LOOPS

CIS 41A– INTRODUCTION TO PROGRAMMING IN PYTHON

BASED ON MATERIALS FROM CLARE NGUYEN

The range Function

- The range function creates a range of integers as the output.

range (6)	Output: 0, 1, 2, 3, 4, 5
range(2, 5)	Output: 2, 3, 4
range(10, 18, 2)	Output: 10, 12, 14, 16
range(10, 4, -1)	Output: 10, 9, 8, 7, 6, 5

- Format: range(start, stop, step)
  - start: an optional number which is the starting number for the output. If not used, the start is 0.
  - stop: a required number which is the stopping point of the range. The range does not include the stopping number.
  - step: an optional number to specify the step or difference between values in the range. If not used, the step is +1.

Repetition

- Recall our first line of code:

```
>>> print ("Hello world!")
Hello world!
```

The print statement will output one line of text.

- What if we want the same line of text to be printed 50 times? Instead of having to copy and paste the print statement 50 times, we write the print statement one time and then ask the computer to repeatedly run it 50 times for us.

- To ask the computer to run a block of code repeatedly for a specific number of time, we use a for loop.

The for Loop (1 of 2)

- Example:

```
for i in range(6):
    print ("Hello world!")
```

- There are 6 values in the list, from the range function output:
  0, 1, 2, 3, 4, 5

- 1st loop iteration: i is 0 "Hello world!" is printed
  2nd iteration: i is 1 "Hello world!" is printed
  3rd iteration: i is 2 "Hello world!" is printed
  4th iteration: i is 3 "Hello world!" is printed
  5th iteration: i is 4 "Hello world!" is printed
  6th iteration: i is 5 "Hello world!" is printed
  No more data in list, loop stops

More for Loop Examples

- Note how the iterator i contains each value in the list, one value for each iteration of the loop:

code

```
for i in range (5, 32, 4):
    print(i)
```

output

```
5
9
13
17
21
25
29
```

The while Loop

- The while loop is used when we want the block of code to keep running repeatedly while some condition is True.

- Format:

  while Boolean_expression statement block

- The Boolean_expression is called the *test condition* because it is the condition that determines whether the loop continues.

- Looping continues as long as the test condition is True.

while Loop Example (1 of 2)

- The following script prints the square of positive integers, starting from 1, up to a max limit.

- The max limit is from a user input.

Code:

```
max = int(input("Enter a max limit: "))
num = 1
while num**2 < max:
    print (num**2)
    num = num + 1
print ("reached your limit")
```

Output:

```
Enter a max limit: 30
1
4
9
16
25
reached your limit
```

while Loop Example (2 of 2)

- Taking a closer look at how the example code runs:

```
max = int(input("Enter a max limit: "))
num = 1
while num**2 < max:
    print (num**2)
    num = num + 1
print ("reached your limit")
```

```
Enter a max limit: 30
1
4
9
16
25
reached your limit
```

- Start with test: $1^2 < 30$ is True => print 1
  num is updated to 2
- Loop back to test: $2^2 < 30$ is True => print 4
  num is updated to 3
- Loop back to test with num = 3, 4, 5 and run loop body
- Loop back to test: $6^2 < 30$ is False => the loop stops

Number of Iterations

- What is the minimum number of iterations for a while loop?

```
num = 5
while num < 0:
    num = num + 1
```

The test condition is False right away on the very first test, so the loop never runs. The minimum number of iterations is 0.

- What is the maximum number of iterations for a while loop?

```
num = 5
while num > 0:
    num = num + 1
```

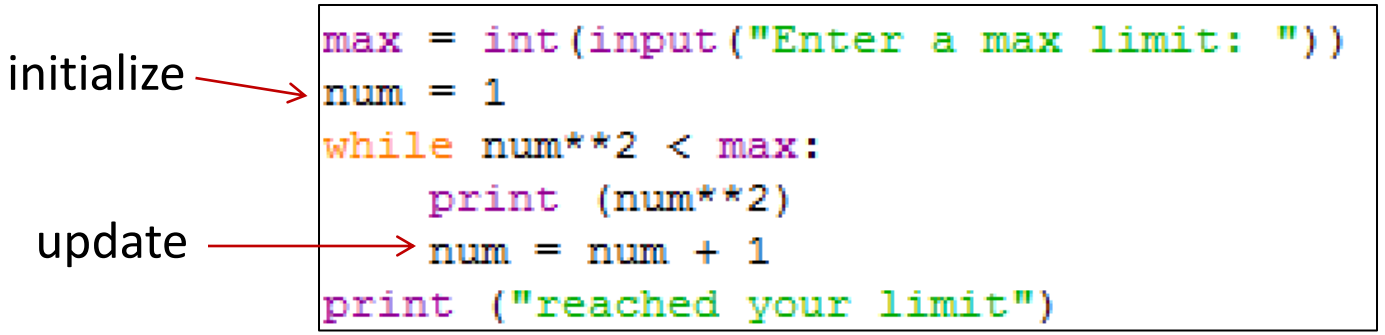
The test condition is True on the first test, so num is incremented. This means the test condition is also True on the next tests as num keeps incrementing. The test condition never becomes False so the loop keeps running. This is known as an *infinite loop*.

Test Condition Must-Haves

- The test condition controls how many iterations the loop will run

- There are 2 steps that we must ensure for the test condition:
  1. Initialize: before the test statement
  2. Update: in the loop body

- In the example code:



1. Initialize to 1 for the test condition
2. Update the test condition to prevent infinite loop

Which Loop To Use

- There are2 types of loops: for and while.

- If the block of code runs for a certain number of times, then it is simplest to use the for loop.

- The while loop can be used for repeating code a number of times, but it takes more effort to remember to initialize and update the test condition.

- If the block of code is to be repeatedly run as long as a condition is True, then it is simplest to use the while loop because it has a built-in test condition in its format.

- When using the while loop, we should make sure that there is an initialization and an update of the test condition so that the loop will run the correct number of iterations.