<https://www.tutorialspoint.com/python/python_modules.htm>

Python

Python is a high-level, interpreted, interactive and object-oriented scripting language. Python is designed to be highly readable. It uses English keywords frequently where as other languages use punctuation, and it has fewer syntactical constructions than other languages.

* **Python is Interpreted** − Python is processed at runtime by the interpreter. You do not need to compile your program before executing it. This is similar to PERL and PHP.
* **Python is Interactive** − You can actually sit at a Python prompt and interact with the interpreter directly to write your programs.
* **Python is Object-Oriented** − Python supports Object-Oriented style or technique of programming that encapsulates code within objects.
* **Python is a Beginner's Language** − Python is a great language for the beginner-level programmers and supports the development of a wide range of applications from simple text processing to WWW browsers to games.

## **Python Features**

Python's features include −

* **Easy-to-learn** − Python has few keywords, simple structure, and a clearly defined syntax. This allows the student to pick up the language quickly.
* **Easy-to-read** − Python code is more clearly defined and visible to the eyes.
* **Easy-to-maintain** − Python's source code is fairly easy-to-maintain.
* **A broad standard library** − Python's bulk of the library is very portable and cross-platform compatible on UNIX, Windows, and Macintosh.
* **Interactive Mode** − Python has support for an interactive mode which allows interactive testing and debugging of snippets of code.
* **Portable** − Python can run on a wide variety of hardware platforms and has the same interface on all platforms.
* **Extendable** − You can add low-level modules to the Python interpreter. These modules enable programmers to add to or customize their tools to be more efficient.
* **Databases** − Python provides interfaces to all major commercial databases.
* **GUI Programming** − Python supports GUI applications that can be created and ported to many system calls, libraries and windows systems, such as Windows MFC, Macintosh, and the X Window system of Unix.
* **Scalable** − Python provides a better structure and support for large programs than shell scripting.

Apart from the above-mentioned features, Python has a big list of good features, few are listed below −

* It supports functional and structured programming methods as well as OOP.
* It can be used as a scripting language or can be compiled to byte-code for building large applications.
* It provides very high-level dynamic data types and supports dynamic type checking.
* It supports automatic garbage collection.
* It can be easily integrated with C, C++, COM, ActiveX, CORBA, and Java.

Python is available on a wide variety of platforms including Linux and Mac OS X. Let's understand how to set up our Python environment.

## **Setting up PATH**

Programs and other executable files can be in many directories, so operating systems provide a search path that lists the directories that the OS searches for executables.

The path is stored in an environment variable, which is a named string maintained by the operating system. This variable contains information available to the command shell and other programs.

The **path** variable is named as PATH in Unix or Path in Windows (Unix is case sensitive; Windows is not).

In Mac OS, the installer handles the path details. To invoke the Python interpreter from any particular directory, you must add the Python directory to your path.

## **Setting path at Unix/Linux**

To add the Python directory to the path for a particular session in Unix −

* **In the csh shell** − type setenv PATH "$PATH:/usr/local/bin/python" and press Enter.
* **In the bash shell (Linux)** − type export PATH="$PATH:/usr/local/bin/python" and press Enter.
* **In the sh or ksh shell** − type PATH="$PATH:/usr/local/bin/python" and press Enter.
* **Note** − /usr/local/bin/python is the path of the Python directory

## **Setting path at Windows**

To add the Python directory to the path for a particular session in Windows −

**At the command prompt** − type path %path%;C:\Python and press Enter.

**Note** − C:\Python is the path of the Python directory

## **Python Environment Variables**

Here are important environment variables, which can be recognized by Python −

|  |  |
| --- | --- |
| **Sr.No.** | **Variable & Description** |
| 1 | **PYTHONPATH**  It has a role similar to PATH. This variable tells the Python interpreter where to locate the module files imported into a program. It should include the Python source library directory and the directories containing Python source code. PYTHONPATH is sometimes preset by the Python installer. |
| 2 | **PYTHONSTARTUP**  It contains the path of an initialization file containing Python source code. It is executed every time you start the interpreter. It is named as .pythonrc.py in Unix and it contains commands that load utilities or modify PYTHONPATH. |
| 3 | **PYTHONCASEOK**  It is used in Windows to instruct Python to find the first case-insensitive match in an import statement. Set this variable to any value to activate it. |
| 4 | **PYTHONHOME**  It is an alternative module search path. It is usually embedded in the PYTHONSTARTUP or PYTHONPATH directories to make switching module libraries easy. |

## **Python Identifiers**

A Python identifier is a name used to identify a variable, function, class, module or other object. An identifier starts with a letter A to Z or a to z or an underscore (\_) followed by zero or more letters, underscores and digits (0 to 9).

Python does not allow punctuation characters such as @, $, and % within identifiers. Python is a case sensitive programming language. Thus, **Manpower** and **manpower** are two different identifiers in Python.

Here are naming conventions for Python identifiers −

* Class names start with an uppercase letter. All other identifiers start with a lowercase letter.
* Starting an identifier with a single leading underscore indicates that the identifier is private.
* Starting an identifier with two leading underscores indicates a strongly private identifier.
* If the identifier also ends with two trailing underscores, the identifier is a language-defined special name.

## **Reserved Words**

The following list shows the Python keywords. These are reserved words and you cannot use them as constant or variable or any other identifier names. All the Python keywords contain lowercase letters only.

|  |  |  |
| --- | --- | --- |
| and | exec | not |
| assert | finally | or |
| break | for | pass |
| class | from | print |
| continue | global | raise |
| def | if | return |
| del | import | try |
| elif | in | while |
| else | is | with |
| except | lambda | yield |

## **Multi-Line Statements**

Statements in Python typically end with a new line. Python does, however, allow the use of the line continuation character (\) to denote that the line should continue. For example −

total = item\_one + \

item\_two + \

item\_three

Statements contained within the [], {}, or () brackets do not need to use the line continuation character. For example −

days = ['Monday', 'Tuesday', 'Wednesday',

'Thursday', 'Friday']

## **Quotation in Python**

Python accepts single ('), double (") and triple (''' or """) quotes to denote string literals, as long as the same type of quote starts and ends the string.

The triple quotes are used to span the string across multiple lines. For example, all the following are legal −

word = 'word'

sentence = "This is a sentence."

paragraph = """This is a paragraph. It is

made up of multiple lines and sentences."""

## **Waiting for the User**

The following line of the program displays the prompt, the statement saying “Press the enter key to exit”, and waits for the user to take action −

#!/usr/bin/python

raw\_input("\n\nPress the enter key to exit.")

Here, "\n\n" is used to create two new lines before displaying the actual line. Once the user presses the key, the program ends. This is a nice trick to keep a console window open until the user is done with an application.

## **Multiple Statements on a Single Line**

The semicolon ( ; ) allows multiple statements on the single line given that neither statement starts a new code block. Here is a sample snip using the semicolon −

import sys; x = 'foo'; sys.stdout.write(x + '\n')

## **Multiple Statement Groups as Suites**

A group of individual statements, which make a single code block are called **suites** in Python. Compound or complex statements, such as if, while, def, and class require a header line and a suite.

Header lines begin the statement (with the keyword) and terminate with a colon ( : ) and are followed by one or more lines which make up the suite. For example −

if expression :

suite

elif expression :

suite

else :

suite

## **Multiple Assignment**

Python allows you to assign a single value to several variables simultaneously. For example −

a = b = c = 1

Here, an integer object is created with the value 1, and all three variables are assigned to the same memory location. You can also assign multiple objects to multiple variables. For example −

a,b,c = 1,2,"john"

Here, two integer objects with values 1 and 2 are assigned to variables a and b respectively, and one string object with the value "john" is assigned to the variable c.

Standard Data Types

The data stored in memory can be of many types. For example, a person's age is stored as a numeric value and his or her address is stored as alphanumeric characters. Python has various standard data types that are used to define the operations possible on them and the storage method for each of them.

Python has five standard data types −

* Numbers
* String
* List
* Tuple
* Dictionary

Python Numbers

Number data types store numeric values. Number objects are created when you assign a value to them. For example −

var1 = 1

var2 = 10

You can also delete the reference to a number object by using the del statement. The syntax of the del statement is −

del var1[,var2[,var3[....,varN]]]]

You can delete a single object or multiple objects by using the del statement. For example −

del var

del var\_a, var\_b

Python supports four different numerical types −

* int (signed integers)
* long (long integers, they can also be represented in octal and hexadecimal)
* float (floating point real values)
* complex (complex numbers)

Examples

Here are some examples of numbers −

|  |  |  |  |
| --- | --- | --- | --- |
| **int** | **long** | **float** | **complex** |
| 10 | 51924361L | 0.0 | 3.14j |
| 100 | -0x19323L | 15.20 | 45.j |
| -786 | 0122L | -21.9 | 9.322e-36j |
| 080 | 0xDEFABCECBDAECBFBAEl | 32.3+e18 | .876j |
| -0490 | 535633629843L | -90. | -.6545+0J |
| -0x260 | -052318172735L | -32.54e100 | 3e+26J |
| 0x69 | -4721885298529L | 70.2-E12 | 4.53e-7j |

* Python allows you to use a lowercase l with long, but it is recommended that you use only an uppercase L to avoid confusion with the number 1. Python displays long integers with an uppercase L.
* A complex number consists of an ordered pair of real floating-point numbers denoted by x + yj, where x and y are the real numbers and j is the imaginary unit.

## **Python Strings**

Strings in Python are identified as a contiguous set of characters represented in the quotation marks. Python allows for either pairs of single or double quotes. Subsets of strings can be taken using the slice operator ([ ] and [:] ) with indexes starting at 0 in the beginning of the string and working their way from -1 at the end.

The plus (+) sign is the string concatenation operator and the asterisk (\*) is the repetition operator. For example −

#!/usr/bin/python

str = 'Hello World!'

print str # Prints complete string

print str[0] # Prints first character of the string

print str[2:5] # Prints characters starting from 3rd to 5th

print str[2:] # Prints string starting from 3rd character

print str \* 2 # Prints string two times

print str + "TEST" # Prints concatenated string

This will produce the following result −

Hello World!

H

llo

llo World!

Hello World!Hello World!

Hello World!TEST

## **Python Lists**

Lists are the most versatile of Python's compound data types. A list contains items separated by commas and enclosed within square brackets ([]). To some extent, lists are similar to arrays in C. One difference between them is that all the items belonging to a list can be of different data type.

The values stored in a list can be accessed using the slice operator ([ ] and [:]) with indexes starting at 0 in the beginning of the list and working their way to end -1. The plus (+) sign is the list concatenation operator, and the asterisk (\*) is the repetition operator. For example −

#!/usr/bin/python

list = [ 'abcd', 786 , 2.23, 'john', 70.2 ]

tinylist = [123, 'john']

print list # Prints complete list

print list[0] # Prints first element of the list

print list[1:3] # Prints elements starting from 2nd till 3rd

print list[2:] # Prints elements starting from 3rd element

print tinylist \* 2 # Prints list two times

print list + tinylist # Prints concatenated lists

This produce the following result −

['abcd', 786, 2.23, 'john', 70.2]

abcd

[786, 2.23]

[2.23, 'john', 70.2]

[123, 'john', 123, 'john']

['abcd', 786, 2.23, 'john', 70.2, 123, 'john']

## **Python Tuples**

A tuple is another sequence data type that is similar to the list. A tuple consists of a number of values separated by commas. Unlike lists, however, tuples are enclosed within parentheses.

The main differences between lists and tuples are: Lists are enclosed in brackets ( [ ] ) and their elements and size can be changed, while tuples are enclosed in parentheses ( ( ) ) and cannot be updated. Tuples can be thought of as **read-only** lists. For example −

#!/usr/bin/python

tuple = ( 'abcd', 786 , 2.23, 'john', 70.2 )

tinytuple = (123, 'john')

print tuple # Prints complete list

print tuple[0] # Prints first element of the list

print tuple[1:3] # Prints elements starting from 2nd till 3rd

print tuple[2:] # Prints elements starting from 3rd element

print tinytuple \* 2 # Prints list two times

print tuple + tinytuple # Prints concatenated lists

This produce the following result −

('abcd', 786, 2.23, 'john', 70.2)

abcd

(786, 2.23)

(2.23, 'john', 70.2)

(123, 'john', 123, 'john')

('abcd', 786, 2.23, 'john', 70.2, 123, 'john')

The following code is invalid with tuple, because we attempted to update a tuple, which is not allowed. Similar case is possible with lists −

#!/usr/bin/python

tuple = ( 'abcd', 786 , 2.23, 'john', 70.2 )

list = [ 'abcd', 786 , 2.23, 'john', 70.2 ]

tuple[2] = 1000 # Invalid syntax with tuple

list[2] = 1000 # Valid syntax with list

## **Python Dictionary**

Python's dictionaries are kind of hash table type. They work like associative arrays or hashes found in Perl and consist of key-value pairs. A dictionary key can be almost any Python type, but are usually numbers or strings. Values, on the other hand, can be any arbitrary Python object.

Dictionaries are enclosed by curly braces ({ }) and values can be assigned and accessed using square braces ([]). For example −

#!/usr/bin/python

dict = {}

dict['one'] = "This is one"

dict[2] = "This is two"

tinydict = {'name': 'john','code':6734, 'dept': 'sales'}

print dict['one'] # Prints value for 'one' key

print dict[2] # Prints value for 2 key

print tinydict # Prints complete dictionary

print tinydict.keys() # Prints all the keys

print tinydict.values() # Prints all the values

This produce the following result −

This is one

This is two

{'dept': 'sales', 'code': 6734, 'name': 'john'}

['dept', 'code', 'name']

['sales', 6734, 'john']

Dictionaries have no concept of order among elements. It is incorrect to say that the elements are "out of order"; they are simply unordered.

## **Data Type Conversion**

Sometimes, you may need to perform conversions between the built-in types. To convert between types, you simply use the type name as a function.

There are several built-in functions to perform conversion from one data type to another. These functions return a new object representing the converted value.

|  |  |
| --- | --- |
| **Sr.No.** | **Function & Description** |
| 1 | **int(x [,base])**  Converts x to an integer. base specifies the base if x is a string. |
| 2 | **long(x [,base] )**  Converts x to a long integer. base specifies the base if x is a string. |
| 3 | **float(x)**  Converts x to a floating-point number. |
| 4 | **complex(real [,imag])**  Creates a complex number. |
| 5 | **str(x)**  Converts object x to a string representation. |
| 6 | **repr(x)**  Converts object x to an expression string. |
| 7 | **eval(str)**  Evaluates a string and returns an object. |
| 8 | **tuple(s)**  Converts s to a tuple. |
| 9 | **list(s)**  Converts s to a list. |
| 10 | **set(s)**  Converts s to a set. |
| 11 | **dict(d)**  Creates a dictionary. d must be a sequence of (key,value) tuples. |
| 12 | **frozenset(s)**  Converts s to a frozen set. |
| 13 | **chr(x)**  Converts an integer to a character. |
| 14 | **unichr(x)**  Converts an integer to a Unicode character. |
| 15 | **ord(x)**  Converts a single character to its integer value. |
| 16 | **hex(x)**  Converts an integer to a hexadecimal string. |
| 17 | **oct(x)**  Converts an integer to an octal string. |

## **Python Arithmetic Operators**

Assume variable a holds 10 and variable b holds 20, then −

[ [Show Example](https://www.tutorialspoint.com/python/arithmetic_operators_example.htm) ]

|  |  |  |
| --- | --- | --- |
| **Operator** | **Description** | **Example** |
| + Addition | Adds values on either side of the operator. | a + b = 30 |
| - Subtraction | Subtracts right hand operand from left hand operand. | a – b = -10 |
| \* Multiplication | Multiplies values on either side of the operator | a \* b = 200 |
| / Division | Divides left hand operand by right hand operand | b / a = 2 |
| % Modulus | Divides left hand operand by right hand operand and returns remainder | b % a = 0 |
| \*\* Exponent | Performs exponential (power) calculation on operators | a\*\*b =10 to the power 20 |
| // | Floor Division - The division of operands where the result is the quotient in which the digits after the decimal point are removed. But if one of the operands is negative, the result is floored, i.e., rounded away from zero (towards negative infinity) − | 9//2 = 4 and 9.0//2.0 = 4.0, -11//3 = -4, -11.0//3 = -4.0 |

## **Python Comparison Operators**

These operators compare the values on either sides of them and decide the relation among them. They are also called Relational operators.

Assume variable a holds 10 and variable b holds 20, then −

[ [Show Example](https://www.tutorialspoint.com/python/comparison_operators_example.htm) ]

|  |  |  |
| --- | --- | --- |
| **Operator** | **Description** | **Example** |
| == | If the values of two operands are equal, then the condition becomes true. | (a == b) is not true. |
| != | If values of two operands are not equal, then condition becomes true. | (a != b) is true. |
| <> | If values of two operands are not equal, then condition becomes true. | (a <> b) is true. This is similar to != operator. |
| > | If the value of left operand is greater than the value of right operand, then condition becomes true. | (a > b) is not true. |
| < | If the value of left operand is less than the value of right operand, then condition becomes true. | (a < b) is true. |
| >= | If the value of left operand is greater than or equal to the value of right operand, then condition becomes true. | (a >= b) is not true. |
| <= | If the value of left operand is less than or equal to the value of right operand, then condition becomes true. | (a <= b) is true. |

## **Python Assignment Operators**

Assume variable a holds 10 and variable b holds 20, then −

[ [Show Example](https://www.tutorialspoint.com/python/assignment_operators_example.htm) ]

|  |  |  |
| --- | --- | --- |
| **Operator** | **Description** | **Example** |
| = | Assigns values from right side operands to left side operand | c = a + b assigns value of a + b into c |
| += Add AND | It adds right operand to the left operand and assign the result to left operand | c += a is equivalent to c = c + a |
| -= Subtract AND | It subtracts right operand from the left operand and assign the result to left operand | c -= a is equivalent to c = c - a |
| \*= Multiply AND | It multiplies right operand with the left operand and assign the result to left operand | c \*= a is equivalent to c = c \* a |
| /= Divide AND | It divides left operand with the right operand and assign the result to left operand | c /= a is equivalent to c = c / ac /= a is equivalent to c = c / a |
| %= Modulus AND | It takes modulus using two operands and assign the result to left operand | c %= a is equivalent to c = c % a |
| \*\*= Exponent AND | Performs exponential (power) calculation on operators and assign value to the left operand | c \*\*= a is equivalent to c = c \*\* a |
| //= Floor Division | It performs floor division on operators and assign value to the left operand | c //= a is equivalent to c = c // a |

## **Python Bitwise Operators**

Bitwise operator works on bits and performs bit by bit operation. Assume if a = 60; and b = 13; Now in binary format they will be as follows −

a = 0011 1100

b = 0000 1101

-----------------

a&b = 0000 1100

a|b = 0011 1101

a^b = 0011 0001

~a  = 1100 0011

There are following Bitwise operators supported by Python language

[ [Show Example](https://www.tutorialspoint.com/python/bitwise_operators_example.htm) ]

|  |  |  |
| --- | --- | --- |
| **Operator** | **Description** | **Example** |
| & Binary AND | Operator copies a bit to the result if it exists in both operands | (a & b) (means 0000 1100) |
| | Binary OR | It copies a bit if it exists in either operand. | (a | b) = 61 (means 0011 1101) |
| ^ Binary XOR | It copies the bit if it is set in one operand but not both. | (a ^ b) = 49 (means 0011 0001) |
| ~ Binary Ones Complement | It is unary and has the effect of 'flipping' bits. | (~a ) = -61 (means 1100 0011 in 2's complement form due to a signed binary number. |
| << Binary Left Shift | The left operands value is moved left by the number of bits specified by the right operand. | a << 2 = 240 (means 1111 0000) |
| >> Binary Right Shift | The left operands value is moved right by the number of bits specified by the right operand. | a >> 2 = 15 (means 0000 1111) |

## **Python Logical Operators**

There are following logical operators supported by Python language. Assume variable a holds 10 and variable b holds 20 then

[ [Show Example](https://www.tutorialspoint.com/python/logical_operators_example.htm) ]

|  |  |  |
| --- | --- | --- |
| **Operator** | **Description** | **Example** |
| and Logical AND | If both the operands are true then condition becomes true. | (a and b) is true. |
| or Logical OR | If any of the two operands are non-zero then condition becomes true. | (a or b) is true. |
| not Logical NOT | Used to reverse the logical state of its operand. | Not(a and b) is false. |

Used to reverse the logical state of its operand.

## **Python Membership Operators**

Python’s membership operators test for membership in a sequence, such as strings, lists, or tuples. There are two membership operators as explained below −

[ [Show Example](https://www.tutorialspoint.com/python/membership_operators_example.htm) ]

|  |  |  |
| --- | --- | --- |
| **Operator** | **Description** | **Example** |
| in | Evaluates to true if it finds a variable in the specified sequence and false otherwise. | x in y, here in results in a 1 if x is a member of sequence y. | |
| not in | Evaluates to true if it does not finds a variable in the specified sequence and false otherwise. | x not in y, here not in results in a 1 if x is not a member of sequence y. | |

## **Python Identity Operators**

Identity operators compare the memory locations of two objects. There are two Identity operators explained below −

[ [Show Example](https://www.tutorialspoint.com/python/identity_operators_example.htm) ]

|  |  |  |
| --- | --- | --- |
| **Operator** | **Description** | **Example** |
| is | Evaluates to true if the variables on either side of the operator point to the same object and false otherwise. | x is y, here **is** results in 1 if id(x) equals id(y). |
| is not | Evaluates to false if the variables on either side of the operator point to the same object and true otherwise. | x is not y, here **is not** results in 1 if id(x) is not equal to id(y). |

## **Python Operators Precedence**

The following table lists all operators from highest precedence to lowest.

[ [Show Example](https://www.tutorialspoint.com/python/operators_precedence_example.htm) ]

|  |  |
| --- | --- |
| **Sr.No.** | **Operator & Description** |
| 1 | **\*\***  Exponentiation (raise to the power) |
| 2 | **~ + -**  Complement, unary plus and minus (method names for the last two are +@ and -@) |
| 3 | **\* / % //**  Multiply, divide, modulo and floor division |
| 4 | **+ -**  Addition and subtraction |
| 5 | **>> <<**  Right and left bitwise shift |
| 6 | **&**  Bitwise 'AND' |
| 7 | **^ |**  Bitwise exclusive `OR' and regular `OR' |
| 8 | **<= < > >=**  Comparison operators |
| 9 | **<> == !=**  Equality operators |
| 10 | **= %= /= //= -= += \*= \*\*=**  Assignment operators |
| 11 | **is is not**  Identity operators |
| 12 | **in not in**  Membership operators |
| 13 | **not or and**  Logical operators |

## **Mathematical Functions**

Python includes following functions that perform mathematical calculations.

|  |  |
| --- | --- |
| **Sr.No.** | **Function & Returns ( description )** |
| 1 | [**abs(x)**](https://www.tutorialspoint.com/python/number_abs.htm)  The absolute value of x: the (positive) distance between x and zero. |
| 2 | [**ceil(x)**](https://www.tutorialspoint.com/python/number_ceil.htm)  The ceiling of x: the smallest integer not less than x |
| 3 | [**cmp(x, y)**](https://www.tutorialspoint.com/python/number_cmp.htm)  -1 if x < y, 0 if x == y, or 1 if x > y |
| 4 | [**exp(x)**](https://www.tutorialspoint.com/python/number_exp.htm)  The exponential of x: ex |
| 5 | [**fabs(x)**](https://www.tutorialspoint.com/python/number_fabs.htm)  The absolute value of x. |
| 6 | [**floor(x)**](https://www.tutorialspoint.com/python/number_floor.htm)  The floor of x: the largest integer not greater than x |
| 7 | [**log(x)**](https://www.tutorialspoint.com/python/number_log.htm)  The natural logarithm of x, for x> 0 |
| 8 | [**log10(x)**](https://www.tutorialspoint.com/python/number_log10.htm)  The base-10 logarithm of x for x> 0. |
| 9 | [**max(x1, x2,...)**](https://www.tutorialspoint.com/python/number_max.htm)  The largest of its arguments: the value closest to positive infinity |
| 10 | [**min(x1, x2,...)**](https://www.tutorialspoint.com/python/number_min.htm)  The smallest of its arguments: the value closest to negative infinity |
| 11 | [**modf(x)**](https://www.tutorialspoint.com/python/number_modf.htm)  The fractional and integer parts of x in a two-item tuple. Both parts have the same sign as x. The integer part is returned as a float. |
| 12 | [**pow(x, y)**](https://www.tutorialspoint.com/python/number_pow.htm)  The value of x\*\*y. |
| 13 | [**round(x [,n])**](https://www.tutorialspoint.com/python/number_round.htm)  **x** rounded to n digits from the decimal point. Python rounds away from zero as a tie-breaker: round(0.5) is 1.0 and round(-0.5) is -1.0. |
| 14 | [**sqrt(x)**](https://www.tutorialspoint.com/python/number_sqrt.htm)  The square root of x for x > 0 |

## **Random Number Functions**

Random numbers are used for games, simulations, testing, security, and privacy applications. Python includes following functions that are commonly used.

|  |  |
| --- | --- |
| **Sr.No.** | **Function & Description** |
| 1 | [**choice(seq)**](https://www.tutorialspoint.com/python/number_choice.htm)  A random item from a list, tuple, or string. |
| 2 | [**randrange ([start,] stop [,step])**](https://www.tutorialspoint.com/python/number_randrange.htm)  A randomly selected element from range(start, stop, step) |
| 3 | [**random()**](https://www.tutorialspoint.com/python/number_random.htm)  A random float r, such that 0 is less than or equal to r and r is less than 1 |
| 4 | [**seed([x])**](https://www.tutorialspoint.com/python/number_seed.htm)  Sets the integer starting value used in generating random numbers. Call this function before calling any other random module function. Returns None. |
| 5 | [**shuffle(lst)**](https://www.tutorialspoint.com/python/number_shuffle.htm)  Randomizes the items of a list in place. Returns None. |
| 6 | [**uniform(x, y)**](https://www.tutorialspoint.com/python/number_uniform.htm)  A random float r, such that x is less than or equal to r and r is less than y |

## **Trigonometric Functions**

Python includes following functions that perform trigonometric calculations.

|  |  |
| --- | --- |
| **Sr.No.** | **Function & Description** |
| 1 | [**acos(x)**](https://www.tutorialspoint.com/python/number_acos.htm)  Return the arc cosine of x, in radians. |
| 2 | [**asin(x)**](https://www.tutorialspoint.com/python/number_asin.htm)  Return the arc sine of x, in radians. |
| 3 | [**atan(x)**](https://www.tutorialspoint.com/python/number_atan.htm)  Return the arc tangent of x, in radians. |
| 4 | [**atan2(y, x)**](https://www.tutorialspoint.com/python/number_atan2.htm)  Return atan(y / x), in radians. |
| 5 | [**cos(x)**](https://www.tutorialspoint.com/python/number_cos.htm)  Return the cosine of x radians. |
| 6 | [**hypot(x, y)**](https://www.tutorialspoint.com/python/number_hypot.htm)  Return the Euclidean norm, sqrt(x\*x + y\*y). |
| 7 | [**sin(x)**](https://www.tutorialspoint.com/python/number_sin.htm)  Return the sine of x radians. |
| 8 | [**tan(x)**](https://www.tutorialspoint.com/python/number_tan.htm)  Return the tangent of x radians. |
| 9 | [**degrees(x)**](https://www.tutorialspoint.com/python/number_degrees.htm)  Converts angle x from radians to degrees. |
| 10 | [**radians(x)**](https://www.tutorialspoint.com/python/number_radians.htm)  Converts angle x from degrees to radians. |

## **Mathematical Constants**

The module also defines two mathematical constants −

|  |  |
| --- | --- |
| **Sr.No.** | **Constants & Description** |
| 1 | **pi**  The mathematical constant pi. |
| 2 | **e**  The mathematical constant e. |

## **Escape Characters**

Following table is a list of escape or non-printable characters that can be represented with backslash notation.

An escape character gets interpreted; in a single quoted as well as double quoted strings.

|  |  |  |
| --- | --- | --- |
| **Backslash notation** | **Hexadecimal character** | **Description** |
| \a | 0x07 | Bell or alert |
| \b | 0x08 | Backspace |
| \cx |  | Control-x |
| \C-x |  | Control-x |
| \e | 0x1b | Escape |
| \f | 0x0c | Formfeed |
| \M-\C-x |  | Meta-Control-x |
| \n | 0x0a | Newline |
| \nnn |  | Octal notation, where n is in the range 0.7 |
| \r | 0x0d | Carriage return |
| \s | 0x20 | Space |
| \t | 0x09 | Tab |
| \v | 0x0b | Vertical tab |
| \x |  | Character x |
| \xnn |  | Hexadecimal notation, where n is in the range 0.9, a.f, or A.F |

## **String Special Operators**

Assume string variable **a** holds 'Hello' and variable **b** holds 'Python', then −

|  |  |  |
| --- | --- | --- |
| **Operator** | **Description** | **Example** |
| + | Concatenation - Adds values on either side of the operator | a + b will give HelloPython |
| \* | Repetition - Creates new strings, concatenating multiple copies of the same string | a\*2 will give -HelloHello |
| [] | Slice - Gives the character from the given index | a[1] will give e |
| [ : ] | Range Slice - Gives the characters from the given range | a[1:4] will give ell |
| in | Membership - Returns true if a character exists in the given string | H in a will give 1 |
| not in | Membership - Returns true if a character does not exist in the given string | M not in a will give 1 |
| r/R | Raw String - Suppresses actual meaning of Escape characters. The syntax for raw strings is exactly the same as for normal strings with the exception of the raw string operator, the letter "r," which precedes the quotation marks. The "r" can be lowercase (r) or uppercase (R) and must be placed immediately preceding the first quote mark. | print r'\n' prints \n and print R'\n'prints \n |
| % | Format - Performs String formatting | See at next section |

## **String Formatting Operator**

One of Python's coolest features is the string format operator %. This operator is unique to strings and makes up for the pack of having functions from C's printf() family. Following is a simple example −

#!/usr/bin/python

print "My name is %s and weight is %d kg!" % ('Zara', 21)

When the above code is executed, it produces the following result −

My name is Zara and weight is 21 kg!

Here is the list of complete set of symbols which can be used along with % −

|  |  |
| --- | --- |
| **Format Symbol** | **Conversion** |
| %c | character |
| %s | string conversion via str() prior to formatting |
| %i | signed decimal integer |
| %d | signed decimal integer |
| %u | unsigned decimal integer |
| %o | octal integer |
| %x | hexadecimal integer (lowercase letters) |
| %X | hexadecimal integer (UPPERcase letters) |
| %e | exponential notation (with lowercase 'e') |
| %E | exponential notation (with UPPERcase 'E') |
| %f | floating point real number |
| %g | the shorter of %f and %e |
| %G | the shorter of %f and %E |

Other supported symbols and functionality are listed in the following table −

|  |  |
| --- | --- |
| **Symbol** | **Functionality** |
| \* | argument specifies width or precision |
| - | left justification |
| + | display the sign |
| <sp> | leave a blank space before a positive number |
| # | add the octal leading zero ( '0' ) or hexadecimal leading '0x' or '0X', depending on whether 'x' or 'X' were used. |
| 0 | pad from left with zeros (instead of spaces) |
| % | '%%' leaves you with a single literal '%' |
| (var) | mapping variable (dictionary arguments) |
| m.n. | m is the minimum total width and n is the number of digits to display after the decimal point (if appl.) |

## **Built-in String Methods**

Python includes the following built-in methods to manipulate strings −

|  |  |  |
| --- | --- | --- |
| **Sr.No.** | **Methods with Description** | |
| 1 | [**capitalize()**](https://www.tutorialspoint.com/python/string_capitalize.htm)  Capitalizes first letter of string |
| 2 | [**center(width, fillchar)**](https://www.tutorialspoint.com/python/string_center.htm)  Returns a space-padded string with the original string centered to a total of width columns. |
| 3 | [**count(str, beg= 0,end=len(string))**](https://www.tutorialspoint.com/python/string_count.htm)  Counts how many times str occurs in string or in a substring of string if starting index beg and ending index end are given. |
| 4 | [**decode(encoding='UTF-8',errors='strict')**](https://www.tutorialspoint.com/python/string_decode.htm)  Decodes the string using the codec registered for encoding. encoding defaults to the default string encoding. |
| 5 | [**encode(encoding='UTF-8',errors='strict')**](https://www.tutorialspoint.com/python/string_encode.htm)  Returns encoded string version of string; on error, default is to raise a ValueError unless errors is given with 'ignore' or 'replace'. |
| 6 | [**endswith(suffix, beg=0, end=len(string))**](https://www.tutorialspoint.com/python/string_endswith.htm)  Determines if string or a substring of string (if starting index beg and ending index end are given) ends with suffix; returns true if so and false otherwise. |
| 7 | [**expandtabs(tabsize=8)**](https://www.tutorialspoint.com/python/string_expandtabs.htm)  Expands tabs in string to multiple spaces; defaults to 8 spaces per tab if tabsize not provided. |
| 8 | [**find(str, beg=0 end=len(string))**](https://www.tutorialspoint.com/python/string_find.htm)  Determine if str occurs in string or in a substring of string if starting index beg and ending index end are given returns index if found and -1 otherwise. |
| 9 | [**index(str, beg=0, end=len(string))**](https://www.tutorialspoint.com/python/string_index.htm)  Same as find(), but raises an exception if str not found. |
| 10 | [**isalnum()**](https://www.tutorialspoint.com/python/string_isalnum.htm)  Returns true if string has at least 1 character and all characters are alphanumeric and false otherwise. |
| 11 | [**isalpha()**](https://www.tutorialspoint.com/python/string_isalpha.htm)  Returns true if string has at least 1 character and all characters are alphabetic and false otherwise. |
| 12 | [**isdigit()**](https://www.tutorialspoint.com/python/string_isdigit.htm)  Returns true if string contains only digits and false otherwise. |
| 13 | [**islower()**](https://www.tutorialspoint.com/python/string_islower.htm)  Returns true if string has at least 1 cased character and all cased characters are in lowercase and false otherwise. |
| 14 | [**isnumeric()**](https://www.tutorialspoint.com/python/string_isnumeric.htm)  Returns true if a unicode string contains only numeric characters and false otherwise. |
| 15 | [**isspace()**](https://www.tutorialspoint.com/python/string_isspace.htm)  Returns true if string contains only whitespace characters and false otherwise. |
| 16 | [**istitle()**](https://www.tutorialspoint.com/python/string_istitle.htm)  Returns true if string is properly "titlecased" and false otherwise. |
| 17 | [**isupper()**](https://www.tutorialspoint.com/python/string_isupper.htm)  Returns true if string has at least one cased character and all cased characters are in uppercase and false otherwise. |
| 18 | [**join(seq)**](https://www.tutorialspoint.com/python/string_join.htm)  Merges (concatenates) the string representations of elements in sequence seq into a string, with separator string. |
| 19 | [**len(string)**](https://www.tutorialspoint.com/python/string_len.htm)  Returns the length of the string |
| 20 | [**ljust(width[, fillchar])**](https://www.tutorialspoint.com/python/string_ljust.htm)  Returns a space-padded string with the original string left-justified to a total of width columns. |
| 21 | [**lower()**](https://www.tutorialspoint.com/python/string_lower.htm)  Converts all uppercase letters in string to lowercase. |
| 22 | [**lstrip()**](https://www.tutorialspoint.com/python/string_lstrip.htm)  Removes all leading whitespace in string. |
| 23 | [**maketrans()**](https://www.tutorialspoint.com/python/string_maketrans.htm)  Returns a translation table to be used in translate function. |
| 24 | [**max(str)**](https://www.tutorialspoint.com/python/string_max.htm)  Returns the max alphabetical character from the string str. |
| 25 | [**min(str)**](https://www.tutorialspoint.com/python/string_min.htm)  Returns the min alphabetical character from the string str. |
| 26 | [**replace(old, new [, max])**](https://www.tutorialspoint.com/python/string_replace.htm)  Replaces all occurrences of old in string with new or at most max occurrences if max given. |
| 27 | [**rfind(str, beg=0,end=len(string))**](https://www.tutorialspoint.com/python/string_rfind.htm)  Same as find(), but search backwards in string. |
| 28 | [**rindex( str, beg=0, end=len(string))**](https://www.tutorialspoint.com/python/string_rindex.htm)  Same as index(), but search backwards in string. |
| 29 | [**rjust(width,[, fillchar])**](https://www.tutorialspoint.com/python/string_rjust.htm)  Returns a space-padded string with the original string right-justified to a total of width columns. |
| 30 | [**rstrip()**](https://www.tutorialspoint.com/python/string_rstrip.htm)  Removes all trailing whitespace of string. |
| 31 | [**split(str="", num=string.count(str))**](https://www.tutorialspoint.com/python/string_split.htm)  Splits string according to delimiter str (space if not provided) and returns list of substrings; split into at most num substrings if given. |
| 32 | [**splitlines( num=string.count('\n'))**](https://www.tutorialspoint.com/python/string_splitlines.htm)  Splits string at all (or num) NEWLINEs and returns a list of each line with NEWLINEs removed. |
| 33 | [**startswith(str, beg=0,end=len(string))**](https://www.tutorialspoint.com/python/string_startswith.htm)  Determines if string or a substring of string (if starting index beg and ending index end are given) starts with substring str; returns true if so and false otherwise. |
| 34 | [**strip([chars])**](https://www.tutorialspoint.com/python/string_strip.htm)  Performs both lstrip() and rstrip() on string. |
| 35 | [**swapcase()**](https://www.tutorialspoint.com/python/string_swapcase.htm)  Inverts case for all letters in string. |
| 36 | [**title()**](https://www.tutorialspoint.com/python/string_title.htm)  Returns "titlecased" version of string, that is, all words begin with uppercase and the rest are lowercase. |
| 37 | [**translate(table, deletechars="")**](https://www.tutorialspoint.com/python/string_translate.htm)  Translates string according to translation table str(256 chars), removing those in the del string. |
| 38 | [**upper()**](https://www.tutorialspoint.com/python/string_upper.htm)  Converts lowercase letters in string to uppercase. |
| 39 | [**zfill (width)**](https://www.tutorialspoint.com/python/string_zfill.htm)  Returns original string leftpadded with zeros to a total of width characters; intended for numbers, zfill() retains any sign given (less one zero). |
| 40 | [**isdecimal()**](https://www.tutorialspoint.com/python/string_isdecimal.htm)  Returns true if a unicode string contains only decimal characters and false otherwise. |

## **Python Lists**

The list is a most versatile datatype available in Python which can be written as a list of comma-separated values (items) between square brackets. Important thing about a list is that items in a list need not be of the same type.

Creating a list is as simple as putting different comma-separated values between square brackets. For example −

list1 = ['physics', 'chemistry', 1997, 2000];

list2 = [1, 2, 3, 4, 5 ];

list3 = ["a", "b", "c", "d"]

Similar to string indices, list indices start at 0, and lists can be sliced, concatenated and so on.

## **Accessing Values in Lists**

To access values in lists, use the square brackets for slicing along with the index or indices to obtain value available at that index. For example −

#!/usr/bin/python

list1 = ['physics', 'chemistry', 1997, 2000];

list2 = [1, 2, 3, 4, 5, 6, 7 ];

print "list1[0]: ", list1[0]

print "list2[1:5]: ", list2[1:5]

When the above code is executed, it produces the following result −

list1[0]: physics

list2[1:5]: [2, 3, 4, 5]

## **Updating Lists**

You can update single or multiple elements of lists by giving the slice on the left-hand side of the assignment operator, and you can add to elements in a list with the append() method. For example −

#!/usr/bin/python

list = ['physics', 'chemistry', 1997, 2000];

print "Value available at index 2 : "

print list[2]

list[2] = 2001;

print "New value available at index 2 : "

print list[2]

**Note** − append() method is discussed in subsequent section.

When the above code is executed, it produces the following result −

Value available at index 2 :

1997

New value available at index 2 :

2001

## **Delete List Elements**

To remove a list element, you can use either the del statement if you know exactly which element(s) you are deleting or the remove() method if you do not know. For example −

#!/usr/bin/python

list1 = ['physics', 'chemistry', 1997, 2000];

print list1

del list1[2];

print "After deleting value at index 2 : "

print list1

When the above code is executed, it produces following result −

['physics', 'chemistry', 1997, 2000]

After deleting value at index 2 :

['physics', 'chemistry', 2000]

**Note** − remove() method is discussed in subsequent section.

Basic List Operations

Lists respond to the + and \* operators much like strings; they mean concatenation and repetition here too, except that the result is a new list, not a string.

In fact, lists respond to all of the general sequence operations we used on strings in the prior chapter.

|  |  |  |
| --- | --- | --- |
| **Python Expression** | **Results** | **Description** |
| len([1, 2, 3]) | 3 | Length |
| [1, 2, 3] + [4, 5, 6] | [1, 2, 3, 4, 5, 6] | Concatenation |
| ['Hi!'] \* 4 | ['Hi!', 'Hi!', 'Hi!', 'Hi!'] | Repetition |
| 3 in [1, 2, 3] | True | Membership |
| for x in [1, 2, 3]: print x, | 1 2 3 | Iteration |

## **Indexing, Slicing, and Matrixes**

Because lists are sequences, indexing and slicing work the same way for lists as they do for strings.

Assuming following input −

L = ['spam', 'Spam', 'SPAM!']

|  |  |  |
| --- | --- | --- |
| **Python Expression** | **Results** | **Description** |
| L[2] | SPAM! | Offsets start at zero |
| L[-2] | Spam | Negative: count from the right |
| L[1:] | ['Spam', 'SPAM!'] | Slicing fetches sections |

## **Built-in List Functions & Methods**

Python includes the following list functions −

|  |  |
| --- | --- |
| **Sr.No.** | **Function with Description** |
| 1 | [**cmp(list1, list2)**](https://www.tutorialspoint.com/python/list_cmp.htm)  Compares elements of both lists. |
| 2 | [**len(list)**](https://www.tutorialspoint.com/python/list_len.htm)  Gives the total length of the list. |
| 3 | [**max(list)**](https://www.tutorialspoint.com/python/list_max.htm)  Returns item from the list with max value. |
| 4 | [**min(list)**](https://www.tutorialspoint.com/python/list_min.htm)  Returns item from the list with min value. |
| 5 | [**list(seq)**](https://www.tutorialspoint.com/python/list_list.htm)  Converts a tuple into list. |

Python includes following list methods

|  |  |
| --- | --- |
| **Sr.No.** | **Methods with Description** |
| 1 | [**list.append(obj)**](https://www.tutorialspoint.com/python/list_append.htm)  Appends object obj to list |
| 2 | [**list.count(obj)**](https://www.tutorialspoint.com/python/list_count.htm)  Returns count of how many times obj occurs in list |
| 3 | [**list.extend(seq)**](https://www.tutorialspoint.com/python/list_extend.htm)  Appends the contents of seq to list |
| 4 | [**list.index(obj)**](https://www.tutorialspoint.com/python/list_index.htm)  Returns the lowest index in list that obj appears |
| 5 | [**list.insert(index, obj)**](https://www.tutorialspoint.com/python/list_insert.htm)  Inserts object obj into list at offset index |
| 6 | [**list.pop(obj=list[-1])**](https://www.tutorialspoint.com/python/list_pop.htm)  Removes and returns last object or obj from list |
| 7 | [**list.remove(obj)**](https://www.tutorialspoint.com/python/list_remove.htm)  Removes object obj from list |
| 8 | [**list.reverse()**](https://www.tutorialspoint.com/python/list_reverse.htm)  Reverses objects of list in place |
| 9 | [**list.sort([func])**](https://www.tutorialspoint.com/python/list_sort.htm)  Sorts objects of list, use compare func if given |

# Python - Tuples

A tuple is a sequence of immutable Python objects. Tuples are sequences, just like lists. The differences between tuples and lists are, the tuples cannot be changed unlike lists and tuples use parentheses, whereas lists use square brackets.

Creating a tuple is as simple as putting different comma-separated values. Optionally you can put these comma-separated values between parentheses also. For example −

tup1 = ('physics', 'chemistry', 1997, 2000);

tup2 = (1, 2, 3, 4, 5 );

tup3 = "a", "b", "c", "d";

The empty tuple is written as two parentheses containing nothing −

tup1 = ();

To write a tuple containing a single value you have to include a comma, even though there is only one value −

tup1 = (50,);

Like string indices, tuple indices start at 0, and they can be sliced, concatenated, and so on.

## **Accessing Values in Tuples**

To access values in tuple, use the square brackets for slicing along with the index or indices to obtain value available at that index. For example −

#!/usr/bin/python

tup1 = ('physics', 'chemistry', 1997, 2000);

tup2 = (1, 2, 3, 4, 5, 6, 7 );

print "tup1[0]: ", tup1[0];

print "tup2[1:5]: ", tup2[1:5];

When the above code is executed, it produces the following result −

tup1[0]: physics

tup2[1:5]: [2, 3, 4, 5]

## **Updating Tuples**

Tuples are immutable which means you cannot update or change the values of tuple elements. You are able to take portions of existing tuples to create new tuples as the following example demonstrates −

#!/usr/bin/python

tup1 = (12, 34.56);

tup2 = ('abc', 'xyz');

# Following action is not valid for tuples

# tup1[0] = 100;

# So let's create a new tuple as follows

tup3 = tup1 + tup2;

print tup3;

When the above code is executed, it produces the following result −

(12, 34.56, 'abc', 'xyz')

## **Delete Tuple Elements**

Removing individual tuple elements is not possible. There is, of course, nothing wrong with putting together another tuple with the undesired elements discarded.

To explicitly remove an entire tuple, just use the **del** statement. For example −

#!/usr/bin/python

tup = ('physics', 'chemistry', 1997, 2000);

print tup;

del tup;

print "After deleting tup : ";

print tup;

This produces the following result. Note an exception raised, this is because after **del tup** tuple does not exist any more −

('physics', 'chemistry', 1997, 2000)

After deleting tup :

Traceback (most recent call last):

File "test.py", line 9, in <module>

print tup;

NameError: name 'tup' is not defined

## **Basic Tuples Operations**

Tuples respond to the + and \* operators much like strings; they mean concatenation and repetition here too, except that the result is a new tuple, not a string.

In fact, tuples respond to all of the general sequence operations we used on strings in the prior chapter −

|  |  |  |
| --- | --- | --- |
| **Python Expression** | **Results** | **Description** |
| len((1, 2, 3)) | 3 | Length |
| (1, 2, 3) + (4, 5, 6) | (1, 2, 3, 4, 5, 6) | Concatenation |
| ('Hi!',) \* 4 | ('Hi!', 'Hi!', 'Hi!', 'Hi!') | Repetition |
| 3 in (1, 2, 3) | True | Membership |
| for x in (1, 2, 3): print x, | 1 2 3 | Iteration |

## **Indexing, Slicing, and Matrixes**

Because tuples are sequences, indexing and slicing work the same way for tuples as they do for strings. Assuming following input −

L = ('spam', 'Spam', 'SPAM!')

|  |  |  |
| --- | --- | --- |
| **Python Expression** | **Results** | **Description** |
| L[2] | 'SPAM!' | Offsets start at zero |
| L[-2] | 'Spam' | Negative: count from the right |
| L[1:] | ['Spam', 'SPAM!'] | Slicing fetches sections |

## **No Enclosing Delimiters**

Any set of multiple objects, comma-separated, written without identifying symbols, i.e., brackets for lists, parentheses for tuples, etc., default to tuples, as indicated in these short examples −

#!/usr/bin/python

print 'abc', -4.24e93, 18+6.6j, 'xyz';

x, y = 1, 2;

print "Value of x , y : ", x,y;

When the above code is executed, it produces the following result −

abc -4.24e+93 (18+6.6j) xyz

Value of x , y : 1 2

## **Built-in Tuple Functions**

Python includes the following tuple functions −

|  |  |
| --- | --- |
| **Sr.No.** | **Function with Description** |
| 1 | [**cmp(tuple1, tuple2)**](https://www.tutorialspoint.com/python/tuple_cmp.htm)  Compares elements of both tuples. |
| 2 | [**len(tuple)**](https://www.tutorialspoint.com/python/tuple_len.htm)  Gives the total length of the tuple. |
| 3 | [**max(tuple)**](https://www.tutorialspoint.com/python/tuple_max.htm)  Returns item from the tuple with max value. |
| 4 | [**min(tuple)**](https://www.tutorialspoint.com/python/tuple_min.htm)  Returns item from the tuple with min value. |
| 5 | [**tuple(seq)**](https://www.tutorialspoint.com/python/tuple_tuple.htm)  Converts a list into tuple. |

# Python - Dictionary

Each key is separated from its value by a colon (:), the items are separated by commas, and the whole thing is enclosed in curly braces. An empty dictionary without any items is written with just two curly braces, like this: {}.

Keys are unique within a dictionary while values may not be. The values of a dictionary can be of any type, but the keys must be of an immutable data type such as strings, numbers, or tuples.

## **Accessing Values in Dictionary**

To access dictionary elements, you can use the familiar square brackets along with the key to obtain its value. Following is a simple example −

#!/usr/bin/python

dict = {'Name': 'Zara', 'Age': 7, 'Class': 'First'}

print "dict['Name']: ", dict['Name']

print "dict['Age']: ", dict['Age']

When the above code is executed, it produces the following result −

dict['Name']: Zara

dict['Age']: 7

If we attempt to access a data item with a key, which is not part of the dictionary, we get an error as follows −

#!/usr/bin/python

dict = {'Name': 'Zara', 'Age': 7, 'Class': 'First'}

print "dict['Alice']: ", dict['Alice']

When the above code is executed, it produces the following result −

dict['Alice']:

Traceback (most recent call last):

File "test.py", line 4, in <module>

print "dict['Alice']: ", dict['Alice'];

KeyError: 'Alice'

## **Updating Dictionary**

You can update a dictionary by adding a new entry or a key-value pair, modifying an existing entry, or deleting an existing entry as shown below in the simple example −

#!/usr/bin/python

dict = {'Name': 'Zara', 'Age': 7, 'Class': 'First'}

dict['Age'] = 8; # update existing entry

dict['School'] = "DPS School"; # Add new entry

print "dict['Age']: ", dict['Age']

print "dict['School']: ", dict['School']

When the above code is executed, it produces the following result −

dict['Age']: 8

dict['School']: DPS School

## **Delete Dictionary Elements**

You can either remove individual dictionary elements or clear the entire contents of a dictionary. You can also delete entire dictionary in a single operation.

To explicitly remove an entire dictionary, just use the **del** statement. Following is a simple example −

#!/usr/bin/python

dict = {'Name': 'Zara', 'Age': 7, 'Class': 'First'}

del dict['Name']; # remove entry with key 'Name'

dict.clear(); # remove all entries in dict

del dict ; # delete entire dictionary

print "dict['Age']: ", dict['Age']

print "dict['School']: ", dict['School']

This produces the following result. Note that an exception is raised because after **del dict** dictionary does not exist any more −

dict['Age']:

Traceback (most recent call last):

File "test.py", line 8, in <module>

print "dict['Age']: ", dict['Age'];

TypeError: 'type' object is unsubscriptable

**Note** − del() method is discussed in subsequent section.

## **Properties of Dictionary Keys**

Dictionary values have no restrictions. They can be any arbitrary Python object, either standard objects or user-defined objects. However, same is not true for the keys.

There are two important points to remember about dictionary keys −

**(a)** More than one entry per key not allowed. Which means no duplicate key is allowed. When duplicate keys encountered during assignment, the last assignment wins. For example −

#!/usr/bin/python

dict = {'Name': 'Zara', 'Age': 7, 'Name': 'Manni'}

print "dict['Name']: ", dict['Name']

When the above code is executed, it produces the following result −

dict['Name']: Manni

**(b)** Keys must be immutable. Which means you can use strings, numbers or tuples as dictionary keys but something like ['key'] is not allowed. Following is a simple example −

#!/usr/bin/python

dict = {['Name']: 'Zara', 'Age': 7}

print "dict['Name']: ", dict['Name']

When the above code is executed, it produces the following result −

Traceback (most recent call last):

File "test.py", line 3, in <module>

dict = {['Name']: 'Zara', 'Age': 7};

TypeError: unhashable type: 'list'

## **Built-in Dictionary Functions & Methods**

Python includes the following dictionary functions −

|  |  |
| --- | --- |
| **Sr.No.** | **Function with Description** |
| 1 | [**cmp(dict1, dict2)**](https://www.tutorialspoint.com/python/dictionary_cmp.htm)  Compares elements of both dict. |
| 2 | [**len(dict)**](https://www.tutorialspoint.com/python/dictionary_len.htm)  Gives the total length of the dictionary. This would be equal to the number of items in the dictionary. |
| 3 | [**str(dict)**](https://www.tutorialspoint.com/python/dictionary_str.htm)  Produces a printable string representation of a dictionary |
| 4 | [**type(variable)**](https://www.tutorialspoint.com/python/dictionary_type.htm)  Returns the type of the passed variable. If passed variable is dictionary, then it would return a dictionary type. |

Python includes following dictionary methods −

|  |  |
| --- | --- |
| **Sr.No.** | **Methods with Description** |
| 1 | [**dict.clear()**](https://www.tutorialspoint.com/python/dictionary_clear.htm)  Removes all elements of dictionary *dict* |
| 2 | [**dict.copy()**](https://www.tutorialspoint.com/python/dictionary_copy.htm)  Returns a shallow copy of dictionary *dict* |
| 3 | [**dict.fromkeys()**](https://www.tutorialspoint.com/python/dictionary_fromkeys.htm)  Create a new dictionary with keys from seq and values *set* to *value*. |
| 4 | [**dict.get(key, default=None)**](https://www.tutorialspoint.com/python/dictionary_get.htm)  For *key* key, returns value or default if key not in dictionary |
| 5 | [**dict.has\_key(key)**](https://www.tutorialspoint.com/python/dictionary_has_key.htm)  Returns *true* if key in dictionary *dict*, *false* otherwise |
| 6 | [**dict.items()**](https://www.tutorialspoint.com/python/dictionary_items.htm)  Returns a list of *dict*'s (key, value) tuple pairs |
| 7 | [**dict.keys()**](https://www.tutorialspoint.com/python/dictionary_keys.htm)  Returns list of dictionary dict's keys |
| 8 | [**dict.setdefault(key, default=None)**](https://www.tutorialspoint.com/python/dictionary_setdefault.htm)  Similar to get(), but will set dict[key]=default if *key* is not already in dict |
| 9 | [**dict.update(dict2)**](https://www.tutorialspoint.com/python/dictionary_update.htm)  Adds dictionary *dict2*'s key-values pairs to *dict* |
| 10 | [**dict.values()**](https://www.tutorialspoint.com/python/dictionary_values.htm)  Returns list of dictionary *dict*'s values |

# Python - Date & Time

A Python program can handle date and time in several ways. Converting between date formats is a common chore for computers. Python's time and calendar modules help track dates and times.

## **What is Tick?**

Time intervals are floating-point numbers in units of seconds. Particular instants in time are expressed in seconds since 12:00am, January 1, 1970(epoch).

There is a popular **time** module available in Python which provides functions for working with times, and for converting between representations. The function *time.time()* returns the current system time in ticks since 12:00am, January 1, 1970(epoch).

## **Example**

#!/usr/bin/python

import time; # This is required to include time module.

ticks = time.time()

print "Number of ticks since 12:00am, January 1, 1970:", ticks

This would produce a result something as follows −

Number of ticks since 12:00am, January 1, 1970: 7186862.73399

Date arithmetic is easy to do with ticks. However, dates before the epoch cannot be represented in this form. Dates in the far future also cannot be represented this way - the cutoff point is sometime in 2038 for UNIX and Windows.

## **What is TimeTuple?**

Many of Python's time functions handle time as a tuple of 9 numbers, as shown below −

|  |  |  |
| --- | --- | --- |
| **Index** | **Field** | **Values** |
| 0 | 4-digit year | 2008 |
| 1 | Month | 1 to 12 |
| 2 | Day | 1 to 31 |
| 3 | Hour | 0 to 23 |
| 4 | Minute | 0 to 59 |
| 5 | Second | 0 to 61 (60 or 61 are leap-seconds) |
| 6 | Day of Week | 0 to 6 (0 is Monday) |
| 7 | Day of year | 1 to 366 (Julian day) |
| 8 | Daylight savings | -1, 0, 1, -1 means library determines DST |

The above tuple is equivalent to **struct\_time** structure. This structure has following attributes −

|  |  |  |
| --- | --- | --- |
| **Index** | **Attributes** | **Values** |
| 0 | tm\_year | 2008 |
| 1 | tm\_mon | 1 to 12 |
| 2 | tm\_mday | 1 to 31 |
| 3 | tm\_hour | 0 to 23 |
| 4 | tm\_min | 0 to 59 |
| 5 | tm\_sec | 0 to 61 (60 or 61 are leap-seconds) |
| 6 | tm\_wday | 0 to 6 (0 is Monday) |
| 7 | tm\_yday | 1 to 366 (Julian day) |
| 8 | tm\_isdst | -1, 0, 1, -1 means library determines DST |

## **Getting current time**

To translate a time instant from a *seconds since the epoch* floating-point value into a time-tuple, pass the floating-point value to a function (e.g., localtime) that returns a time-tuple with all nine items valid.

#!/usr/bin/python

import time;

localtime = time.localtime(time.time())

print "Local current time :", localtime

This would produce the following result, which could be formatted in any other presentable form −

Local current time : time.struct\_time(tm\_year=2013, tm\_mon=7,

tm\_mday=17, tm\_hour=21, tm\_min=26, tm\_sec=3, tm\_wday=2, tm\_yday=198, tm\_isdst=0)

## **Getting formatted time**

You can format any time as per your requirement, but simple method to get time in readable format is asctime() −

#!/usr/bin/python

import time;

localtime = time.asctime( time.localtime(time.time()) )

print "Local current time :", localtime

This would produce the following result −

Local current time : Tue Jan 13 10:17:09 2009

## **Getting calendar for a month**

The calendar module gives a wide range of methods to play with yearly and monthly calendars. Here, we print a calendar for a given month ( Jan 2008 ) −

#!/usr/bin/python

import calendar

cal = calendar.month(2008, 1)

print "Here is the calendar:"

print cal

This would produce the following result −

Here is the calendar:

January 2008

Mo Tu We Th Fr Sa Su

1 2 3 4 5 6

7 8 9 10 11 12 13

14 15 16 17 18 19 20

21 22 23 24 25 26 27

28 29 30 31

## **The *time* Module**

There is a popular **time** module available in Python which provides functions for working with times and for converting between representations. Here is the list of all available methods −

|  |  |
| --- | --- |
| **Sr.No.** | **Function with Description** |
| 1 | [**time.altzone**](https://www.tutorialspoint.com/python/time_altzone.htm)  The offset of the local DST timezone, in seconds west of UTC, if one is defined. This is negative if the local DST timezone is east of UTC (as in Western Europe, including the UK). Only use this if daylight is nonzero. |
| 2 | [**time.asctime([tupletime])**](https://www.tutorialspoint.com/python/time_asctime.htm)  Accepts a time-tuple and returns a readable 24-character string such as 'Tue Dec 11 18:07:14 2008'. |
| 3 | [**time.clock( )**](https://www.tutorialspoint.com/python/time_clock.htm)  Returns the current CPU time as a floating-point number of seconds. To measure computational costs of different approaches, the value of time.clock is more useful than that of time.time(). |
| 4 | [**time.ctime([secs])**](https://www.tutorialspoint.com/python/time_ctime.htm)  Like asctime(localtime(secs)) and without arguments is like asctime( ) |
| 5 | [**time.gmtime([secs])**](https://www.tutorialspoint.com/python/time_gmtime.htm)  Accepts an instant expressed in seconds since the epoch and returns a time-tuple t with the UTC time. Note : t.tm\_isdst is always 0 |
| 6 | [**time.localtime([secs])**](https://www.tutorialspoint.com/python/time_localtime.htm)  Accepts an instant expressed in seconds since the epoch and returns a time-tuple t with the local time (t.tm\_isdst is 0 or 1, depending on whether DST applies to instant secs by local rules). |
| 7 | [**time.mktime(tupletime)**](https://www.tutorialspoint.com/python/time_mktime.htm)  Accepts an instant expressed as a time-tuple in local time and returns a floating-point value with the instant expressed in seconds since the epoch. |
| 8 | [**time.sleep(secs)**](https://www.tutorialspoint.com/python/time_sleep.htm)  Suspends the calling thread for secs seconds. |
| 9 | [**time.strftime(fmt[,tupletime])**](https://www.tutorialspoint.com/python/time_strftime.htm)  Accepts an instant expressed as a time-tuple in local time and returns a string representing the instant as specified by string fmt. |
| 10 | [**time.strptime(str,fmt='%a %b %d %H:%M:%S %Y')**](https://www.tutorialspoint.com/python/time_strptime.htm)  Parses str according to format string fmt and returns the instant in time-tuple format. |
| 11 | [**time.time( )**](https://www.tutorialspoint.com/python/time_time.htm)  Returns the current time instant, a floating-point number of seconds since the epoch. |
| 12 | [**time.tzset()**](https://www.tutorialspoint.com/python/time_tzset.htm)  Resets the time conversion rules used by the library routines. The environment variable TZ specifies how this is done. |

Let us go through the functions briefly −

There are following two important attributes available with time module −

|  |  |
| --- | --- |
| **Sr.No.** | **Attribute with Description** |
| 1 | **time.timezone**  Attribute time.timezone is the offset in seconds of the local time zone (without DST) from UTC (>0 in the Americas; <=0 in most of Europe, Asia, Africa). |
| 2 | **time.tzname**  Attribute time.tzname is a pair of locale-dependent strings, which are the names of the local time zone without and with DST, respectively. |

## **The *calendar* Module**

The calendar module supplies calendar-related functions, including functions to print a text calendar for a given month or year.

By default, calendar takes Monday as the first day of the week and Sunday as the last one. To change this, call calendar.setfirstweekday() function.

Here is a list of functions available with the *calendar* module −

|  |  |
| --- | --- |
| **Sr.No.** | **Function with Description** |
| 1 | **calendar.calendar(year,w=2,l=1,c=6)**  Returns a multiline string with a calendar for year year formatted into three columns separated by c spaces. w is the width in characters of each date; each line has length 21\*w+18+2\*c. l is the number of lines for each week. |
| 2 | **calendar.firstweekday( )**  Returns the current setting for the weekday that starts each week. By default, when calendar is first imported, this is 0, meaning Monday. |
| 3 | **calendar.isleap(year)**  Returns True if year is a leap year; otherwise, False. |
| 4 | **calendar.leapdays(y1,y2)**  Returns the total number of leap days in the years within range(y1,y2). |
| 5 | **calendar.month(year,month,w=2,l=1)**  Returns a multiline string with a calendar for month month of year year, one line per week plus two header lines. w is the width in characters of each date; each line has length 7\*w+6. l is the number of lines for each week. |
| 6 | **calendar.monthcalendar(year,month)**  Returns a list of lists of ints. Each sublist denotes a week. Days outside month month of year year are set to 0; days within the month are set to their day-of-month, 1 and up. |
| 7 | **calendar.monthrange(year,month)**  Returns two integers. The first one is the code of the weekday for the first day of the month month in year year; the second one is the number of days in the month. Weekday codes are 0 (Monday) to 6 (Sunday); month numbers are 1 to 12. |
| 8 | **calendar.prcal(year,w=2,l=1,c=6)**  Like print calendar.calendar(year,w,l,c). |
| 9 | **calendar.prmonth(year,month,w=2,l=1)**  Like print calendar.month(year,month,w,l). |
| 10 | **calendar.setfirstweekday(weekday)**  Sets the first day of each week to weekday code weekday. Weekday codes are 0 (Monday) to 6 (Sunday). |
| 11 | **calendar.timegm(tupletime)**  The inverse of time.gmtime: accepts a time instant in time-tuple form and returns the same instant as a floating-point number of seconds since the epoch. |
| 12 | **calendar.weekday(year,month,day)**  Returns the weekday code for the given date. Weekday codes are 0 (Monday) to 6 (Sunday); month numbers are 1 (January) to 12 (December). |

## **Other Modules & Functions**

If you are interested, then here you would find a list of other important modules and functions to play with date & time in Python −

* [The *datetime* Module](http://docs.python.org/library/datetime.html#module-datetime)
* [The *pytz*Module](http://www.twinsun.com/tz/tz-link.htm)
* [The *dateutil* Module](http://labix.org/python-dateutil)

# Python - Functions

A function is a block of organized, reusable code that is used to perform a single, related action. Functions provide better modularity for your application and a high degree of code reusing.

As you already know, Python gives you many built-in functions like print(), etc. but you can also create your own functions. These functions are called *user-defined functions.*

## **Defining a Function**

You can define functions to provide the required functionality. Here are simple rules to define a function in Python.

* Function blocks begin with the keyword **def** followed by the function name and parentheses ( ( ) ).
* Any input parameters or arguments should be placed within these parentheses. You can also define parameters inside these parentheses.
* The first statement of a function can be an optional statement - the documentation string of the function or *docstring*.
* The code block within every function starts with a colon (:) and is indented.
* The statement return [expression] exits a function, optionally passing back an expression to the caller. A return statement with no arguments is the same as return None.

## **Syntax**

def functionname( parameters ):

"function\_docstring"

function\_suite

return [expression]

By default, parameters have a positional behavior and you need to inform them in the same order that they were defined.

## **Example**

The following function takes a string as input parameter and prints it on standard screen.

def printme( str ):

"This prints a passed string into this function"

print str

return

## **Calling a Function**

Defining a function only gives it a name, specifies the parameters that are to be included in the function and structures the blocks of code.

Once the basic structure of a function is finalized, you can execute it by calling it from another function or directly from the Python prompt. Following is the example to call printme() function −

#!/usr/bin/python

# Function definition is here

def printme( str ):

"This prints a passed string into this function"

print str

return;

# Now you can call printme function

printme("I'm first call to user defined function!")

printme("Again second call to the same function")

When the above code is executed, it produces the following result −

I'm first call to user defined function!

Again second call to the same function

## **Pass by reference vs value**

All parameters (arguments) in the Python language are passed by reference. It means if you change what a parameter refers to within a function, the change also reflects back in the calling function. For example −

#!/usr/bin/python

# Function definition is here

def changeme( mylist ):

"This changes a passed list into this function"

mylist.append([1,2,3,4]);

print "Values inside the function: ", mylist

return

# Now you can call changeme function

mylist = [10,20,30];

changeme( mylist );

print "Values outside the function: ", mylist

Here, we are maintaining reference of the passed object and appending values in the same object. So, this would produce the following result −

Values inside the function: [10, 20, 30, [1, 2, 3, 4]]

Values outside the function: [10, 20, 30, [1, 2, 3, 4]]

There is one more example where argument is being passed by reference and the reference is being overwritten inside the called function.

#!/usr/bin/python

# Function definition is here

def changeme( mylist ):

"This changes a passed list into this function"

mylist = [1,2,3,4]; # This would assig new reference in mylist

print "Values inside the function: ", mylist

return

# Now you can call changeme function

mylist = [10,20,30];

changeme( mylist );

print "Values outside the function: ", mylist

The parameter *mylist* is local to the function changeme. Changing mylist within the function does not affect *mylist*. The function accomplishes nothing and finally this would produce the following result −

Values inside the function: [1, 2, 3, 4]

Values outside the function: [10, 20, 30]

## **Function Arguments**

You can call a function by using the following types of formal arguments −

* Required arguments
* Keyword arguments
* Default arguments
* Variable-length arguments

## **Required arguments**

Required arguments are the arguments passed to a function in correct positional order. Here, the number of arguments in the function call should match exactly with the function definition.

To call the function *printme()*, you definitely need to pass one argument, otherwise it gives a syntax error as follows −

#!/usr/bin/python

# Function definition is here

def printme( str ):

"This prints a passed string into this function"

print str

return;

# Now you can call printme function

printme()

When the above code is executed, it produces the following result −

Traceback (most recent call last):

File "test.py", line 11, in <module>

printme();

TypeError: printme() takes exactly 1 argument (0 given)

## **Keyword arguments**

Keyword arguments are related to the function calls. When you use keyword arguments in a function call, the caller identifies the arguments by the parameter name.

This allows you to skip arguments or place them out of order because the Python interpreter is able to use the keywords provided to match the values with parameters. You can also make keyword calls to the *printme()* function in the following ways −

#!/usr/bin/python

# Function definition is here

def printme( str ):

"This prints a passed string into this function"

print str

return;

# Now you can call printme function

printme( str = "My string")

When the above code is executed, it produces the following result −

My string

The following example gives more clear picture. Note that the order of parameters does not matter.

#!/usr/bin/python

# Function definition is here

def printinfo( name, age ):

"This prints a passed info into this function"

print "Name: ", name

print "Age ", age

return;

# Now you can call printinfo function

printinfo( age=50, name="miki" )

When the above code is executed, it produces the following result −

Name: miki

Age 50

## **Default arguments**

A default argument is an argument that assumes a default value if a value is not provided in the function call for that argument. The following example gives an idea on default arguments, it prints default age if it is not passed −

#!/usr/bin/python

# Function definition is here

def printinfo( name, age = 35 ):

"This prints a passed info into this function"

print "Name: ", name

print "Age ", age

return;

# Now you can call printinfo function

printinfo( age=50, name="miki" )

printinfo( name="miki" )

When the above code is executed, it produces the following result −

Name: miki

Age 50

Name: miki

Age 35

## **Variable-length arguments**

You may need to process a function for more arguments than you specified while defining the function. These arguments are called *variable-length*arguments and are not named in the function definition, unlike required and default arguments.

Syntax for a function with non-keyword variable arguments is this −

def functionname([formal\_args,] \*var\_args\_tuple ):

"function\_docstring"

function\_suite

return [expression]

An asterisk (\*) is placed before the variable name that holds the values of all nonkeyword variable arguments. This tuple remains empty if no additional arguments are specified during the function call. Following is a simple example −

#!/usr/bin/python

# Function definition is here

def printinfo( arg1, \*vartuple ):

"This prints a variable passed arguments"

print "Output is: "

print arg1

for var in vartuple:

print var

return;

# Now you can call printinfo function

printinfo( 10 )

printinfo( 70, 60, 50 )

When the above code is executed, it produces the following result −

Output is:

10

Output is:

70

60

50

## **The *Anonymous* Functions**

These functions are called anonymous because they are not declared in the standard manner by using the *def* keyword. You can use the *lambda* keyword to create small anonymous functions.

* Lambda forms can take any number of arguments but return just one value in the form of an expression. They cannot contain commands or multiple expressions.
* An anonymous function cannot be a direct call to print because lambda requires an expression
* Lambda functions have their own local namespace and cannot access variables other than those in their parameter list and those in the global namespace.
* Although it appears that lambda's are a one-line version of a function, they are not equivalent to inline statements in C or C++, whose purpose is by passing function stack allocation during invocation for performance reasons.

## **Syntax**

The syntax of *lambda* functions contains only a single statement, which is as follows −

lambda [arg1 [,arg2,.....argn]]:expression

Following is the example to show how *lambda* form of function works −

#!/usr/bin/python

# Function definition is here

sum = lambda arg1, arg2: arg1 + arg2;

# Now you can call sum as a function

print "Value of total : ", sum( 10, 20 )

print "Value of total : ", sum( 20, 20 )

When the above code is executed, it produces the following result −

Value of total : 30

Value of total : 40

## **The *return* Statement**

The statement return [expression] exits a function, optionally passing back an expression to the caller. A return statement with no arguments is the same as return None.

All the above examples are not returning any value. You can return a value from a function as follows −

#!/usr/bin/python

# Function definition is here

def sum( arg1, arg2 ):

# Add both the parameters and return them."

total = arg1 + arg2

print "Inside the function : ", total

return total;

# Now you can call sum function

total = sum( 10, 20 );

print "Outside the function : ", total

When the above code is executed, it produces the following result −

Inside the function : 30

Outside the function : 30

## **Scope of Variables**

All variables in a program may not be accessible at all locations in that program. This depends on where you have declared a variable.

The scope of a variable determines the portion of the program where you can access a particular identifier. There are two basic scopes of variables in Python −

* Global variables
* Local variables

## **Global vs. Local variables**

Variables that are defined inside a function body have a local scope, and those defined outside have a global scope.

This means that local variables can be accessed only inside the function in which they are declared, whereas global variables can be accessed throughout the program body by all functions. When you call a function, the variables declared inside it are brought into scope. Following is a simple example −

#!/usr/bin/python

total = 0; # This is global variable.

# Function definition is here

def sum( arg1, arg2 ):

# Add both the parameters and return them."

total = arg1 + arg2; # Here total is local variable.

print "Inside the function local total : ", total

return total;

# Now you can call sum function

sum( 10, 20 );

print "Outside the function global total : ", total

When the above code is executed, it produces the following result −

Inside the function local total : 30

Outside the function global total : 0