

Introduction to Python

Direct Loops: For Loops

Topics

- 1) For Loops
- 2) Break vs. Continue
- 3) Nested Loops

For Loops

In general, a loop allows a sequence of instructions to execute repeatedly until some condition is met.

Python's *for* loop iterates over items of a sequence (e.g. a list, string or tuple) and process them with some code.

```
for x in sequence:  
    block
```

This is a list. More on lists in a later lecture.

```
In[1]: for x in [2,3,5,7]:  
        print(x, end=" ")    # print all on same line
```

2 3 5 7

For Loops

```
In[1]:  for x in [2,3,5,7]:  
        print(x)
```

2

3

5

7

range(stop)

A simple use of a *for* loop runs some code a specified number of times using the *range()* function.

`range(stop)`: returns sequence of numbers from 0 (default) up to but not including stop. Increment by 1 (default).

```
In[1]: for i in range(10):  
        print(i, end=" ")
```

0 1 2 3 4 5 6 7 8 9

range(start, stop)

range(start, stop): from start up to but not including stop. Increment by 1 (default).

```
In[2]: for i in range(2, 8):  
        print(i, end=' ')
```

2 3 4 5 6 7

range(start, stop, step)

range(start, stop, step): from start up to but not including stop, increment by step.

```
In[3]: for i in range(1, 10, 2):  
        print(i, end=' ')
```

1 3 5 7 9

If step is negative, a list can be traversed backwards.

```
In[4]: for i in range(10, 2, -1):  
        print(i, end=' ')
```

10 9 8 7 6 5 4 3

continue vs. break

The **continue** statement is used to skip the current iteration and move to the next iteration whereas the **break** statement is used to exit a for loop.

```
In [1]: for n in range(10):  
        if n % 2 == 0:  
            continue  
        print(n, end=' ')
```

1 3 5 7 9

continue vs. break

The **continue** statement is used to skip the current iteration and move to the next iteration whereas the **break** statement is used to exit a loop.

```
In [2]: for n in range(5):  
        if n == 3:  
            break  
        print(n, end=' ')
```

0 1 2

Definite Loop

The for loop is an example of a **definite** loop. We can determine ahead of time the number of times the loop repeats. Later, we will talk about **indefinite loop**, a loop where we cannot predict the number of times it repeats.

```
In [1]: for i in range(5):  
        print("*", end="")
```

```
*****
```

The loop above prints five '*'s. We can determine this from the for loop statement.

Summing and Counting

There are two common tasks that uses for loops.

- 1) Summing
- 2) Counting

Summing Values

Write a segment of code that solve the problem

$$1 + 2 + 3 + \dots + 98 + 99 + 100.$$

```
In [1]: sum = 0
        for i in range(1, 101):
            sum += i
```

Writing a function to sum

Now write a function that accepts a non-negative integer input n and returns the sum of integers from 1 to n (including).

```
In [1]: def sum(n):  
        sum = 0  
        for i in range(1, n+1):  
            sum += i  
        return sum
```

```
In [2]: print(sum(5))    # 1+2+3+4+5=15  
15
```

Conditional Summing

Write a segment of code that compute the sum of all numbers from 1 to 100 that are multiples of 3.

```
In [1]:  sum = 0
         for i in range(0, 101, 3):
             sum += i
```

Or equivalently, we can use a conditional to select the numbers to add:

```
In [2]:  sum = 0
         for i in range(1, 101):
             if i % 3 == 0:
                 sum += i
```

Better to use if conditional for filtering.
In general, using the step size above might not always work.

Conditional Summing Example

Write a segment of code that compute the sum of all numbers from 1 to 100. However:

- 1) if a number is a multiple of 3, double it before adding,
- 2) if a number is a multiple of 5, triple it before adding,
- 3) If a number is a multiple of both, quadruple it before adding.

Conditional Summing Solution?

Is the following a correct solution?

```
sum = 0
for i in range(1, 101):
    if i % 3 == 0:
        sum += 2 * i
    elif i % 5 == 0:
        sum += 3 * i
    elif i % 3 == 0 and i % 5 == 0:
        sum += 4 * i
    else:
        sum += i
```

No! Why not?

Conditional Summing Solution

The following is correct.

```
sum = 0
for i in range(1, 101):
    if i % 3 == 0 and i % 5 == 0:
        sum += 4 * i
    elif i % 3 == 0:
        sum += 2 * i
    elif i % 5 == 0 :
        sum += 3 * i
    else:
        sum += i
```

Counting

Write a function that accepts an integer n and returns the number of factors of n .

```
In [1]: def count_factors(n):  
        count = 0  
        for i in range(1, n+1):  
            if n % i == 0: # i is a factor of n  
                count += 1  
        return count
```

```
In [2]: print(count_factors(10))
```

```
4                # 4 factors of 10={1,2,5,10}
```

Nested Loops

A *nested loop* is a loop inside of another loop.

```
In[1]: for i in range(1, 4):  
        for j in range(1, 5):  
            print(i * j, end=' ')  
        print()
```

```
1 2 3 4  
2 4 6 8  
3 6 9 12
```

Nested Loops Example I

```
In[1]: for i in range(1, 6):  
        for j in range(1, i+1):  
            print(j, end=' ')  
        print()
```

1

1 2

1 2 3

1 2 3 4

1 2 3 4 5

Nested Loops Example 2

```
In[2]: for i in range(1, 6):  
        for j in range(6, i, -1):  
            print(j, end=' ')  
        print()
```

6 5 4 3 2

6 5 4 3

6 5 4

6 5

6

For Loop in Movies and TV-Shows

Movies:

Groundhog Day(1993); Bill Murray.

Looper(2010); Bruce Willis and Joseph Gordon-Levitt, Emily Blunt.

Edge of Tomorrow(2014); Tom Cruise, Emily Blunt.

Happy Death Day(2017).

TV-Show:

Russian Doll(Netflix, Emmy-Nominated)

Lab I

Create a new repl on repl.it.

Write **a for loop** to do each of the following:

- 1) Print out "Hello!" 10 times, each on a different line.
- 2) Alternate between printing "Hello" and "Hi" for a total of 20 times, each on a separate line. Use only one for loop. (Hint: Use and a conditional)
- 3) Print 1 4 9 16 ... 100
- 4) Print 10 8 6 4 2 0 -2
- 5) Compute the sum: $1^2 + 2^2 + 3^2 + 4^2 + \dots + 19^2 + 20^2$

Continue on next page.

Lab I

Write **a nested for loop** to do each of the following:

1) Print out 10 lines, each line containing 5 "Hello" separated by spaces.

2) *****

3) Print

*

**

Lab 2

Create a new repl.

- 1) Rewrite the function `count_factors` as explained in a previous slide.
- 2) A number n is prime if its only factors are 1 and n . Write the function `is_prime` which accepts an integer n and returns whether it is prime. **You must call the function `count_factors` in your implementation of `is_prime`.**
- 3) Write the function `printPrimes` which accepts an integer n and and print out all the primes from 2 up to and including n . **You must call the function `is_prime` in your implementation.**

References

- I) Vanderplas, Jake, A Whirlwind Tour of Python, O'reilly Media.