Topics:

- Introduction
- Getting Started
- Indentation
- Comments
- Variables: Name, Assign Multiple Value, Output and Global Variable, Keywords
- Data Types
- Numbers
- Casting
- Operators
- Booleans
- Strings: Slicing, Modify, Concatenate, Format, Escape, Methods
- Basic Built-in math functions
- Lists
- Tuples
- Sets
- Dictionaries

Introduction:

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?

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

Why Python?

- Python works on different platforms (Windows, Mac, Linux).
- 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-oriented way or a functional way.

Python Syntax compared to other programming languages

- Python was designed for readability
- 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.

Example: `print("Hello, World!")`

Getting Started:

Python Install

- Many PCs and Macs will have python already installed.
- To check if you have python installed on a Windows PC, search in the start bar for Python or run the following on the Command Line (cmd.exe):

```
C:\Users\Your Name>python --version
```

Python Quickstart

- Python is an interpreted programming language, this means that as a developer you write Python (.py) files in a text editor and then put those files into the python interpreter to be executed.
- The way to run a python file is like this on the command line:

```
C:\Users\Your Name>python helloworld.py
```

- Where "helloworld.py" is the name of your python file.

The Python Command Line

- To test a short amount of code in python sometimes it is quickest and easiest not to write the code in a file. This is made possible because Python can be run as a command line itself.
- Type the following on the Windows, Mac or Linux command line:

```
C:\Users\Your Name>python
```

- Whenever you are done in the python command line, you can simply type the following to quit the python command line interface:

```
exit()
```

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!")
```

Comments:

Python has commenting capability for the purpose of in-code documentation.
Comments can be used to:

- Explain Python code.
- Make the code more readable.
- Prevent execution when testing code.

Creating a Comment

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

```
#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:

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

A comment does not have to be text that explains the code, it can also be used to prevent Python from executing code:

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

Multi Line Comments

Python does not really have syntax for multi-line comments.
To add a multiline comment you could insert a # for each line:

```
#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:

```
"""
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.

Variables:

Variables are containers for storing data values.

Creating Variables

Python has no command for declaring a variable.
A variable is created the moment you first assign a value to it.

```
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.

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

Casting

If you want to specify the data type of a variable, this can be done with casting.

```
x = str(3)    # x will be '3'
y = int(3)    # y will be 3
z = float(3)  # z will be 3.0
```

Get the Type

You can get the data type of a variable with the `type()` function.

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

Single or Double Quotes?

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

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

Case-Sensitive

Variable names are case-sensitive.
This will create two variables:

```
a = 4
A = "Sally"
#A will not overwrite a
```

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)

Legal variable names:

```
myvar = "John"
my_var = "John"
_my_var = "John"
myVar = "John"
MYVAR = "John"
```

Illegal variable names:

```
2myvar = "John"
my-var = "John"
my var = "John"
```

Remember that variable names are case-sensitive

Multi Words Variable Names

Variable names with more than one word can be difficult to read.
There are several techniques you can use to make them more readable:

Camel Case

Each word, except the first, starts with a capital letter:

```
myVariableName = "John"
```

Pascal Case

Each word starts with a capital letter:

```
MyVariableName = "John"
```

Snake Case

Each word is separated by an underscore character:

```
my_variable_name = "John"
```

Many Values to Multiple Variables

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

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

Note: Make sure the number of variables matches the number of values, or else you will get an error.

One Value to Multiple Variables

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

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

Unpack a Collection

If you have a collection of values in a list, tuple etc. Python allows you extract the values into variables. This is called *unpacking*.

Unpack a list:

```
fruits = ["apple", "banana", "cherry"]
x, y, z = fruits
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:

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

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

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

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

```
x = 5
y = 10
print(x + y)
```

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

```
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.

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

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

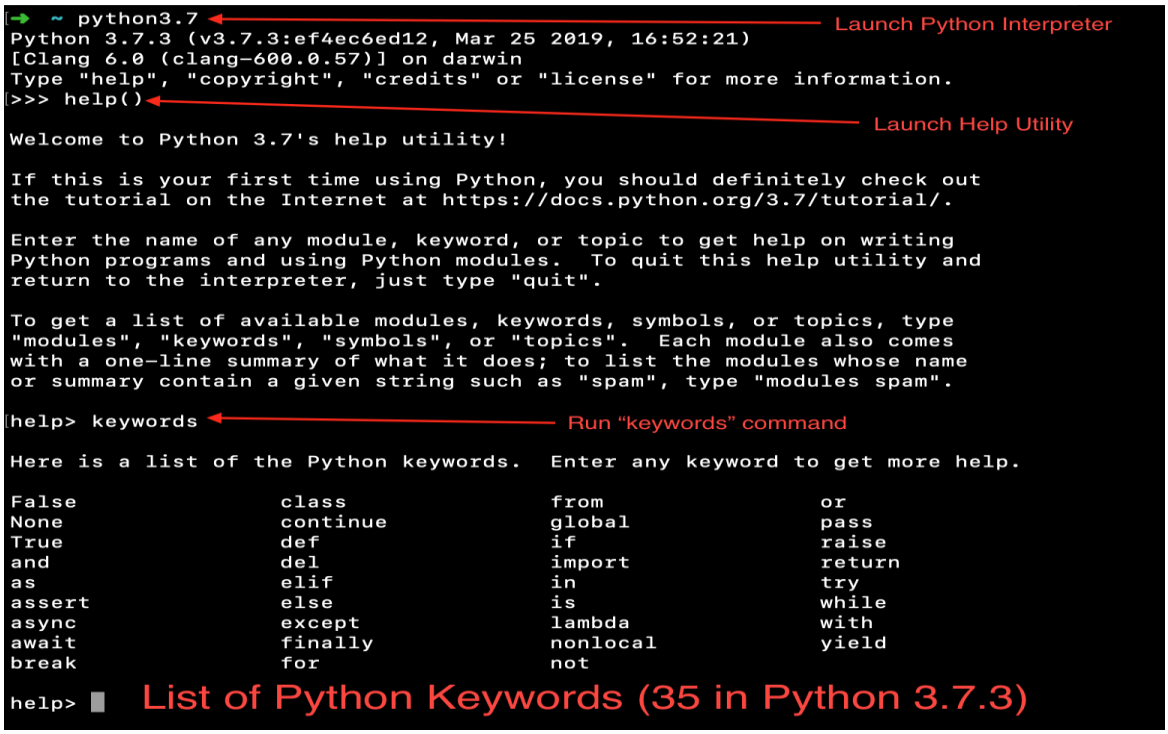
If you create a variable with the same name inside a function, this variable will be local, and can only be used inside the function. The global variable with the same name will remain as it was, global and with the original value.

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)
```

Keywords

Python has a set of keywords that are reserved words that cannot be used as variable names, function names, or any other identifiers:



Data Types:

Built-in Data Types

In programming, data type is an important concept.
Variables can store data of different types.
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:

```
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 = True`	bool

Numbers:

There are three numeric types in Python:

- int
- float
- complex

Variables of numeric types are created when you assign a value to them:

```
x = 1    # int
y = 2.8  # float
z = 1j   # complex
```

To verify the type of any object in Python, use the type() function:

```
print(type(x))
print(type(y))
print(type(z))
```

Int

Int, or integer, is a whole number, positive or negative, without decimals, of unlimited length.

Integers:

```
x = 1
y = 35656222554887711
z = -3255522
```

Float

Float, or "floating point number" is a number, positive or negative, containing one or more decimals.

Floats:

```
x = 1.10
y = 1.0
z = -35.59
```

Float can also be scientific numbers with an "e" to indicate the power of 10.

Floats:

```
x = 35e3
y = 12E4
z = -87.7e100
```

Complex

Complex numbers are written with a "j" as the imaginary part:

Complex:

```
x = 3+5j
y = 5j
z = -5j
```

Type Conversion

You can convert from one type to another with the `int()`, `float()`, and `complex()` methods:

Convert from one type to another:

```
x = 1    # int
y = 2.8  # float
z = 1j   # complex

#convert from int to float:
a = float(x)

#convert from float to int:
b = int(y)

#convert from int to complex:
c = complex(x)

print(a)   #1.0
print(b)   #2
print(c)   #(1+0j)
```

Note: You cannot convert complex numbers into another number type.

Casting:

Specify a Variable Type

There may be times when you want to specify a type on to a variable. This can be done with casting. Python is an object-orientated language, and as such it uses classes to define data types, including its primitive types.
Casting in python is therefore done using constructor functions:

- `int()` - constructs an integer number from an integer literal, a float literal (by removing all decimals), or a string literal (*providing the string represents a whole number only*)
- `float()` - constructs a float number from an integer literal, a float literal or a string literal (*providing the string represents a float or an integer*)
- `str()` - constructs a string from a wide variety of data types, including strings, integer literals and float literals

Integers:

```
x = int(1)   # x will be 1
y = int(2.8) # y will be 2
z = int("3") # z will be 3
```

Floats:

```
x = float(1)     # x will be 1.0
y = float(2.8)   # y will be 2.8
z = float("3")   # z will be 3.0
w = float("4.2") # w will be 4.2
```

Strings:

```
x = str("s1") # x will be 's1'
y = str(2)    # y will be '2'
z = str(3.0)  # z will be '3.0'
```

Operators

Operators are used to perform operations on variables and values.
In the example below, we use the + operator to add together two values:

```
print(10 + 5)
```

Python divides the operators in the following groups:

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

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

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

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

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)

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

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

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

Booleans:

Booleans represent one of two values: `True` or `False`.

Boolean Values

In programming you often need to know if an expression is `True` or `False`.
You can evaluate any expression in Python, and get one of two answers, `True` or `False`.
When you compare two values, the expression is evaluated and Python returns the Boolean answer.

```
print(10 > 9)
```

When you run a condition in an if statement, Python returns `True` or `False`:

```
a = 200
b = 33

if b > a:
  print("b is greater than a")
else:
  print("b is not greater than a")
```

Evaluate Values and Variables

Most Values are True

Almost any value is evaluated to `True` if it has some sort of content.
Any string is `True`, except empty strings.
Any number is `True`, except `0`.
Any list, tuple, set, and dictionary are `True`, except empty ones.

Example

The following will return True:

```
bool("abc")
bool(123)
bool(["apple", "cherry", "banana"])
```

Some Values are False

In fact, there are not many values that evaluate to `False`, except empty values, such as `()`, `[]`, `{}`, `""`, the number `0`, and the value `None`. And of course the value `False` evaluates to `False`.

The following will return False:

```
bool(False)
bool(None)
bool(0)
bool("")
bool(())
bool([])
bool({})
```

Strings:

Strings 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:

```
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:

```
a = "Hello"
print(a)
```

Multiline Strings

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

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

```
a = "Hello, World!"
print(a[1])
```

Looping Through a String

Since strings are arrays, we can loop through the characters in a string, with a `for` loop.

Loop through the letters in the word "banana":

```
for x in "banana":
  print(x)
```

String Length

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

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

```
a = "Hello, World!"
print(len(a))
```

Check String

To check if a certain phrase or character is present in a string, we can use the keyword `in`.

Check if "free" is present in the following text:

```
txt = "The best things in life are free!"
print("free" in txt)
```

Use it in an `if` statement:

Print only if "free" is present:

```
txt = "The best things in life are free!"
if "free" in txt:
  print("Yes, 'free' is present.")
```

Check if NOT

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

Check if "expensive" is NOT present in the following text:

```
txt = "The best things in life are free!"
print("expensive" not in txt)
```

Use it in an `if` statement:

print only if "expensive" is NOT present:

```
txt = "The best things in life are free!"
if "expensive" not in txt:
  print("Yes, 'expensive' is NOT present.")
```

Slicing Strings

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.

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

```
b = "Hello, World!"
print(b[2:5])
```

Note: The first character has index 0.

Slice From the Start

By leaving out the start index, the range will start at the first character:

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

```
b = "Hello, World!"
print(b[:5])
```

Slice To the End

By leaving out the *end* index, the range will go to the end:

Get the characters from position 2, and all the way to the end:

```
b = "Hello, World!"
print(b[2:])
```

Negative Indexing

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

Get the characters:
From: "o" in "World!" (position -5)
To, but not included: "d" in "World!" (position -2):

```
b = "Hello, World!"
print(b[-5:-2])
```

Modify Strings

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

Upper Case

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

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

Lower Case

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

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

Remove Whitespace

Whitespace is the space before and/or after the actual text, and very often you want to remove this space.

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

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

Replace String

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

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

Split String

The `split()` method returns a list where the text between the specified separator becomes the list items.

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

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

String Concatenation

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

Merge variable `a` with variable `b` into variable `c`:

```
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:

```
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:

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:

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

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

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

```
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))
```

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")`:

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

String format() Method

Definition and Usage

The `format()` method formats the specified value(s) and insert them inside the string's placeholder.
The placeholder is defined using curly brackets: {}.
The `format()` method returns the formatted string.

Syntax

string.format(*value1, value2...*)

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:
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 \":
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."
```

Escape Characters

Other escape characters used in Python:

Code	Result
\'	Single Quote
\\	Backslash
\n	New Line
\r	Carriage Return
\t	Tab
\b	Backspace

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()	Converts the first character to upper case
casefold()	Converts string into lower case
center()	Returns a centered string

count()	Returns the number of times a specified value occurs in a string
encode()	Returns an encoded version of the string
endswith()	Returns true if the string ends with the specified value
expandtabs()	Sets the tab size of the string
find()	Searches the string for a specified value and returns the position of where it was found
format()	Formats specified values in a string
format_map()	Formats specified values in a string
index()	Searches the string for a specified value and returns the position of where it was found
isalnum()	Returns True if all characters in the string are alphanumeric
isalpha()	Returns True if all characters in the string are in the alphabet
isdecimal()	Returns True if all characters in the string are decimals
isdigit()	Returns True if all characters in the string are digits
isidentifier()	Returns True if the string is an identifier
islower()	Returns True if all characters in the string are lower case
isnumeric()	Returns True if all characters in the string are numeric
isprintable()	Returns True if all characters in the string are printable
isspace()	Returns True if all characters in the string are whitespaces
istitle()	Returns True if the string follows the rules of a title
isupper()	Returns True if all characters in the string are upper case
join()	Joins the elements of an iterable to the end of the string
ljust()	Returns a left justified version of the string
lower()	Converts a string into lower case
lstrip()	Returns a left trim version of the string
maketrans()	Returns a translation table to be used in translations
partition()	Returns a tuple where the string is parted into three parts

replace()	Returns a string where a specified value is replaced with a specified value
rfind()	Searches the string for a specified value and returns the last position of where it was found
rindex()	Searches the string for a specified value and returns the last position of where it was found
rjust()	Returns a right justified version of the string
rpartition()	Returns a tuple where the string is parted into three parts
rsplit()	Splits the string at the specified separator, and returns a list
rstrip()	Returns a right trim version of the string
split()	Splits the string at the specified separator, and returns a list
splitlines()	Splits the string at line breaks and returns a list
startswith()	Returns true if the string starts with the specified value
strip()	Returns a trimmed version of the string
swapcase()	Swaps cases, lower case becomes upper case and vice versa
title()	Converts the first character of each word to upper case
translate()	Returns a translated string
upper()	Converts a string into upper case
zfill()	Fills the string with a specified number of 0 values at the beginning

Built-in Math Functions:

Python has a set of built-in math functions, including an extensive math module, that allows you to perform mathematical tasks on numbers.

The `min()` and `max()` functions can be used to find the lowest or highest value in an iterable:

```
x = min(5, 10, 25)
y = max(5, 10, 25)
```

The `abs()` function returns the absolute (positive) value of the specified number:

```
x = abs(-7.25)
```

The `pow(x, y)` function returns the value of x to the power of y (x^y).
Return the value of 4 to the power of 3 (same as 4 * 4 * 4):

```
x = pow(4, 3)
```

The Math Module

Python has also a built-in module called `math`, which extends the list of mathematical functions.
To use it, you must import the `math` module:

```
import math
```

When you have imported the `math` module, you can start using methods and constants of the module.
The `math.sqrt()` method for example, returns the square root of a number:

```
import math
x = math.sqrt(64)
```

The `math.ceil()` method rounds a number upwards to its nearest integer, and the `math.floor()` method rounds a number downwards to its nearest integer, and returns the result:

```
import math

x = math.ceil(1.4)
y = math.floor(1.4)

print(x) # returns 2
print(y) # returns 1
```

The `math.pi` constant, returns the value of PI (3.14...):

```
import math
x = math.pi
print(x)
```