What is Python?

Python is a popular programming language. It was created by Guido van Rossum, and released in 1991.

It is used for:

* web development (server-side),
* software development,
* mathematics,
* system scripting.

What can Python do?

* Python can be used on a server to create web applications.
* Python can be used alongside software to create workflows.
* Python can connect to database systems. It can also read and modify files.
* Python can be used to handle big data and perform complex mathematics.
* Python can be used for rapid prototyping, or for production-ready software development.

Why Python?

* Python works on different platforms (Windows, Mac, Linux, Raspberry Pi, etc).
* Python has a simple syntax similar to the English language.
* Python has syntax that allows developers to write programs with fewer lines than some other programming languages.
* Python runs on an interpreter system, meaning that code can be executed as soon as it is written. This means that prototyping can be very quick.
* Python can be treated in a procedural way, an object-orientated way or a functional way.

Good to know

* The most recent major version of Python is Python 3, which we shall be using in this tutorial. However, Python 2, although not being updated with anything other than security updates, is still quite popular.
* In this tutorial Python will be written in a text editor. It is possible to write Python in an Integrated Development Environment, such as Thonny, Pycharm, Netbeans or Eclipse which are particularly useful when managing larger collections of Python files.

Python Syntax compared to other programming languages

* Python was designed for readability, and has some similarities to the English language with influence from mathematics.
* Python uses new lines to complete a command, as opposed to other programming languages which often use semicolons or parentheses.
* Python relies on indentation, using whitespace, to define scope; such as the scope of loops, functions and classes. Other programming languages often use curly-brackets for this purpose.

Execute Python Syntax

As we learned in the previous page, Python syntax can be executed by writing directly in the Command Line:

>>> print("Hello, World!")  
Hello, World!

Or by creating a python file on the server, using the .py file extension, and running it in the Command Line:

C:\Users\*Your Name*>python3 myfile.py

Python Indentation

Indentation refers to the spaces at the beginning of a code line.

Where in other programming languages the indentation in code is for readability only, the indentation in Python is very important.

Python uses indentation to indicate a block of code.

Example

if 5 > 2:  
  print("Five is greater than two!")

Python will give you an error if you skip the indentation:

Example

Syntax Error:

if 5 > 2:  
print("Five is greater than two!")

The number of spaces is up to you as a programmer, but it has to be at least one.

Example

if 5 > 2:  
 print("Five is greater than two!")   
if 5 > 2:  
        print("Five is greater than two!")

You have to use the same number of spaces in the same block of code, otherwise Python will give you an error:

Example

Syntax Error:

if 5 > 2:  
 print("Five is greater than two!")  
        print("Five is greater than two!")

Python Variables

In Python, variables are created when you assign a value to it:

Example

Variables in Python:

x = 5  
y = "Hello, World!"

Python has no command for declaring a variable.

You will learn more about variables in the [Python Variables](https://www.w3schools.com/python/python_variables.asp) chapter.

Comments

Python has commenting capability for the purpose of in-code documentation.

Comments start with a #, and Python will render the rest of the line as a comment:

Example

Comments in Python:

#This is a comment.  
print("Hello, World!")

Top of Form

# Python Comments

Comments can be used to explain Python code.

Comments can be used to make the code more readable.

Comments can be used to prevent execution when testing code.

## Creating a Comment

Comments starts with a #, and Python will ignore them:

### Example

#This is a comment  
print("Hello, World!")

Comments can be placed at the end of a line, and Python will ignore the rest of the line:

### Example

print("Hello, World!") #This is a comment

Comments does not have to be text to explain the code, it can also be used to prevent Python from executing code:

### Example

#print("Hello, World!")  
print("Cheers, Mate!")

## Multi Line Comments

Python does not really have a syntax for multi line comments.

To add a multiline comment you could insert a # for each line:

### Example

#This is a comment  
#written in  
#more than just one line  
print("Hello, World!")

Or, not quite as intended, you can use a multiline string.

Since Python will ignore string literals that are not assigned to a variable, you can add a multiline string (triple quotes) in your code, and place your comment inside it:

### Example

"""  
This is a comment  
written in  
more than just one line  
"""  
print("Hello, World!")

As long as the string is not assigned to a variable, Python will read the code, but then ignore it, and you have made a multiline comment.

* Bottom of Form

# Python Variables

## Creating Variables

Variables are containers for storing data values.

Unlike other programming languages, Python has no command for declaring a variable.

A variable is created the moment you first assign a value to it.

### Example

x = 5  
y = "John"  
print(x)  
print(y)

Variables do not need to be declared with any particular type and can even change type after they have been set.

### Example

x = 4 # x is of type int  
x = "Sally" # x is now of type str  
print(x)

String variables can be declared either by using single or double quotes:

### Example

x = "John"  
# is the same as  
x = 'John'

## Variable Names

A variable can have a short name (like x and y) or a more descriptive name (age, carname, total\_volume). Rules for Python variables:

* A variable name must start with a letter or the underscore character
* A variable name cannot start with a number
* A variable name can only contain alpha-numeric characters and underscores (A-z, 0-9, and \_ )
* Variable names are case-sensitive (age, Age and AGE are three different variables)

### Example

#Legal variable names:  
myvar = "John"  
my\_var = "John"  
\_my\_var = "John"  
myVar = "John"  
MYVAR = "John"  
myvar2 = "John"  
  
#Illegal variable names:  
2myvar = "John"  
my-var = "John"  
my var = "John"

## Assign Value to Multiple Variables

Python allows you to assign values to multiple variables in one line:

### Example

x, y, z = "Orange", "Banana", "Cherry"  
print(x)  
print(y)  
print(z)

And you can assign the same value to multiple variables in one line:

### Example

x = y = z = "Orange"  
print(x)  
print(y)  
print(z)

## Output Variables

The Python print statement is often used to output variables.

To combine both text and a variable, Python uses the + character:

### Example

x = "awesome"  
print("Python is " + x)

You can also use the + character to add a variable to another variable:

### Example

x = "Python is "  
y = "awesome"  
z =  x + y  
print(z)

For numbers, the + character works as a mathematical operator:

### Example

x = 5  
y = 10  
print(x + y)

If you try to combine a string and a number, Python will give you an error:

### Example

x = 5  
y = "John"  
print(x + y)

## Global Variables

Variables that are created outside of a function (as in all of the examples above) are known as global variables.

Global variables can be used by everyone, both inside of functions and outside.

### Example

Create a variable outside of a function, and use it inside the function

x = "awesome"  
  
def myfunc():  
  print("Python is " + x)  
  
myfunc()

If you create a variable with the same name inside a function, this variable will be local, and can only be used inside the function. The global variable with the same name will remain as it was, global and with the original value.

### Example

Create a variable inside a function, with the same name as the global variable

x = "awesome"  
  
def myfunc():  
  x = "fantastic"  
  print("Python is " + x)  
  
myfunc()  
  
print("Python is " + x)

## The global Keyword

Normally, when you create a variable inside a function, that variable is local, and can only be used inside that function.

To create a global variable inside a function, you can use the global keyword.

### Example

If you use the global keyword, the variable belongs to the global scope:

def myfunc():  
  global x  
  x = "fantastic"  
  
myfunc()  
  
print("Python is " + x)

Also, use the global keyword if you want to change a global variable inside a function.

### Example

To change the value of a global variable inside a function, refer to the variable by using the global keyword:

x = "awesome"  
  
def myfunc():  
  global x  
  x = "fantastic"  
  
myfunc()  
  
print("Python is " + x)

# Python Data Types

## Built-in Data Types

In programming, data type is an important concept.

Variables can store data of different types, and different types can do different things.

Python has the following data types built-in by default, in these categories:

|  |  |
| --- | --- |
| Text Type: | str |
| Numeric Types: | int, float, complex |
| Sequence Types: | list, tuple, range |
| Mapping Type: | dict |
| Set Types: | set, frozenset |
| Boolean Type: | bool |
| Binary Types: | bytes, bytearray, memoryview |

## Getting the Data Type

You can get the data type of any object by using the type() function:

### Example

Print the data type of the variable x:

x = 5  
print(type(x))

## Setting the Data Type

In Python, the data type is set when you assign a value to a variable:

|  |  |
| --- | --- |
| **Example** | **Data Type** |
| x = "Hello World" | str |
| x = 20 | int |
| x = 20.5 | float |
| x = 1j | complex |
| x = ["apple", "banana", "cherry"] | list |
| x = ("apple", "banana", "cherry") | tuple |
| x = range(6) | range |
| x = {"name" : "John", "age" : 36} | dict |
| x = {"apple", "banana", "cherry"} | set |
| x = frozenset({"apple", "banana", "cherry"}) | frozenset |
| x = True | bool |
| x = b"Hello" | bytes |
| x = bytearray(5) | bytearray |
| x = memoryview(bytes(5)) | memoryview |

## Setting the Specific Data Type

If you want to specify the data type, you can use the following constructor functions:

|  |  |
| --- | --- |
| **Example** | **Data Type** |
| x = str("Hello World") | str |
| x = int(20) | int |
| x = float(20.5) | float |
| x = complex(1j) | complex |
| x = list(("apple", "banana", "cherry")) | list |
| x = tuple(("apple", "banana", "cherry")) | tuple |
| x = range(6) | range |
| x = dict(name="John", age=36) | dict |
| x = set(("apple", "banana", "cherry")) | set |
| x = frozenset(("apple", "banana", "cherry")) | frozenset |
| x = bool(5) | bool |
| x = bytes(5) | bytes |
| x = bytearray(5) | bytearray |
| x = memoryview(bytes(5)) | memoryview |

# Python Strings

## String Literals

String literals in python are surrounded by either single quotation marks, or double quotation marks.

'hello' is the same as "hello".

You can display a string literal with the print() function:

### Example

print("Hello")  
print('Hello')

## Assign String to a Variable

Assigning a string to a variable is done with the variable name followed by an equal sign and the string:

### Example

a = "Hello"  
print(a)

## Multiline Strings

You can assign a multiline string to a variable by using three quotes:

### Example

You can use three double quotes:

a = """Lorem ipsum dolor sit amet,  
consectetur adipiscing elit,  
sed do eiusmod tempor incididunt  
ut labore et dolore magna aliqua."""  
print(a)

Or three single quotes:

### Example

a = '''Lorem ipsum dolor sit amet,  
consectetur adipiscing elit,  
sed do eiusmod tempor incididunt  
ut labore et dolore magna aliqua.'''  
print(a)

**Note:** in the result, the line breaks are inserted at the same position as in the code.

## Strings are Arrays

Like many other popular programming languages, strings in Python are arrays of bytes representing unicode characters.

However, Python does not have a character data type, a single character is simply a string with a length of 1.

Square brackets can be used to access elements of the string.

### Example

Get the character at position 1 (remember that the first character has the position 0):

a = "Hello, World!"  
print(a[1])

## Slicing

You can return a range of characters by using the slice syntax.

Specify the start index and the end index, separated by a colon, to return a part of the string.

### Example

Get the characters from position 2 to position 5 (not included):

b = "Hello, World!"  
print(b[2:5])

## Negative Indexing

Use negative indexes to start the slice from the end of the string:

### Example

Get the characters from position 5 to position 1, starting the count from the end of the string:

b = "Hello, World!"  
print(b[-5:-2])

## String Length

To get the length of a string, use the len() function.

### Example

The len() function returns the length of a string:

a = "Hello, World!"  
print(len(a))

## String Methods

Python has a set of built-in methods that you can use on strings.

### Example

The strip() method removes any whitespace from the beginning or the end:

a = " Hello, World! "  
print(a.strip()) # returns "Hello, World!"

### Example

The lower() method returns the string in lower case:

a = "Hello, World!"  
print(a.lower())

### Example

The upper() method returns the string in upper case:

a = "Hello, World!"  
print(a.upper())

### Example

The replace() method replaces a string with another string:

a = "Hello, World!"  
print(a.replace("H", "J"))

### Example

The split() method splits the string into substrings if it finds instances of the separator:

a = "Hello, World!"  
print(a.split(",")) # returns ['Hello', ' World!']

Learn more about String Methods with our [String Methods Reference](https://www.w3schools.com/python/python_ref_string.asp)

## Check String

To check if a certain phrase or character is present in a string, we can use the keywords in or not in.

### Example

Check if the phrase "ain" is present in the following text:

txt = "The rain in Spain stays mainly in the plain"  
x = "ain" in txt  
print(x)

### Example

Check if the phrase "ain" is NOT present in the following text:

txt = "The rain in Spain stays mainly in the plain"  
x = "ain" not in txt  
print(x)

## String Concatenation

To concatenate, or combine, two strings you can use the + operator.

### Example

Merge variable a with variable b into variable c:

a = "Hello"  
b = "World"  
c = a + b  
print(c)

### Example

To add a space between them, add a " ":

a = "Hello"  
b = "World"  
c = a + " " + b  
print(c)

## String Format

As we learned in the Python Variables chapter, we cannot combine strings and numbers like this:

### Example

age = 36  
txt = "My name is John, I am " + age  
print(txt)

But we can combine strings and numbers by using the format() method!

The format() method takes the passed arguments, formats them, and places them in the string where the placeholders {} are:

### Example

Use the format() method to insert numbers into strings:

age = 36  
txt = "My name is John, and I am {}"  
print(txt.format(age))

The format() method takes unlimited number of arguments, and are placed into the respective placeholders:

### Example

quantity = 3  
itemno = 567  
price = 49.95  
myorder = "I want {} pieces of item {} for {} dollars."  
print(myorder.format(quantity, itemno, price))

You can use index numbers {0} to be sure the arguments are placed in the correct placeholders:

### Example

quantity = 3  
itemno = 567  
price = 49.95  
myorder = "I want to pay {2} dollars for {0} pieces of item {1}."  
print(myorder.format(quantity, itemno, price))

## Escape Character

To insert characters that are illegal in a string, use an escape character.

An escape character is a backslash \ followed by the character you want to insert.

An example of an illegal character is a double quote inside a string that is surrounded by double quotes:

### Example

You will get an error if you use double quotes inside a string that is surrounded by double quotes:

txt = "We are the so-called "Vikings" from the north."

To fix this problem, use the escape character \":

### Example

The escape character allows you to use double quotes when you normally would not be allowed:

txt = "We are the so-called \"Vikings\" from the north."

Other escape characters used in Python:

|  |  |
| --- | --- |
| **Code** | **Result** |
| \' | Single Quote |
| \\ | Backslash |
| \n | New Line |
| \r | Carriage Return |
| \t | Tab |
| \b | Backspace |
| \f | Form Feed |
| \ooo | Octal value |
| \xhh | Hex value |

## String Methods

Python has a set of built-in methods that you can use on strings.

**Note:** All string methods returns new values. They do not change the original string.

|  |  |
| --- | --- |
| **Method** | **Description** |
| [capitalize()](https://www.w3schools.com/python/ref_string_capitalize.asp) | Converts the first character to upper case |
| [casefold()](https://www.w3schools.com/python/ref_string_casefold.asp) | Converts string into lower case |
| [center()](https://www.w3schools.com/python/ref_string_center.asp) | Returns a centered string |
| [count()](https://www.w3schools.com/python/ref_string_count.asp) | Returns the number of times a specified value occurs in a string |
| [encode()](https://www.w3schools.com/python/ref_string_encode.asp) | Returns an encoded version of the string |
| [endswith()](https://www.w3schools.com/python/ref_string_endswith.asp) | Returns true if the string ends with the specified value |
| [expandtabs()](https://www.w3schools.com/python/ref_string_expandtabs.asp) | Sets the tab size of the string |
| [find()](https://www.w3schools.com/python/ref_string_find.asp) | Searches the string for a specified value and returns the position of where it was found |
| [format()](https://www.w3schools.com/python/ref_string_format.asp) | Formats specified values in a string |
| format\_map() | Formats specified values in a string |
| [index()](https://www.w3schools.com/python/ref_string_index.asp) | Searches the string for a specified value and returns the position of where it was found |
| [isalnum()](https://www.w3schools.com/python/ref_string_isalnum.asp) | Returns True if all characters in the string are alphanumeric |
| [isalpha()](https://www.w3schools.com/python/ref_string_isalpha.asp) | Returns True if all characters in the string are in the alphabet |
| [isdecimal()](https://www.w3schools.com/python/ref_string_isdecimal.asp) | Returns True if all characters in the string are decimals |
| [isdigit()](https://www.w3schools.com/python/ref_string_isdigit.asp) | Returns True if all characters in the string are digits |
| [isidentifier()](https://www.w3schools.com/python/ref_string_isidentifier.asp) | Returns True if the string is an identifier |
| [islower()](https://www.w3schools.com/python/ref_string_islower.asp) | Returns True if all characters in the string are lower case |
| [isnumeric()](https://www.w3schools.com/python/ref_string_isnumeric.asp) | Returns True if all characters in the string are numeric |
| [isprintable()](https://www.w3schools.com/python/ref_string_isprintable.asp) | Returns True if all characters in the string are printable |
| [isspace()](https://www.w3schools.com/python/ref_string_isspace.asp) | Returns True if all characters in the string are whitespaces |
| [istitle()](https://www.w3schools.com/python/ref_string_istitle.asp) | Returns True if the string follows the rules of a title |
| [isupper()](https://www.w3schools.com/python/ref_string_isupper.asp) | Returns True if all characters in the string are upper case |
| [join()](https://www.w3schools.com/python/ref_string_join.asp) | Joins the elements of an iterable to the end of the string |
| [ljust()](https://www.w3schools.com/python/ref_string_ljust.asp) | Returns a left justified version of the string |
| [lower()](https://www.w3schools.com/python/ref_string_lower.asp) | Converts a string into lower case |
| [lstrip()](https://www.w3schools.com/python/ref_string_lstrip.asp) | Returns a left trim version of the string |
| maketrans() | Returns a translation table to be used in translations |
| [partition()](https://www.w3schools.com/python/ref_string_partition.asp) | Returns a tuple where the string is parted into three parts |
| [replace()](https://www.w3schools.com/python/ref_string_replace.asp) | Returns a string where a specified value is replaced with a specified value |
| [rfind()](https://www.w3schools.com/python/ref_string_rfind.asp) | Searches the string for a specified value and returns the last position of where it was found |
| [rindex()](https://www.w3schools.com/python/ref_string_rindex.asp) | Searches the string for a specified value and returns the last position of where it was found |
| [rjust()](https://www.w3schools.com/python/ref_string_rjust.asp) | Returns a right justified version of the string |
| [rpartition()](https://www.w3schools.com/python/ref_string_rpartition.asp) | Returns a tuple where the string is parted into three parts |
| [rsplit()](https://www.w3schools.com/python/ref_string_rsplit.asp) | Splits the string at the specified separator, and returns a list |
| [rstrip()](https://www.w3schools.com/python/ref_string_rstrip.asp) | Returns a right trim version of the string |
| [split()](https://www.w3schools.com/python/ref_string_split.asp) | Splits the string at the specified separator, and returns a list |
| [splitlines()](https://www.w3schools.com/python/ref_string_splitlines.asp) | Splits the string at line breaks and returns a list |
| [startswith()](https://www.w3schools.com/python/ref_string_startswith.asp) | Returns true if the string starts with the specified value |
| [strip()](https://www.w3schools.com/python/ref_string_strip.asp) | Returns a trimmed version of the string |
| [swapcase()](https://www.w3schools.com/python/ref_string_swapcase.asp) | Swaps cases, lower case becomes upper case and vice versa |
| [title()](https://www.w3schools.com/python/ref_string_title.asp) | Converts the first character of each word to upper case |
| translate() | Returns a translated string |
| [upper()](https://www.w3schools.com/python/ref_string_upper.asp) | Converts a string into upper case |
| [zfill()](https://www.w3schools.com/python/ref_string_zfill.asp) | Fills the string with a specified number of 0 values at the beginning |

# Python User Input

## User Input

Python allows for user input.

That means we are able to ask the user for input.

The method is a bit different in Python 3.6 than Python 2.7.

Python 3.6 uses the input() method.

Python 2.7 uses the raw\_input() method.

The following example asks for the username, and when you entered the username, it gets printed on the screen:

### Python 3.6

username = input("Enter username:")  
print("Username is: " + username)

### Python 2.7

username = raw\_input("Enter username:")  
print("Username is: " + username)

# Python String Formatting

To make sure a string will display as expected, we can format the result with the format() method.

## String format()

The format() method allows you to format selected parts of a string.

Sometimes there are parts of a text that you do not control, maybe they come from a database, or user input?

To control such values, add placeholders (curly brackets {}) in the text, and run the values through the format() method:

### Example

Add a placeholder where you want to display the price:

price = 49  
txt = "The price is {} dollars"  
print(txt.format(price))

You can add parameters inside the curly brackets to specify how to convert the value:

### Example

Format the price to be displayed as a number with two decimals:

txt = "The price is {:.2f} dollars"

Check out all formatting types in our [String format() Reference](https://www.w3schools.com/python/ref_string_format.asp).

## Multiple Values

If you want to use more values, just add more values to the format() method:

print(txt.format(price, itemno, count))

And add more placeholders:

### Example

quantity = 3  
itemno = 567  
price = 49  
myorder = "I want {} pieces of item number {} for {:.2f} dollars."  
print(myorder.format(quantity, itemno, price))

## Index Numbers

You can use index numbers (a number inside the curly brackets {0}) to be sure the values are placed in the correct placeholders:

### Example

quantity = 3  
itemno = 567  
price = 49  
myorder = "I want {0} pieces of item number {1} for {2:.2f} dollars."  
print(myorder.format(quantity, itemno, price))

Also, if you want to refer to the same value more than once, use the index number:

### Example

age = 36  
name = "John"  
txt = "His name is {1}. {1} is {0} years old."  
print(txt.format(age, name))

## Named Indexes

You can also use named indexes by entering a name inside the curly brackets {carname}, but then you must use names when you pass the parameter values txt.format(carname = "Ford"):

### Example

myorder = "I have a {carname}, it is a {model}."  
print(myorder.format(carname = "Ford", model = "Mustang"))

# Python Operators

## Python Operators

Operators are used to perform operations on variables and values.

Python divides the operators in the following groups:

* Arithmetic operators
* Assignment operators
* Comparison operators
* Logical operators
* Identity operators
* Membership operators
* Bitwise operators

## Python Arithmetic Operators

Arithmetic operators are used with numeric values to perform common mathematical operations:

|  |  |  |
| --- | --- | --- |
| **Operator** | **Name** | **Example** |
| + | Addition | x + y |
| - | Subtraction | x - y |
| \* | Multiplication | x \* y |
| / | Division | x / y |
| % | Modulus | x % y |
| \*\* | Exponentiation | x \*\* y |
| // | Floor division | x // y |

## Python Assignment Operators

Assignment operators are used to assign values to variables:

|  |  |  |
| --- | --- | --- |
| **Operator** | **Example** | **Same As** |
| = | x = 5 | x = 5 |
| += | x += 3 | x = x + 3 |
| -= | x -= 3 | x = x - 3 |
| \*= | x \*= 3 | x = x \* 3 |
| /= | x /= 3 | x = x / 3 |
| %= | x %= 3 | x = x % 3 |
| //= | x //= 3 | x = x // 3 |
| \*\*= | x \*\*= 3 | x = x \*\* 3 |
| &= | x &= 3 | x = x & 3 |
| |= | x |= 3 | x = x | 3 |
| ^= | x ^= 3 | x = x ^ 3 |
| >>= | x >>= 3 | x = x >> 3 |
| <<= | x <<= 3 | x = x << 3 |

## Python Comparison Operators

Comparison operators are used to compare two values:

|  |  |  |
| --- | --- | --- |
| **Operator** | **Name** | **Example** |
| == | Equal | x == y |
| != | Not equal | x != y |
| > | Greater than | x > y |
| < | Less than | x < y |
| >= | Greater than or equal to | x >= y |
| <= | Less than or equal to | x <= y |

## Python Logical Operators

Logical operators are used to combine conditional statements:

|  |  |  |
| --- | --- | --- |
| **Operator** | **Description** | **Example** |
| and | Returns True if both statements are true | x < 5 and  x < 10 |
| or | Returns True if one of the statements is true | x < 5 or x < 4 |
| not | Reverse the result, returns False if the result is true | not(x < 5 and x < 10) |

## Python Identity Operators

Identity operators are used to compare the objects, not if they are equal, but if they are actually the same object, with the same memory location:

|  |  |  |
| --- | --- | --- |
| **Operator** | **Description** | **Example** |
| is | Returns True if both variables are the same object | x is y |
| is not | Returns True if both variables are not the same object | x is not y |

## Python Membership Operators

Membership operators are used to test if a sequence is presented in an object:

|  |  |  |
| --- | --- | --- |
| **Operator** | **Description** | **Example** |
| in | Returns True if a sequence with the specified value is present in the object | x in y |
| not in | Returns True if a sequence with the specified value is not present in the object | x not in y |

## Python Bitwise Operators

Bitwise operators are used to compare (binary) numbers:

|  |  |  |
| --- | --- | --- |
| **Operator** | **Name** | **Description** |
| & | AND | Sets each bit to 1 if both bits are 1 |
| | | OR | Sets each bit to 1 if one of two bits is 1 |
| ^ | XOR | Sets each bit to 1 if only one of two bits is 1 |
| ~ | NOT | Inverts all the bits |
| << | Zero fill left shift | Shift left by pushing zeros in from the right and let the leftmost bits fall off |
| >> | Signed right shift | Shift right by pushing copies of the leftmost bit in from the left, and let the rightmost bits fall off |

# Python If ... Else

## Python Conditions and If statements

Python supports the usual logical conditions from mathematics:

* Equals: a == b
* Not Equals: a != b
* Less than: a < b
* Less than or equal to: a <= b
* Greater than: a > b
* Greater than or equal to: a >= b

These conditions can be used in several ways, most commonly in "if statements" and loops.

An "if statement" is written by using the if keyword.

### Example

If statement:

a = 33  
b = 200  
if b > a:  
  print("b is greater than a")

In this example we use two variables, a and b, which are used as part of the if statement to test whether b is greater than a. As a is 33, and b is 200, we know that 200 is greater than 33, and so we print to screen that "b is greater than a".

## Indentation

Python relies on indentation (whitespace at the beginning of a line) to define scope in the code. Other programming languages often use curly-brackets for this purpose.

### Example

If statement, without indentation (will raise an error):

a = 33  
b = 200  
if b > a:  
print("b is greater than a") # you will get an error

## Elif

The elif keyword is pythons way of saying "if the previous conditions were not true, then try this condition".

### Example

a = 33  
b = 33  
if b > a:  
  print("b is greater than a")  
elif a == b:  
  print("a and b are equal")

In this example a is equal to b, so the first condition is not true, but the elif condition is true, so we print to screen that "a and b are equal".

## Else

The else keyword catches anything which isn't caught by the preceding conditions.

### Example

a = 200  
b = 33  
if b > a:  
  print("b is greater than a")  
elif a == b:  
  print("a and b are equal")  
else:  
  print("a is greater than b")

In this example a is greater than b, so the first condition is not true, also the elif condition is not true, so we go to the else condition and print to screen that "a is greater than b".

You can also have an else without the elif:

### Example

a = 200  
b = 33  
if b > a:  
  print("b is greater than a")  
else:  
  print("b is not greater than a")

## Short Hand If

If you have only one statement to execute, you can put it on the same line as the if statement.

### Example

One line if statement:

if a > b: print("a is greater than b")

## Short Hand If ... Else

If you have only one statement to execute, one for if, and one for else, you can put it all on the same line:

### Example

One line if else statement:

a = 2  
b = 330  
print("A") if a > b else print("B")

This technique is known as **Ternary Operators**, or **Conditional Expressions**.

You can also have multiple else statements on the same line:

### Example

One line if else statement, with 3 conditions:

a = 330  
b = 330  
print("A") if a > b else print("=") if a == b else print("B")

## And

The and keyword is a logical operator, and is used to combine conditional statements:

### Example

Test if a is greater than b, AND if c is greater than a:

a = 200  
b = 33  
c = 500  
if a > b and c > a:  
  print("Both conditions are True")

## Or

The or keyword is a logical operator, and is used to combine conditional statements:

### Example

Test if a is greater than b, OR if a is greater than c:

a = 200  
b = 33  
c = 500  
if a > b or a > c:  
  print("At least one of the conditions is True")

## Nested If

You can have if statements inside if statements, this is called nested if statements.

### Example

x = 41  
  
if x > 10:  
  print("Above ten,")  
  if x > 20:  
    print("and also above 20!")  
  else:  
    print("but not above 20.")

## The pass Statement

if statements cannot be empty, but if you for some reason have an if statement with no content, put in the pass statement to avoid getting an error.

### Example

a = 33  
b = 200  
  
if b > a:  
  pass

Python For Loops

## Python For Loops

A for loop is used for iterating over a sequence (that is either a list, a tuple, a dictionary, a set, or a string).

This is less like the for keyword in other programming languages, and works more like an iterator method as found in other object-orientated programming languages.

With the for loop we can execute a set of statements, once for each item in a list, tuple, set etc.

### Example

Print each fruit in a fruit list:

fruits = ["apple", "banana", "cherry"]  
for x in fruits:  
  print(x)

The for loop does not require an indexing variable to set beforehand.

## Looping Through a String

Even strings are iterable objects, they contain a sequence of characters:

### Example

Loop through the letters in the word "banana":

for x in "banana":  
  print(x)

## The break Statement

With the break statement we can stop the loop before it has looped through all the items:

### Example

Exit the loop when x is "banana":

fruits = ["apple", "banana", "cherry"]  
for x in fruits:  
  print(x)  
  if x == "banana":  
    break

### Example

Exit the loop when x is "banana", but this time the break comes before the print:

fruits = ["apple", "banana", "cherry"]  
for x in fruits:  
  if x == "banana":  
    break  
  print(x)

## The continue Statement

With the continue statement we can stop the current iteration of the loop, and continue with the next:

### Example

Do not print banana:

fruits = ["apple", "banana", "cherry"]  
for x in fruits:  
  if x == "banana":  
    continue  
  print(x)

## The range() Function

To loop through a set of code a specified number of times, we can use the range() function,

The range() function returns a sequence of numbers, starting from 0 by default, and increments by 1 (by default), and ends at a specified number.

### Example

Using the range() function:

for x in range(6):  
  print(x)

Note that range(6) is not the values of 0 to 6, but the values 0 to 5.

The range() function defaults to 0 as a starting value, however it is possible to specify the starting value by adding a parameter: range(2, 6), which means values from 2 to 6 (but not including 6):

### Example

Using the start parameter:

for x in range(2, 6):  
  print(x)

The range() function defaults to increment the sequence by 1, however it is possible to specify the increment value by adding a third parameter: range(2, 30, **3**):

### Example

Increment the sequence with 3 (default is 1):

for x in range(2, 30, 3):  
  print(x)

## Else in For Loop

The else keyword in a for loop specifies a block of code to be executed when the loop is finished:

### Example

Print all numbers from 0 to 5, and print a message when the loop has ended:

for x in range(6):  
  print(x)  
else:  
  print("Finally finished!")

## Nested Loops

A nested loop is a loop inside a loop.

The "inner loop" will be executed one time for each iteration of the "outer loop":

### Example

Print each adjective for every fruit:

adj = ["red", "big", "tasty"]  
fruits = ["apple", "banana", "cherry"]  
  
for x in adj:  
  for y in fruits:  
    print(x, y)

## The pass Statement

for loops cannot be empty, but if you for some reason have a for loop with no content, put in the pass statement to avoid getting an error.

### Example

for x in [0, 1, 2]:  
  pass

# Python While Loops

## The while Loop

With the while loop we can execute a set of statements as long as a condition is true.

### Example

Print i as long as i is less than 6:

i = 1  
while i < 6:  
  print(i)  
  i += 1

**Note:** remember to increment i, or else the loop will continue forever.

The while loop requires relevant variables to be ready, in this example we need to define an indexing variable, i, which we set to 1.

## The break Statement

With the break statement we can stop the loop even if the while condition is true:

### Example

Exit the loop when i is 3:

i = 1  
while i < 6:  
  print(i)  
  if i == 3:  
    break  
  i += 1

## The continue Statement

With the continue statement we can stop the current iteration, and continue with the next:

### Example

Continue to the next iteration if i is 3:

i = 0  
while i < 6:  
  i += 1  
  if i == 3:  
    continue  
  print(i)

## The else Statement

With the else statement we can run a block of code once when the condition no longer is true:

### Example

Print a message once the condition is false:

i = 1  
while i < 6:  
  print(i)  
  i += 1  
else:  
  print("i is no longer less than 6")

Python Collections (Arrays)

There are four collection data types in the Python programming language:

* **List** is a collection which is ordered and changeable. Allows duplicate members.
* **Tuple** is a collection which is ordered and unchangeable. Allows duplicate members.
* **Set** is a collection which is unordered and unindexed. No duplicate members.
* **Dictionary** is a collection which is unordered, changeable and indexed. No duplicate members.

When choosing a collection type, it is useful to understand the properties of that type. Choosing the right type for a particular data set could mean retention of meaning, and, it could mean an increase in efficiency or security.

List

A list is a collection which is ordered and changeable. In Python lists are written with square brackets.

### Example

Create a List:

thislist = ["apple", "banana", "cherry"]  
print(thislist)

## Access Items

You access the list items by referring to the index number:

### Example

Print the second item of the list:

thislist = ["apple", "banana", "cherry"]  
print(thislist[1])

### Negative Indexing

Negative indexing means beginning from the end, -1 refers to the last item, -2 refers to the second last item etc.

### Example

Print the last item of the list:

thislist = ["apple", "banana", "cherry"]  
print(thislist[-1])

### Range of Indexes

You can specify a range of indexes by specifying where to start and where to end the range.

When specifying a range, the return value will be a new list with the specified items.

### Example

Return the third, fourth, and fifth item:

thislist = ["apple", "banana", "cherry", "orange", "kiwi", "melon", "mango"]  
print(thislist[2:5])

**Note:** The search will start at index 2 (included) and end at index 5 (not included).

### Example

This example returns the items from the beginning to "orange":

thislist = ["apple", "banana", "cherry", "orange", "kiwi", "melon", "mango"]  
print(thislist[:4])

By leaving out the end value, the range will go on to the end of the list:

### Example

This example returns the items from "cherry" and to the end:

thislist = ["apple", "banana", "cherry", "orange", "kiwi", "melon", "mango"]  
print(thislist[2:])

### Range of Negative Indexes

Specify negative indexes if you want to start the search from the end of the list:

### Example

This example returns the items from index -4 (included) to index -1 (excluded)

thislist = ["apple", "banana", "cherry", "orange", "kiwi", "melon", "mango"]  
print(thislist[-4:-1])

## Change Item Value

To change the value of a specific item, refer to the index number:

### Example

Change the second item:

thislist = ["apple", "banana", "cherry"]  
thislist[1] = "blackcurrant"  
print(thislist)

## Check if Item Exists

To determine if a specified item is present in a list use the in keyword:

### Example

Check if "apple" is present in the list:

thislist = ["apple", "banana", "cherry"]  
if "apple" in thislist:  
  print("Yes, 'apple' is in the fruits list")

## List Length

To determine how many items a list has, use the len() function:

### Example

Print the number of items in the list:

thislist = ["apple", "banana", "cherry"]  
print(len(thislist))

## Add Items

To add an item to the end of the list, use the append() method:

### Example

Using the append() method to append an item:

thislist = ["apple", "banana", "cherry"]  
thislist.append("orange")  
print(thislist)

To add an item at the specified index, use the insert() method:

### Example

Insert an item as the second position:

thislist = ["apple", "banana", "cherry"]  
thislist.insert(1, "orange")  
print(thislist)

## Remove Item

There are several methods to remove items from a list:

### Example

The remove() method removes the specified item:

thislist = ["apple", "banana", "cherry"]  
thislist.remove("banana")  
print(thislist)

**Example**

The pop() method removes the specified index, (or the last item if index is not specified):

thislist = ["apple", "banana", "cherry"]  
thislist.pop()  
print(thislist)

### Example

The del keyword removes the specified index:

thislist = ["apple", "banana", "cherry"]  
del thislist[0]  
print(thislist)

### Example

The del keyword can also delete the list completely:

thislist = ["apple", "banana", "cherry"]  
del thislist

### Example

The clear() method empties the list:

thislist = ["apple", "banana", "cherry"]  
thislist.clear()  
print(thislist)

# Python Tuples

## Tuple

A tuple is a collection which is ordered and **unchangeable**. In Python tuples are written with round brackets.

### Example

Create a Tuple:

thistuple = ("apple", "banana", "cherry")  
print(thistuple)

## Check if Item Exists

To determine if a specified item is present in a tuple use the in keyword:

### Example

Check if "apple" is present in the tuple:

thistuple = ("apple", "banana", "cherry")  
if "apple" in thistuple:  
  print("Yes, 'apple' is in the fruits tuple")

## Change Tuple Values

Once a tuple is created, you cannot change its values. Tuples are **unchangeable**, or **immutable** as it also is called.

But there is a workaround. You can convert the tuple into a list, change the list, and convert the list back into a tuple.

### Example

Convert the tuple into a list to be able to change it:

x = ("apple", "banana", "cherry")  
y = list(x)  
y[1] = "kiwi"  
x = tuple(y)  
  
print(x)

## Add Items

Once a tuple is created, you cannot add items to it. Tuples are **unchangeable**.

### Example

You cannot add items to a tuple:

thistuple = ("apple", "banana", "cherry")  
thistuple[3] = "orange" # This will raise an error  
print(thistuple)

## Create Tuple With One Item

To create a tuple with only one item, you have add a comma after the item, unless Python will not recognize the variable as a tuple.

### Example

One item tuple, remember the commma:

thistuple = ("apple",)  
print(type(thistuple))  
  
#NOT a tuple  
thistuple = ("apple")  
print(type(thistuple))

## Remove Items

**Note:** You cannot remove items in a tuple.

 Tuples are **unchangeable**, so you cannot remove items from it, but you can delete the tuple completely:

### Example

The del keyword can delete the tuple completely:

thistuple = ("apple", "banana", "cherry")  
del thistuple  
print(thistuple) #this will raise an error because the tuple no longer exists

## Join Two Tuples

To join two or more tuples you can use the + operator:

### Example

Join two tuples:

tuple1 = ("a", "b" , "c")  
tuple2 = (1, 2, 3)  
  
tuple3 = tuple1 + tuple2  
print(tuple3)

# Python Sets

## Set

A set is a collection which is unordered and unindexed. In Python sets are written with curly brackets.

### Example

Create a Set:

thisset = {"apple", "banana", "cherry"}  
print(thisset)

**Note:** Sets are unordered, so you cannot be sure in which order the items will appear.

## Access Items

You cannot access items in a set by referring to an index, since sets are unordered the items has no index.

But you can loop through the set items using a for loop, or ask if a specified value is present in a set, by using the in keyword.

### Example

Loop through the set, and print the values:

thisset = {"apple", "banana", "cherry"}  
  
for x in thisset:  
  print(x)

### Example

Check if "banana" is present in the set:

thisset = {"apple", "banana", "cherry"}  
  
print("banana" in thisset)

## Change Items

Once a set is created, you cannot change its items, but you can add new items.

## Add Items

To add one item to a set use the add() method.

To add more than one item to a set use the update() method.

### Example

Add an item to a set, using the add() method:

thisset = {"apple", "banana", "cherry"}  
  
thisset.add("orange")  
  
print(thisset)

### Example

Add multiple items to a set, using the update() method:

thisset = {"apple", "banana", "cherry"}  
  
thisset.update(["orange", "mango", "grapes"])  
  
print(thisset)

## Get the Length of a Set

To determine how many items a set has, use the len() method.

### Example

Get the number of items in a set:

thisset = {"apple", "banana", "cherry"}  
  
print(len(thisset))

## Remove Item

To remove an item in a set, use the remove(), or the discard() method.

### Example

Remove "banana" by using the remove() method:

thisset = {"apple", "banana", "cherry"}  
  
thisset.remove("banana")  
  
print(thisset)

**Note:** If the item to remove does not exist, remove() will raise an error.

### Example

Remove "banana" by using the discard() method:

thisset = {"apple", "banana", "cherry"}  
  
thisset.discard("banana")  
  
print(thisset)

**Note:** If the item to remove does not exist, discard() will **NOT** raise an error.

You can also use the pop(), method to remove an item, but this method will remove the last item. Remember that sets are unordered, so you will not know what item that gets removed.

The return value of the pop() method is the removed item.

### Example

Remove the last item by using the pop() method:

thisset = {"apple", "banana", "cherry"}  
  
x = thisset.pop()  
  
print(x)  
  
print(thisset)

**Note:** Sets are unordered, so when using the pop() method, you will not know which item that gets removed.

### Example

The clear() method empties the set:

thisset = {"apple", "banana", "cherry"}  
  
thisset.clear()  
  
print(thisset)

### Example

The del keyword will delete the set completely:

thisset = {"apple", "banana", "cherry"}  
  
del thisset  
  
print(thisset)

## Join Two Sets

There are several ways to join two or more sets in Python.

You can use the union() method that returns a new set containing all items from both sets, or the update() method that inserts all the items from one set into another:

### Example

The union() method returns a new set with all items from both sets:

set1 = {"a", "b" , "c"}  
set2 = {1, 2, 3}  
  
set3 = set1.union(set2)  
print(set3)

### Example

The update() method inserts the items in set2 into set1:

set1 = {"a", "b" , "c"}  
set2 = {1, 2, 3}  
  
set1.update(set2)  
print(set1)

# Python Dictionaries

## Dictionary

A dictionary is a collection which is unordered, changeable and indexed. In Python dictionaries are written with curly brackets, and they have keys and values.

### Example

Create and print a dictionary:

thisdict = {  
  "brand": "Ford",  
  "model": "Mustang",  
  "year": 1964  
}  
print(thisdict)

## Accessing Items

You can access the items of a dictionary by referring to its key name, inside square brackets:

### Example

Get the value of the "model" key:

x = thisdict["model"]

There is also a method called get() that will give you the same result:

### Example

Get the value of the "model" key:

x = thisdict.get("model")

## Change Values

You can change the value of a specific item by referring to its key name:

### Example

Change the "year" to 2018:

thisdict = {  
  "brand": "Ford",  
  "model": "Mustang",  
  "year": 1964  
}  
thisdict["year"] = 2018

## Loop Through a Dictionary

You can loop through a dictionary by using a for loop.

When looping through a dictionary, the return value are the keys of the dictionary, but there are methods to return the values as well.

### Example

Print all key names in the dictionary, one by one:

for x in thisdict:  
  print(x)

### Example

Print all values in the dictionary, one by one:

for x in thisdict:  
  print(thisdict[x])

### Example

You can also use the values() function to return values of a dictionary:

for x in thisdict.values():  
  print(x)

### Example

Loop through both keys and values, by using the items() function:

for x, y in thisdict.items():  
  print(x, y)

## Check if Key Exists

To determine if a specified key is present in a dictionary use the in keyword:

### Example

Check if "model" is present in the dictionary:

thisdict = {  
  "brand": "Ford",  
  "model": "Mustang",  
  "year": 1964  
}  
if "model" in thisdict:  
  print("Yes, 'model' is one of the keys in the thisdict dictionary")

## Dictionary Length

To determine how many items (key-value pairs) a dictionary has, use the len() method.

### Example

Print the number of items in the dictionary:

print(len(thisdict))

## Adding Items

Adding an item to the dictionary is done by using a new index key and assigning a value to it:

### Example

thisdict = {  
  "brand": "Ford",  
  "model": "Mustang",  
  "year": 1964  
}  
thisdict["color"] = "red"  
print(thisdict)

## Removing Items

There are several methods to remove items from a dictionary:

### Example

The pop() method removes the item with the specified key name:

thisdict = {  
  "brand": "Ford",  
  "model": "Mustang",  
  "year": 1964  
}  
thisdict.pop("model")  
print(thisdict)

### Example

The popitem() method removes the last inserted item (in versions before 3.7, a random item is removed instead):

thisdict = {  
  "brand": "Ford",  
  "model": "Mustang",  
  "year": 1964  
}  
thisdict.popitem()  
print(thisdict)

### Example

The del keyword removes the item with the specified key name:

thisdict = {  
  "brand": "Ford",  
  "model": "Mustang",  
  "year": 1964  
}  
del thisdict["model"]  
print(thisdict)

### Example

The del keyword can also delete the dictionary completely:

thisdict = {  
  "brand": "Ford",  
  "model": "Mustang",  
  "year": 1964  
}  
del thisdict  
print(thisdict) #this will cause an error because "thisdict" no longer exists.

### Example

The clear() keyword empties the dictionary:

thisdict = {  
  "brand": "Ford",  
  "model": "Mustang",  
  "year": 1964  
}  
thisdict.clear()  
print(thisdict)

## Copy a Dictionary

You cannot copy a dictionary simply by typing dict2 = dict1, because: dict2 will only be a reference to dict1, and changes made in dict1 will automatically also be made in dict2.

There are ways to make a copy, one way is to use the built-in Dictionary method copy().

### Example

Make a copy of a dictionary with the copy() method:

thisdict = {  
  "brand": "Ford",  
  "model": "Mustang",  
  "year": 1964  
}  
mydict = thisdict.copy()  
print(mydict)

Another way to make a copy is to use the built-in method dict().

### Example

Make a copy of a dictionary with the dict() method:

thisdict = {  
  "brand": "Ford",  
  "model": "Mustang",  
  "year": 1964  
}  
mydict = dict(thisdict)  
print(mydict)

## Nested Dictionaries

A dictionary can also contain many dictionaries, this is called nested dictionaries.

### Example

Create a dictionary that contain three dictionaries:

myfamily = {  
  "child1" : {  
    "name" : "Emil",  
    "year" : 2004  
  },  
  "child2" : {  
    "name" : "Tobias",  
    "year" : 2007  
  },  
  "child3" : {  
    "name" : "Linus",  
    "year" : 2011  
  }  
}

Or, if you want to nest three dictionaries that already exists as dictionaries:

### Example

Create three dictionaries, than create one dictionary that will contain the other three dictionaries:

child1 = {  
  "name" : "Emil",  
  "year" : 2004  
}  
child2 = {  
  "name" : "Tobias",  
  "year" : 2007  
}  
child3 = {  
  "name" : "Linus",  
  "year" : 2011  
}  
  
myfamily = {  
  "child1" : child1,  
  "child2" : child2,  
  "child3" : child3  
}

## Loop Through a List

You can loop through the list items by using a for loop:

### Example

Print all items in the list, one by one:

thislist = ["apple", "banana", "cherry"]  
for x in thislist:  
  print(x)

## Loop Through a Tuple

You can loop through the tuple items by using a for loop.

### Example

Iterate through the items and print the values:

thistuple = ("apple", "banana", "cherry")  
for x in thistuple:  
  print(x)

## Access Items

You cannot access items in a set by referring to an index, since sets are unordered the items has no index.

But you can loop through the set items using a for loop, or ask if a specified value is present in a set, by using the in keyword.

### Example

Loop through the set, and print the values:

thisset = {"apple", "banana", "cherry"}  
  
for x in thisset:  
  print(x)