



## Week 2

expressions, variables, for loops

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# Who uses Python?



- “Python is fast enough for our site and allows us to produce maintainable features in record times, with a minimum of developers”  
-Cuong Do, Software Architect, YouTube.com



# Expressions

- Arithmetic is very similar to Java
  - Operators: + - \* / % (plus \*\* for exponentiation)
  - Precedence: () before \*\* before \* / % before + -
  - Integers vs. real numbers (doubles)
  - You may use // for integer division

```
>>> 1 + 1
2
>>> 1 + 3 * 4 - 2
11
>>> 7 // 2
3
>>> 7 / 2
3.5
>>> 7.0 / 2
3.5
```

# Variables

- Declaring
  - no type is written; same syntax as assignment
- Operators
  - no ++ or -- operators (must manually adjust by 1)

Java	Python
<pre>int x = 2; x++; System.out.println(x);  x = x * 8; System.out.println(x);  double d = 3.2; d = d / 2; System.out.println(d);</pre>	<pre>x = 2 x = x + 1 print(x)  x = x * 8 print(x)  d = 3.2 d = d / 2 print(d)</pre>

# Types

- Python is looser about types than Java
  - Variables' types do not need to be declared
  - Variables can change types as a program is running

Value	Java type	Python type
42	int	int
3.14	double	float
"ni!"	String	str

- You can find the type of anything using the `type()` function

```
>>> type(3.3)
<class 'float'>
```

# String Multiplication

- Python strings can be multiplied by an integer.
  - The result is many copies of the string concatenated together.

```
>>> "hello" * 3
"hellohellohello"

>>> print(10 * "yo ")
yo yo yo yo yo yo yo yo yo yo

>>> print(2 * 3 * "4")
444444
```

# String Concatenation

- Integers and strings cannot be concatenated in Python.
  - Workarounds:
    - `str(value)` - converts a value into a string
    - `print(value, value)` - prints values, separated by a space

```
>>> x = 4
>>> print("Thou shalt not count to " + x + ".")
TypeError: cannot concatenate 'str' and 'int' objects

>>> print("Thou shalt not count to " + str(x) + ".")
Thou shalt not count to 4.

>>> print(x + 1, "is out of the question.")
5 is out of the question.
```

# Special Print Options

- You may define the behavior of the print function as follows:
  - end: string appended after the last value, default `\n`
  - sep: string inserted between values, default a space

```
>>> print("One", "two", "five", sep="... ")
One... two... five

>>> print("O", "M", "G", sep="...   ", end="!!!1")
O...   M...   G!!!1
```

# The for Loop

- `for name in range(max) :`
- `statements`
- Repeats for values 0 (inclusive) to max (exclusive)

```
>>> for i in range(5):  
...     print(i)  
0  
1  
2  
3  
4
```

# for Loop Variations

- `for name in range(min, max) :`
- `statements`
- `for name in range(min, max, step) :`
- `statements`
- Can specify a minimum other than 0, and a step other than 1

```
>>> for i in range(2, 6):  
...     print(i)  
2  
3  
4  
5  
>>> for i in range(15, 0, -5):  
...     print(i)  
15  
10  
5
```

# Nested Loops

- Nested loops are often replaced by string \* and +

.....1  
...2  
..3  
.4  
5

## Java

```
1 for (int line = 1; line <= 5; line++) {  
2   for (int j = 1; j <= (5 - line); j++) {  
3     System.out.print(".");  
4   }  
5   System.out.println(line);  
6 }
```

## Python

```
1 for line in range(1, 6):  
2   print((5 - line) * ".", line, sep="")
```

# Constants

- Python doesn't really have constants.
  - Instead, declare a variable at the top of your code.
  - All methods will be able to use this "constant" value.

constant.py

```
1 MAX_VALUE = 3
2
3 def print_top():
4     for i in range(MAX_VALUE):
5         for j in range(i):
6             print(j)
7         print()
8
9 def print_bottom():
10    for i in range(MAX_VALUE, 0, -1):
11        for j in range(i, 0, -1):
12            print(MAX_VALUE)
13    print()
```



# Exercise

- Rewrite the Mirror lecture program in Python. Its output:

```
#=====#
|           |
|    <><>   |
|   <>...<> |
|  <>...<>  |
| <>...<>   |
| <>...<>   |
|  <>...<>  |
|   <>...<> |
|    <><>   |
|           |
#=====#
```

- Make the mirror resizable by using a "constant."



```

def bar():
    print("#", 16 * "=", "#")

def draw_top_half():
    for line in range(1, 5):
        print("|", end=" ")
        print(" " * (-2 * line + 8), end="<>")
        print("." * (4 * line - 4), end="<>")
        print(" " * (-2 * line + 8), end=" ")
        print("|", end="\n")

def draw_bottom_half():
    for line in range(4, 0, -1):
        print("|", end=" ")
        print(" " * (-2 * line + 8), end="<>")
        print("." * (4 * line - 4), end="<>")
        print(" " * (-2 * line + 8), end=" ")
        print("|", end="\n")

bar()
draw_top_half()
draw_bottom_half()
bar()

```

# Exercise Solution

```
# constant
SIZE = 4

def bar():
    print("#", 4 * SIZE * "=", "#")

def draw_top_half():
    for line in range(1, SIZE + 1):
        print("|", end=" ")
        print(" " * (-2 * line + 2 * SIZE), end="<>")
        print("." * (4 * line - 4), end="<>")
        print(" " * (-2 * line + 8), end=" ")
        print("|", end="\n")

def draw_bottom_half():
    for line in range(SIZE, 0, -1):
        print("|", end=" ")
        print(" " * (-2 * line + 2 * SIZE), end="<>")
        print("." * (4 * line - 4), end="<>")
        print(" " * (-2 * line + 2 * SIZE), end=" ")
        print("|", end="\n")

bar()
draw_top_half()
draw_bottom_half()
bar()
```

# Concatenating Ranges

- Ranges can be concatenated with +
  - However, you must use the “list()” command
  - Can be used to loop over a disjoint range of numbers

```
>>> list(range(1, 5)) + list(range(10, 15))
[1, 2, 3, 4, 10, 11, 12, 13, 14]

>>> for i in list(range(4)) + list(range(10, 7, -1)):
...     print(i)
0
1
2
3
10
9
8
```

# Exercise Solution 2

```
SIZE = 4

def bar():
    print("#", 4 * SIZE * "=", "#")

def mirror():
    for line in list(range(1, SIZE + 1)) + list(range(SIZE, 0, -1)):
        print("|", end=" ")
        print(" " * (-2 * line + 2 * SIZE), end="<>")
        print("." * (4 * line - 4), end="<>")
        print(" " * (-2 * line + 8), end=" ")
        print("|", end="\n")

# main
bar()
mirror()
bar()
```