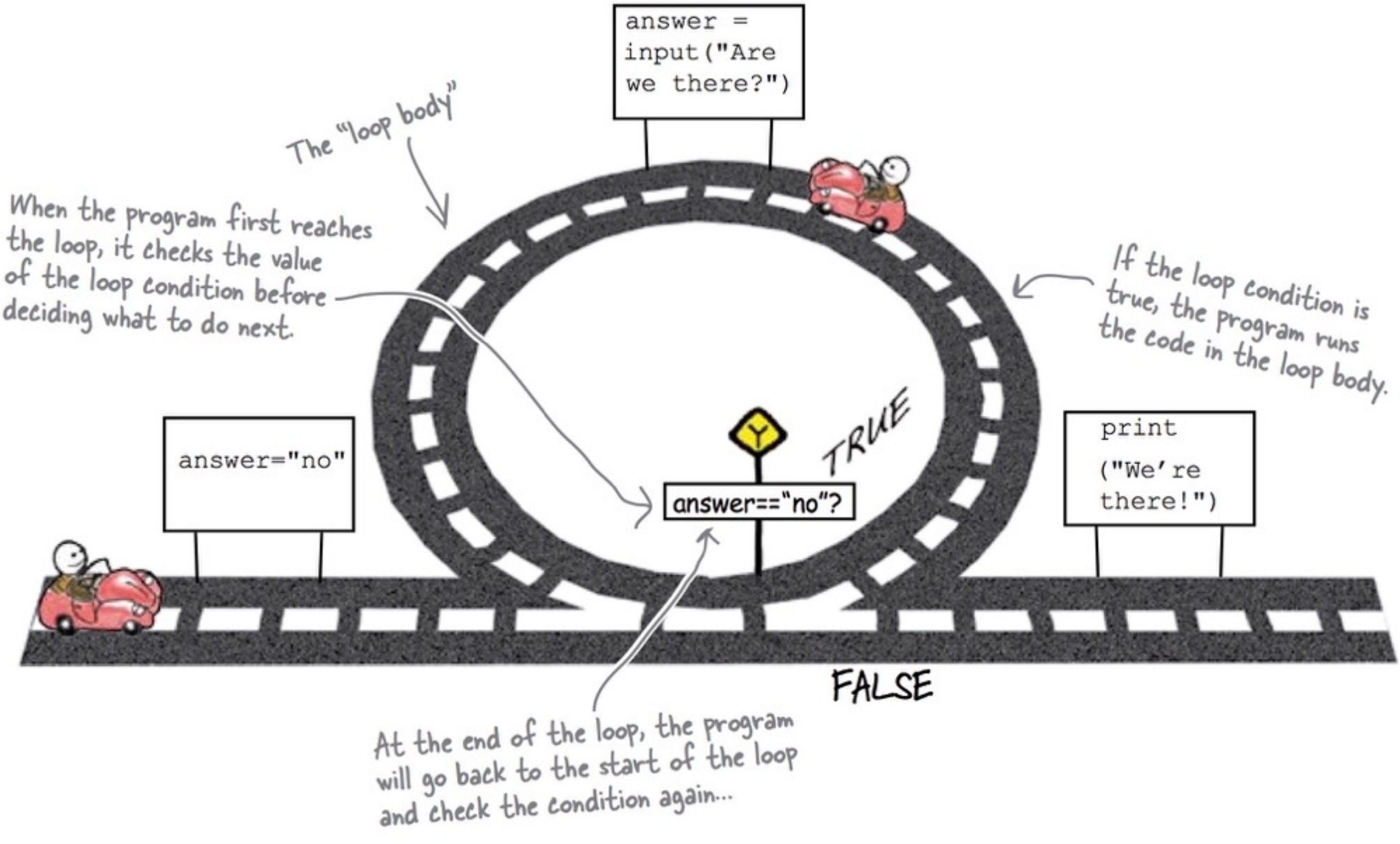
- 依此執行的方式為重複結構，也被稱為迴圈 (loop)



Loops let you run the same piece of code over and over again

Programs often need to keep running the same piece of code many times. In addition to branches, programming languages also provide **loops**.

Loops are a little like branches. Just like branches, loops have a condition (the **loop condition**) that is either true or false. Also, like the `if` part of branches, if the loop condition is true, then a loop will run a given piece of code. For a branch, this code is called the **body**. For a loop, it's called the **loop body**.

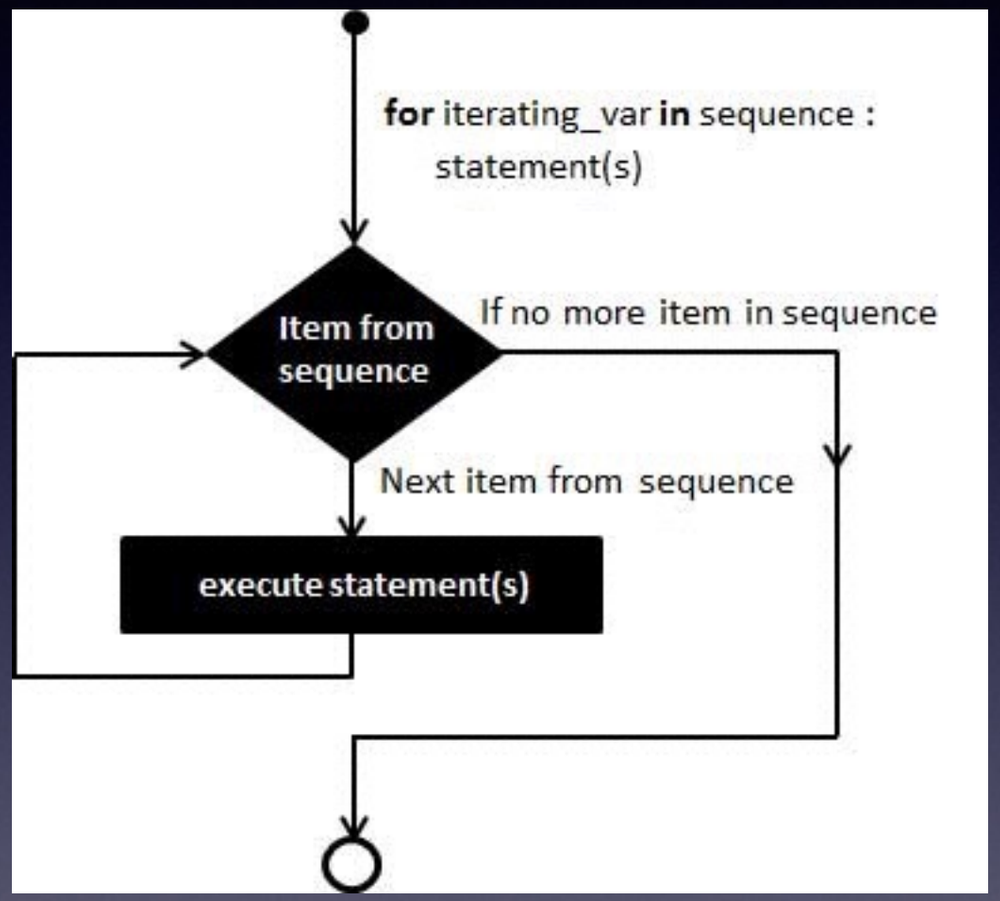

answer = input("Are we there?")
The "loop body"
When the program first reaches the loop, it checks the value of the loop condition before deciding what to do next.
If the loop condition is true, the program runs the code in the loop body.
answer="no"
answer=="no"?
TRUE
print ("We're there!")
FALSE
At the end of the loop, the program will go back to the start of the loop and check the condition again...

The big difference between a loop and a branch is **how many times** it runs the code associated with it. A branch will run its code only once. But a loop will run the loop body, then check the loop condition again and, if it's still true, it will run the loop body again. And again. And again. In fact, it will keep running the loop body until the loop condition becomes **false**.

for...in 迴圈

- for...in 迴圈，一般也會簡稱為 for 迴圈
- 通常來處理有次序性且已知應該執行次數的問題

- 在執行 for 迴圈時需要下列三個條件：
  - 設定控制變數的初始值
  - 設定控制變數的終止值，也就是迴圈的結束條件
  - 設定控制變數值的變動方向與量，也就是迴圈的迭代
- for 迴圈只需要取得元素的控制變數 (variable) ，其餘條件 (condition) 測試與調整控制變數的部份，迴圈中會自動完成


for iterating_var in sequence :
statement(s)
Item from sequence
If no more item in sequence
Next item from sequence
execute statement(s)

- 典型的 for 迴圈如下應用

```
1   a = "abcdefghijklmnopqrstuvwxyz"
2   i = 0
3
4   for x in a:
5       print(x, end=" ")
6       i += 1
7
8       if i % 10 == 0:
9           print()
10
11  print()
```

- 此例印出 26 個英文小寫字母，資料儲存在第 1 行建立的變數 a 之中
- 第 2 行的變數 i ，用來計數，每印 10 個字母便印出新行符號，因此出值設為 0
- for 迴圈從第 4 行到第 9 行

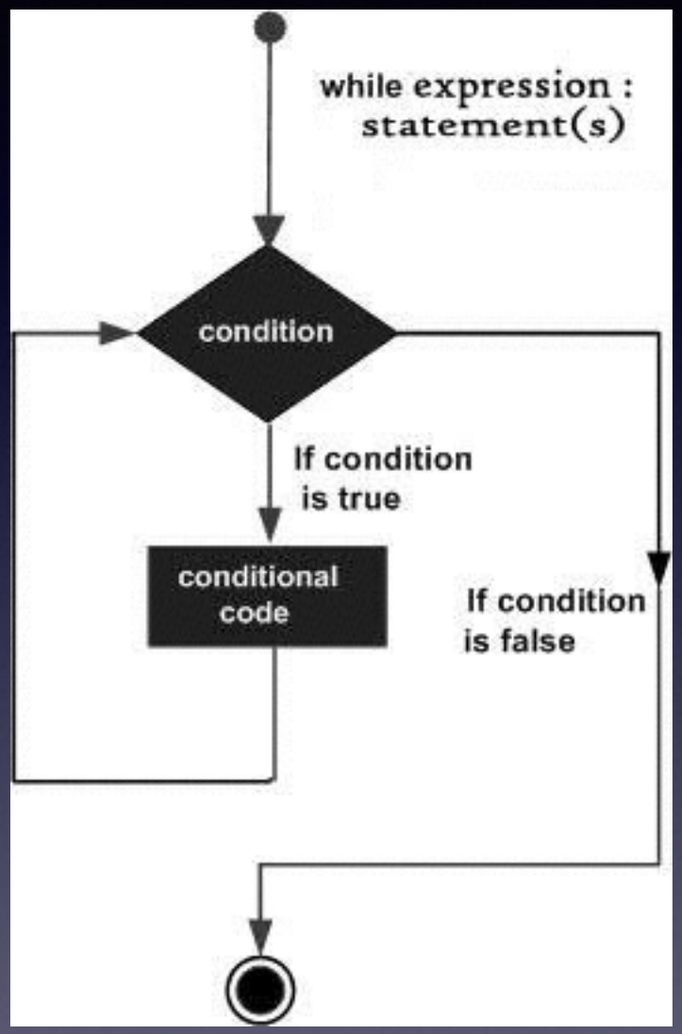
- 第 5 行的 print() 函數 (function) ，我們多增加一個預設的參數 (parameter) end ，這是指定印出 x 之後的結尾符號，如沒有指定，就會印出新行
- 第 8 行的 if 陳述 (if statement) ，我們取 i 除以 10 的餘數是否等於 0 ，也就是說 i 從 0 一路遞增到 9 印出 10 個英文字母後，當 i 遞增到 10 或 10 的倍數，此時程式就會印出新行，因此一行會印 10 個英文字母

while 迴圈

- while 迴圈比較適合拿來處理沒有次序性，或者不知道需要執行幾次的問題
- while 後到冒號間的運算式 (expression) 為迴圈結束的條件 (condition) 測試，即為迴圈開始前進行迴圈結束條件的測試，形式如下
- while condition:

- 由於 while 陳述僅需迴圈的結束條件測試，所以有關控制變數 (variable) 的初始設定及調整，這都需要放在其它地方
- while 迴圈在使用的彈性較大，for 迴圈可以做到的，while 迴圈也都能，不過在能夠使用 for 迴圈的行情下，還是建議使用 for 迴圈就好

- 因為 for 迴圈是特別設計於處理較制式化的問題，故語法通常較為便捷
- 在 while 迴圈因為需要手動加上迭代的條件，因此程式的行數比使用 for 迴圈會來得多


while expression :
statement(s)
condition
If condition
is true
conditional
code
If condition
is false

- 下例計算 1 到 100 所有整數的和，示範 while 迴圈的簡單使用

```
sum = 0
i = 1
while i <= 100:
    sum += i
    i += 1

print("1 + 2 + 3 + ... + 98 + 99 + 100 =", sum)
```

巢狀迴圈

- 迴圈 (loop) 也可以是巢狀的 (nested)，所謂巢狀的迴圈是指迴圈中包含其他的迴圈
- 在巢狀迴圈中，內部迴圈的執行是在外部迴圈之內，如果內部迴圈有使用到外部迴圈中有更動的變數，則內部迴圈會隨著外部迴圈的更動而改變

- 下例程式印出九九乘法表，就是利用兩個 for 迴圈，一個 for 迴圈之中包含另一個 for 迴圈

```
for x in range(10):
    for y in range(10):
        print(x * y, end="  ")
    print()
```

- range() 為內建函數，會自動產生一個從 0 開始到參數減 1 的串列 (list) ，因此 for x in range(10): 就表示 x 會從 0 一路遞增到 10 - 1 ，也就是 9

```
i = 1
j = 1
while i <= 9:
    while j <= 9:
        print(i * j, end = "  ")
        j += 1
    i += 1
    j = 1
    print()
```

break & continue

- 若利用關鍵字 break 則可以挑出迴圈，而利用關鍵字 continue 則會跳過迴圈這一輪的執行
- 下例在印出九九乘法表的程式中加入了 break 與 continue 陳述

```python
for x in range(10):
    if x == 0:
        continue
    elif x == 8:
        break

    for y in range(10):
        if y == 0:
            continue
        print(x * y, end="  ")
    print()
```

- 由於 x 等於 0 與 y 等於 0 的時候都使用 continue 陳述，因此 0 列與 0 行不會被印出
- 此外， x 等於 8 時使用 break 陳述跳出迴圈，結束印出乘法表的迴圈

```
i = 1
j = 1
while i <= 9:
    if i == 8:
        break

    while j <= 9:
        if j == 4:
            j += 1
            continue

        print(i * j, end = "  ")
        j += 1

    i += 1
    j = 1
    print()
```

- 第 5 行使用 break 陳述，因此只印到 7 為止
- 此外，第 10 行使用 contiune 陳述，因此乘法表的 4 不會被印出

The users still don't like it.

The program works, and now generates extra feedback, but there's a problem. If the users want to have another guess, they have to run the program again. They *really* want the program to keep asking them for another guess until they finally get the correct answer.

Can you see what the problem is?

How do we get the computer to do something repeatedly? Should we just make a copy of the code and paste it at the end of the file? That would make sure the user is asked twice. But what if they need to make **3 guesses**? Or **4 guesses**? Or **10,000 guesses**? What about the case where the guess is correct?

The guessing game program needs to be able to run *some* code repeatedly.

Ready Bake Code

If you add these two lines of code to the top of your program:

```
from random import randint
secret = randint(1, 10)
```

The `secret` variable will be set to a random number between 1 and 10. Modify your program from the facing page so that instead of the answer always being 5, it will instead use a random number from 1 to 10 as the answer.

Write the next version of your program here. This version of your program uses the value of the "secret" variable as the correct answer.

Long Exercise Solution

You needed to rewrite your game program so it keeps running until the user guesses the correct answer. You needed to use all of the things you've learned in this chapter. You needed to work out the conditions for each of the branches and loops that are required.

Hint: If you need to test that two things have different values, use the **!=** operator.

Did you remember to set the guess to some sensible default value to make sure the loop ran the first time?

Don't worry if your code doesn't look exactly like this. The important thing is that it works in the same way when you run it.

```
print("Welcome!")
guess = 0
while guess != 5:
    g = input("Guess the number: ")
    guess = int(g)
    if guess == 5:
        print("You win!")
    else:
        if guess > 5:
            print("Too high")
        else:
            print("Too low")
print("Game over!")
```

We need to keep running while the guess is wrong.

All of this code is indented, which means it's all inside the loop body.

This part of the program is very similar to what you had before.

Ready Bake Code

If you add these two lines of code to the top of your program:

```
from random import randint
secret = randint(1, 10)
```

The `secret` variable will be set to a random number between 1 and 10. You were to modify your program from the facing page so that instead of the answer always being 5, it will instead use a random number from 1 to 10 as the answer.

Here are the two lines that create the random number.

```
from random import randint
secret = randint(1, 10)
print("Welcome!")
guess = 0
while guess != secret:
    g = input("Guess the number: ")
    guess = int(g)
    if guess == secret:
        print("You win!")
    else:
        if guess > secret:
            print("Too high")
        else:
            print("Too low")
print("Game over!")
```

Now, instead of checking if the answer's 5, we check it against the random number, which is held in the "secret" variable.

Test Drive

So, what happens when you run the new version of your program?

Python Shell

File Edit Shell Debug Options Windows Help

```
Python 3.0.1 (r301:69556, Feb 17 2009, 15:15:57)
[GCC 4.3.2] on linux2
Type "copyright", "credits" or "license()" for more information.
>>> ========== RESTART ==========
--
>>>
Welcome!
Guess the number: 3
Too low
Guess the number: 9
Too high
Guess the number: 4
Too low
Guess the number: 7
Too low
Guess the number: 8
You win!
Game over!
>>>
```

The program keeps asking for another guess for as long as you keep getting the answer wrong.

The correct answer is now a random number and it should be different each time you play the game.

The program stops when you get the answer right.

Ln: 18 Col: 4

容器型別

- 這個型別裡面的資料就像是箱子一樣，可以裝入各種不同型態的資料，也可以在箱子裡裝入其他的箱子
- tuple：序對，在 ( ) 裡面可以放置一個以上的資料值，有順序性，但是不能更改其內容
- list：串列，在 [ ] 裡面可以放置一個以上的資料值，是一種有順序且可以更改其內容的型態

- set：集合，在 { } 裡面可以放置一個以上的資料值，類似數學裡面的集合概念，所以內容並無順序性
- dict：字典，是 dictionary 的縮寫，以 Key-Value 對應的型態在 { } 裡面放置一個以上的元素
- 字典是種配對型別，而 key 就是用來存取每個 value 的索引值

容器型別	tuple	list	set	dict
中文譯名	序對	串列	集合	字典
使用符號	( )	[ ]	{ }	{ }
具順序性？	有	有	無	無
更改內容？	不可以	可以	可以	可以

```
Python 2.7.6 (default, Sep  9 2014, 15:04:36)
[GCC 4.2.1 Compatible Apple LLVM 6.0 (clang-600.0.39)] on darwin
Type "help", "copyright", "credits" or "license" for more information.
>>> x = 123
>>> print(type(x))
<type 'int'>
>>> x = '123'
>>> print(type(x))
<type 'str'>
>>> x = 123.0
>>> print(type(x))
<type 'float'>
>>> x = 123 + 0j
>>> print(type(x))
<type 'complex'>
>>> x = True
>>> print(type(x))
<type 'bool'>
>>> x = (123, 456)
>>> print(type(x))
<type 'tuple'>
>>> x = [123]
>>> print(type(x))
<type 'list'>
>>> x = {123}
>>> print(type(x))
<type 'set'>
>>> x = {1:123}
>>> print(type(x))
<type 'dict'>
```

`list` 與先前介紹過的字串型態享有共同的操作。`len` 傳回 `list` 長度；`in` 可測試某元素是否在 `list` 中；`+` 可以用來串接兩個 `list`；`*` 可用來複製出指定數量的 `list`。`[]` 可以指定索引，用以從 `list` 中取得元素，負索引是從最後一個元素計數，使用 `[]` 來切割 `list` 或許是最有用的功能。其他操作還有...

```
>>> [0] * 10
[0, 0, 0, 0, 0, 0, 0, 0, 0, 0]
>>> ', '.join(['justin', 'caterpillar', 'openhome'])
'justin, caterpillar, openhome'
>>> list('justin')
['j', 'u', 's', 't', 'i', 'n']
>>>
```

`set` 型態是無序群集，管理的元素不會重複而且是 hashable（這中間還有一些要討論的東西，可以參考 物件相等性（上））。以下是 `set` 的幾個功能示範：

```
>>> admins = {'Justin', 'caterpillar'}  # 建立 set
>>> users = {'momor', 'hamini', 'Justin'}
>>> 'Justin' in admins  # 是否在站長群？
True
>>> admins & users      # 同時是站長群也是使用者群的？
{'Justin'}
>>> admins | users      # 是站長群或是使用者群的？
{'hamini', 'caterpillar', 'Justin', 'momor'}
>>> admins - users      # 站長群但不使用者群的？
{'caterpillar'}
>>> admins ^ users      # XOR
{'hamini', 'caterpillar', 'momor'}
>>> admins > users      # ∈
False
>>> admins < users
False
>>>
```

```
>>> passwords = {'Justin' : 123456, 'caterpillar' : 933933}
>>> passwords['Justin']
123456
>>> passwords['Hamimi'] = 970221   # 增加一對鍵值
>>> passwords
{'caterpillar': 933933, 'Hamimi': 970221, 'Justin': 123456}
>>> del passwords['caterpillar']   # 刪除一對鍵值
>>> passwords
{'Hamimi': 970221, 'Justin': 123456}
>>> passwords.items()
[('Hamimi', 970221), ('Justin', 123456)]
>>> passwords.keys()
['Hamimi', 'Justin']
>>> passwords.values()
[970221, 123456]
>>>
```

使用 `[]` 時如果指定的鍵不存在，會發生 `KeyError`，可以使用 `dict` 的 `get` 方法，指定鍵不存在時傳回的預設值。例如：

```
>>> passwords.get('openhome', '000000')
'000000'
>>> passwords['openhome']
Traceback (most recent call last):
  File "", line 1, in
KeyError: 'openhome'
>>>
```

- 講義、範例程式下載：
- https://github.com/ycwang812/VNU