

Python

A quickstart into the key concepts of programming
Variables & operators



Key concepts in programming

- Variables (*integers, strings, dates, etc.*)
- Flow control (*if then, loop, etc.*)
- Functions (*list of steps the code will follow*)



Variables

variables.ipynb



Variables

- Variables are placeholders for *locations in memory*.
 - Variables are names for values
 - Created by use – no declaration necessary
- Variables always have a *type*
 - Variables only have data types after you use them
 - Use the `type` function to determine variable type
- Variables have a *name*
 - Python is case sensitive.
 - `myVar` is different from `Myvar`
 - Tip: avoid using names that differ only by case.



What variable names are legal?

- Choose meaningful names
- No leading numbers, no spaces
- lowercase, with words separated by underscores as necessary to improve readability (same for function naming)
- Don't use Python keywords

```
In [10]: 1 import keyword
          2 keyword.kwlist

Out[10]: ['False',
          'None',
          'True',
          'and',
          'as',
          'assert',
          'async',
          'await',
```



Python Variables Are References

- Variables must be created (assigned a value) before they can be used
- A variable is created through assignment:

```
x = 4
```

- What happens?
 - Python creates the object 4
 - Everything in Python is an object, this object is stored somewhere in memory.
 - Python binds a name to the object. x is a reference to the object.
- Consequences:
 - No need to “declare” the variable
 - *dynamically typed*: variable names can point to objects of any type.
 - No need to require the variable to always point to information of the same type.

```
x = 1 # x is an integer
x = 'hello' # now x is a string
x = [1, 2, 3] # now x is a list
```



Everything is an object

- In Python, everything is an object:
 - Some associated functionality (*methods*) and metadata (*attributes*).
 - These methods and attributes are accessed via the dot (`.`) syntax.
 - Use `type` to get information on the class
 - Use `dir` to get an overview on the methods
- File: `check_variable_object.py`



Python Variables Are Pointers

```
x = 1 # x is an integer
x = 'hello' # now x is a string
x = [1, 2, 3] # now x is a list
x = [1, 2, 3]
y = x
print(y)
[1, 2, 3]
```

File: `variables_are_pointers.py`

Check: <https://jakevdp.github.io/WhirlwindTourOfPython/03-semantics-variables.html>



dir

- The `dir()` function returns all properties and methods of the specified object, without the values.
- `dir('')`
 - Many of the names in the list start and end with two underscores (*dunder*), like `__add__`. These are all associated with methods and pieces of data used internally by the Python interpreter.
 - The remaining entries in the list are all user-level methods.
 - `dir()` is supplied primarily as a convenience for use at an interactive prompt, it tries to supply an interesting set of names more than it tries to supply a rigorously or consistently defined set of names, and its detailed behavior may change across releases.
- Object notation
`object.method(parameters)`



id() function

- What is the number returned from the function?
 - It is "an integer (or long integer) which is guaranteed to be unique and constant for this object during its lifetime." (Python Standard Library - Built-in Functions)
- Is it similar to memory addresses in C?
 - In CPython, this will be the address of the object.
 - This identity is unique to the Python interpreter, and should not be considered an actual physical address in memory. (Justin Bois - http://justinbois.github.io/bootcamp/2022/lessons/l05_lists_and_tuples.html)

$$x = x + 1$$

- $x = x + 1$
- Evaluate the value on the right hand side of the equal sign
 - need to know what the current value of x
 - Ex. $x = 7$, then $x + 1$ evaluates to 8
- Assign this value (i.e. 8) to the variable name shown on the left hand side x .
- it is a quite a common operation to increase a variable x by some fixed amount c , we can write
 - $x = x + c$
 - $x += c$
 - Note that the order of $+$ and $=$ matters



Operators

operators.ipynb



Arithmetic Operations

Operator	Name	Description
$a + b$	Addition	Sum of a and b
$a - b$	Subtraction	Difference of a and b
$a * b$	Multiplication	Product of a and b
a / b	True division	Quotient of a and b
$a // b$	Floor division	Quotient of a and b, removing fractional parts
$a \% b$	Modulus	Remainder after division of a by b
$a ** b$	Exponentiation	a raised to the power of b
$-a$	Negation	The negative of a
$+a$	Unary plus	a unchanged (rarely used)



Assignment Operations

- $A = \text{value}$ (regular assignment)
- $a \# = b$ is equivalent to $a = a \# b$

$a += b$ $a -= b$ $a *= b$ $a /= b$
 $a \mathrel{//=} b$ $a \mathrel{\%}= b$ $a \mathrel{**}= b$ $a \mathrel{\&}= b$
 $a \mathrel{|}= b$ $a \mathrel{\wedge}= b$ $a \mathrel{<<}= b$ $a \mathrel{>>}= b$



Comparison Operations

<code>a == b</code>	a equal to b
<code>a != b</code>	a not equal to b
<code>a < b</code>	a less than b
<code>a > b</code>	a greater than b
<code>a <= b</code>	a less than or equal to b
<code>a >= b</code>	a greater than or equal to b



Boolean operator

- `and`, `or`, `not`
- A good general rule is to always use parentheses when mixing `and` and `or` in the same condition.
- Different from the bitwise operator! (`&`, `|`, `~`)

`x = 4`

`(x < 6) and (x > 2)`

`2 < x < 6`



The `is` operator

- Compares two objects and determines whether they are exactly the same. The `is` operator evaluates to true if the variables on either side of the operator point to the same object and false otherwise.
- The `==` operator is used when the *values* of two operands are equal, then the condition becomes true.

```
a = 8.8
b = 8.8
print('a == b', a==b)
print('a is b', a is b)
print('id(a): ', id(a))
print('id(b): ', id(b))
a == b True
a is b False
id(a): 1772400854512
id(b): 1772400854256
```



Bitwise operator

- bitwise operators only make sense in terms of the binary representation
- Use built-in `bin` function

Operator	Name	Description
<code>a & b</code>	Bitwise AND	Bits defined in both a and b
<code>a b</code>	Bitwise OR	Bits defined in a or b or both
<code>a ^ b</code>	Bitwise XOR	Bits defined in a or b but not both
<code>a << b</code>	Bit shift left	Shift bits of a left by b units
<code>a >> b</code>	Bit shift right	Shift bits of a right by b units
<code>~a</code>	Bitwise NOT	Bitwise negation of a

