Python Cheat sheet by Avinash Prajapati

1.print("Hello, World!")

2. #(Hash) is used to comment single lines.

3. """ Multi lines """ -> Used for multi lines comment .

VARIABLES IN PYTHON

4. the + character is used to add a variable to another variable:

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

5. For numbers, the + character behave as a mathematical operator:

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

6. combining a string and a number With + character leads an error:

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

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

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

7. Variables that are created outside of a function (as in all of the examples above) are known as ***global variables*** **.** And Variables that are declared inside the function called ***Local variable***.

```
x = "Avi"

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

myfunc()

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

8.Types of variables in python.

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`

9. you can get the type of variable also. i.e:

```
y = 5
print(type(y))
```

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

Type casting

```
x = 1 # int

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

print(c)   #output | 1+0j

print(type(c))
```

10. ## Random Number

Python does not have a `random()` function to make a random number, but it has a built-in module called `random` which can make random numbers:

Example:

Import random module, and display a random number between 1 and 9:

```
import random
print(random.randrange(1,10))
```

11. String in Python

A. In python both `'hello'` is the same as `"hello"`.

B. Multiline Strings : You can assign a multiline string to a variable by using three quotes:

```
a = """ashk kkj kjhlk lkjl lkjl l
    kljlk kjlk lkjl kljhkjhl kjh lkj
    kljhk kj kjh """    # i know any word has no sense,don't bother keep learning
print(a)  # you can also use three quotes '''  '''
```

C. 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.

```
a = "HelloWorld!"
print(a[1])
```

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

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

Negative Indexing

Get the characters from position 5(not include) to position 1, starting the count from the end of the string:

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

len() function returns the length of a string:

```
a = "HelloWorld!"
print(len(a))
```

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

```
a = " HelloWorld! "
print(a.strip()) # output | HelloWorld!
```

lower() method returns the string in lower case:

```
a = "HelloWorld!"
print(a.lower())
```

upper() method returns the string in lower case:

```
a = "HelloWorld!"
print(a.upper())
```

replace() method replaces a string with another string:

```
a = "HelloWorld!"
print(a.replace("l", "J")) # Output | HeJJoWorJd!
```

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

```
a = "HelloWorld!"
print(a.split("o")) # output | ['Hell', 'W', 'rld!']
```

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

```
txt = "The raining"
x = "ain" in txt
y = "mn" in txt
print(x) #output | true
print(y) #output | false
```

The escape character

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

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

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

Python Booleans

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

A. Any string is `True`. Any number is `True`. Any list, tuple, set, and dictionary are `True`, except empty ones, except empty values, such as `()`, `[]`, `{}`, `""`, the number `0`, and the value `None`. And of course the value `False` evaluates to `False`.

Following will return False:

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

Python also has many built-in functions that returns a boolean value, like the `isinstance()` function, which can be used to determine if an object is of a certain data type:

Example :

Check if an object is an integer or not:

```
x = 200
print(isinstance(x, int))  #output | true
```

Python Operators

Operators are used to perform operations on variables and values.

Python divides the operators in the following groups:

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

Arithmetic operators

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

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

Python Assignment Operators

Assignment operators are used to assign values to variables:

Operator	Example	Same As
=	x = 5	x = 5

+=	x += 3	x = x + 3
-=	x -= 3	x = x - 3
*=	x *= 3	x = x * 3
/=	x /= 3	x = x / 3
%=	x %= 3	x = x % 3
//=	x //= 3	x = x // 3
**=	x **= 3	x = x ** 3
&=	x &= 3	x = x & 3
|=	x |= 3	x = x | 3
^=	x ^= 3	x = x ^ 3
>>=	x >>= 3	x = x >> 3
<<=	x <<= 3	x = x << 3

<u>Python Comparison Operators</u>

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

<u>Python Logical Operators</u>

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)

<u>Python Identity Operators</u>

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

<u>Python Membership Operators</u>

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

<u>Python Bitwise Operators</u>

Bitwise operators are used to compare (binary) numbers:

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

Python List

Example :

```
List_one = ["apple", "banana", "cherry"]
Printing the list :
```

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

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

Check if "apple" is present in the list:

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

List Length

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

Example

Print the number of items in the list:

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

Add Items

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

Example

Using the `append()` method to append an item:

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

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

Example

Insert an item as the second position:

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

Remove Item

There are several methods to remove items from a list:

Example

The `remove()` method removes the specified item:

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

Example

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

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

Example

The `del` keyword removes the specified index:

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

Example

The `del` keyword can also delete the list completely:

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

Example

The `clear()` method empties the list:

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

Copy a List

You cannot copy a list simply by typing `list2 = list1`, because: `list2` will only be a *reference* to `list1`, and changes made in `list1` will automatically also be made in `list2`.

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

```
thislist = ["apple", "banana", "cherry"]
mylist = thislist.copy()
print(mylist)
```

Another way :

B. Make a copy of a list with the `list()` method:

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

Join Two Lists

There are several ways to join, or concatenate, two or more lists in Python.

A. One of the easiest ways are by using the `+` operator.

```
list1 = ["a", "b" , "c"]
list2 = [1, 2, 3]

list3 = list1 + list2
print(list3)
```

B. Another way to join two lists are by appending all the items from list2 into list1, one by one:

```
list1 = ["a", "b" , "c"]
list2 = [1, 2, 3]

for x in list2:
  list1.append(x)

print(list1)
```

C. you can use the `extend()` method : Use the `extend()` method to add list2 at the end of list1:

```
list1 = ["a", "b" , "c"]
list2 = [1, 2, 3]

list1.extend(list2)
print(list1)
```

The list() Constructor

It is also possible to use the `list()` constructor to make a new list.

```
thislist = list(("apple", "banana", "cherry")) # note the double round-brackets
print(thislist)
```

Method	Description
append()	Adds an element at the end of the list

clear()	Removes all the elements from the list
copy()	Returns a copy of the list
count()	Returns the number of elements with the specified value
extend()	Add the elements of a list (or any iterable), to the end of the current list
index()	Returns the index of the first element with the specified value
insert()	Adds an element at the specified position
pop()	Removes the element at the specified position
remove()	Removes the item with the specified value
reverse()	Reverses the order of the list
sort()	Sorts the list

Python Tuples

A tuple once created it can't be changed that is :

Example : thetuple = ("apple", "banana", "cherry")

1. You can't add a new tuple .
2. You can't update the item of tuple.
3. You can't remove the item of tuple.

➔ But you can delete the whole tuple :

➔ thetuple = ("apple", "banana", "cherry")

```
del thetuple
print(thetuple)
```

All the properties of list is same as for tuple except above mentioned things.

I am hoping that you can try…………..

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

```
#this is a tuple

thetuple = ("apple",)
print(type(thetuple))

#NOT a tuple
thetuple = ("apple")
print(type(thetuple))
```

Method	Description
count()	Returns the number of times a specified value occurs in a tuple

index()	Searches the tuple for a specified value and returns the position of where it was found

Python Sets

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

Creating a Set:

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

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

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

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

Loop through the set, and print the values:

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

Check if "banana" is present in the set:

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

Change Items

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

Add Items

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

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

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

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

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

Get the Length of a Set

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

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

Remove Item

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

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

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

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

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

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

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

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

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

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

The `clear()` method empties the set:

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

The `del` keyword will delete the set completely:

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

Join Two Sets

to join two or more sets in Python.

1. the `union()` method that returns a new set containing all items from both sets, or

2. the `update()` method that inserts all the items from one set into another:

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

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

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

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

Note: Both `union()` and `update()` will exclude any duplicate items

The set() Constructor

Using the set() constructor to make a set:

```
thisset = set(("apple", "banana", "cherry")) # note the double round-brackets
print(thisset)
```

Method	Description
add()	Adds an element to the set
clear()	Removes all the elements from the set
copy()	Returns a copy of the set
difference()	Returns a set containing the difference between two or more sets
difference_update()	Removes the items in this set that are also included in another, specified set
discard()	Remove the specified item
intersection()	Returns a set, that is the intersection of two other sets
intersection_update()	Removes the items in this set that are not present in other, specified set(s)

isdisjoint()	Returns whether two sets have a intersection or not
issubset()	Returns whether another set contains this set or not
issuperset()	Returns whether this set contains another set or not
pop()	Removes an element from the set
remove()	Removes the specified element
symmetric_difference()	Returns a set with the symmetric differences of two sets
symmetric_difference_update()	inserts the symmetric differences from this set and another
union()	Return a set containing the union of sets
update()	Update the set with the union of this set and others

Python Dictionaries

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

Create and print a dictionary:

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

Accessing Items

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

Get the value of the "model" key:

```
x = thisdict["model"]
```

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

Get the value of the "model" key:

```
x = thisdict.get("model")
```

Change Values

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

Change the "year" to 2018:

```
thisdict = {
  "brand": "Ford",
  "model": "Mustang",
  "year": 1964
}
thisdict["year"] = 201
```

Loop Through a Dictionary

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

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

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

```
thisdict = {
  "brand": "Ford",
  "model": "Mustang",
  "year": 1964
}

for x in thisdict:
  print(x)
```

Print all *values* in the dictionary, one by one:

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

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

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

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

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

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

Check if "model" is present in the dictionary:

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

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

```
print(len(thisdict))
```

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

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

There are several methods to remove items from a dictionary:

A. `pop()` method removes the item with the specified key name:

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

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

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

C. The `del` keyword removes the item with the specified key name:

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

D. The `del` keyword can also delete the dictionary completely:

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

E. The `clear()` method empties the dictionary:

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

Copy a Dictionary

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

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

A. Make a copy of a dictionary with the `copy()` method:

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

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

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

Nested Dictionaries

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

Create a dictionary that contain three dictionaries:

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

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

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

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

myfamily = {
  "child1" : child1,
  "child2" : child2,
  "child3" : child3
}
```

The dict() Constructor

It is also possible to use the `dict()` constructor to make a new dictionary:

```
thisdict = dict(brand="Ford", model="Mustang", year=1964)
# note that keywords are not string literals
# note the use of equals rather than colon for the assignment
print(thisdict)
```

Method	Description
clear()	Removes all the elements from the dictionary
copy()	Returns a copy of the dictionary
fromkeys()	Returns a dictionary with the specified keys and value
get()	Returns the value of the specified key
items()	Returns a list containing a tuple for each key value pair
keys()	Returns a list containing the dictionary's keys
pop()	Removes the element with the specified key
popitem()	Removes the last inserted key-value pair
setdefault()	Returns the value of the specified key. If the key does not exist: insert the key, with the specified value
update()	Updates the dictionary with the specified key-value pairs
values()	Returns a list of all the values in the dictionary

Python If …Elif… Else

Example

```
x = 41

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

The pass Statement

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

Example

```
a = 33
b = 200

if b > a:
  pass
```

Python While Loops

Example

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

Python For Loops

Example

Print each fruit in a fruit list:

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

Example

Loop through the letters in the word "banana":

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

The break Statement

Example

Exit the loop when x is "banana":

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

The continue Statement

Example

Do not print banana:

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

Example

Using the range() function:

```
for x in range(6):
  print(x)
```

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

Example

Using the start parameter:

```
for x in range(2, 6):
  print(x)
```

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

Example

Increment the sequence with 3 (default is 1):

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

Else in For Loop

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

Example

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

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

Nested Loops

A nested loop is a loop inside a loop.

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

Example

Print each adjective for every fruit:

```
adj = ["red", "big", "tasty"]
fruits = ["apple", "banana", "cherry"]

for x in adj:
  for y in fruits:
    print(x, y)
```

The pass Statement

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

Example

```
for x in [0, 1, 2]:
  pass
```

Python Functions

A function is a block of code which only runs when it is called.

You can pass data, known as parameters, into a function.

A function can return data as a result.

Creating a Function

In Python a function is defined using the `def` keyword:

Example

```
def my_function():
  print("Hello from a function")
```

Calling a Function

To call a function, use the function name followed by parenthesis:

Example

```
def my_function():
  print("Hello from a function")

my_function()
```

Arguments

Information can be passed into functions as arguments.

Arguments are specified after the function name, inside the parentheses. You can add as many arguments as you want, just separate them with a comma.

Example

```
def my_function(fname):
  print(fname + " Refsnes")

my_function("Emil")
my_function("Tobias")
my_function("Linus")
```

Arguments are often shortened to *args* in Python documentations.

Parameters or Arguments?

The terms *parameter* and *argument* can be used for the same thing: information that are passed into a function.

From a function's perspective:

A parameter is the variable listed inside the parentheses in the function definition.

An argument is the value that are sent to the function when it is called.

Number of Arguments

By default, a function must be called with the correct number of arguments. Meaning that if your function expects 2 arguments, you have to call the function with 2 arguments, not more, and not less.

Example

This function expects 2 arguments, and gets 2 arguments:

```
def my_function(fname, lname):
  print(fname + " " + lname)
my_function("Emil", "Refsnes")
```

If you try to call the function with 1 or 3 arguments, you will get an error:

Example

This function expects 2 arguments, but gets only 1:

```
def my_function(fname, lname):
  print(fname + " " + lname)
my_function("Emil")
```

Arbitrary Arguments, *args

If you do not know how many arguments that will be passed into your function, add a `*` before the parameter name in the function definition.

This way the function will receive a *tuple* of arguments, and can access the items accordingly:

Example

If the number of arguments is unknown, add a `*` before the parameter name:

```
def my_function(*kids):
  print("The youngest child is " + kids[2])
my_function("Emil", "Tobias", "Linus")
```

Arbitrary Arguments are often shortened to **args* in Python documentations.

Keyword Arguments

You can also send arguments with the *key* = *value* syntax.

This way the order of the arguments does not matter.

Example

```
def my_function(child3, child2, child1):
  print("The youngest child is " + child3)
my_function(child1 = "Emil", child2 = "Tobias", child3 = "Linus")
```

The phrase *Keyword Arguments* are often shortened to *kwargs* in Python documentations.

Arbitrary Keyword Arguments, **kwargs

If you do not know how many keyword arguments that will be passed into your function, add two asterisk: `**` before the parameter name in the function definition.

This way the function will receive a *dictionary* of arguments, and can access the items accordingly:

Example

If the number of keyword arguments is unknown, add a double `**` before the parameter name:

```
def my_function(**kid):
  print("His last name is " + kid["lname"])

my_function(fname = "Tobias", lname = "Refsnes")
```

Arbitrary Kword Arguments are often shortened to ***kwargs* in Python documentations.

Default Parameter Value

The following example shows how to use a default parameter value.

If we call the function without argument, it uses the default value:

Example

```
def my_function(country = "Norway"):
  print("I am from " + country)
my_function("Sweden")
my_function("India")
my_function()
my_function("Brazil")
```

Passing a List as an Argument

You can send any data types of argument to a function (string, number, list, dictionary etc.), and it will be treated as the same data type inside the function.

E.g. if you send a List as an argument, it will still be a List when it reaches the function:

Example

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

Return Values

To let a function return a value, use the `return` statement:

Example

```
def my_function(x):
  return 5 * x
print(my_function(3))
print(my_function(5))
print(my_function(9))
```

The pass Statement

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

Example

```
def myfunction():
  pass
```

Recursion

Python also accepts function recursion, which means a defined function can call itself.

Recursion is a common mathematical and programming concept. It means that a function calls itself. This has the benefit of meaning that you can loop through data to reach a result.

The developer should be very careful with recursion as it can be quite easy to slip into writing a function which never terminates, or one that uses excess amounts of memory or processor power. However, when written correctly recursion can be a very efficient and mathematically-elegant approach to programming.

In this example, `tri_recursion()` is a function that we have defined to call itself ("recurse"). We use the `k` variable as the data, which decrements (`-1`) every time we recurse. The recursion ends when the condition is not greater than 0 (i.e. when it is 0).

To a new developer it can take some time to work out how exactly this works, best way to find out is by testing and modifying it.

Recursion Example

```
def tri_recursion(k):
  if(k > 0):
    result = k + tri_recursion(k - 1)
    print(result)
  else:
    result = 0
  return result

print("\n\nRecursion Example Results")
tri_recursion(6)
```

Why Use Lambda Functions?

The power of lambda is better shown when you use them as an anonymous function inside another function.

Say you have a function definition that takes one argument, and that argument will be multiplied with an unknown number:

```
def myfunc(n):
  return lambda a : a * n
```

Use that function definition to make a function that always doubles the number you send in:

Example

```
def myfunc(n):
  return lambda a : a * n
mydoubler = myfunc(2)
print(mydoubler(11))
```

Or, use the same function definition to make a function that always *triples* the number you send in:

Example

```
def myfunc(n):
  return lambda a : a * n
mytripler = myfunc(3)
print(mytripler(11))
```

Or, use the same function definition to make both functions, in the same program:

Example

```
def myfunc(n):
  return lambda a : a * n
mydoubler = myfunc(2)
mytripler = myfunc(3)
print(mydoubler(11))
print(mytripler(11))
```

Python Arrays

Note: Python does not have built-in support for Arrays, but Python Lists can be used instead.

Arrays

Arrays are used to store multiple values in one single variable:

Example

Create an array containing car names:

```
cars = ["Ford", "Volvo", "BMW"]
```

What is an Array?

An array is a special variable, which can hold more than one value at a time.

An array can hold many values under a single name, and you can access the values by referring to an index number.

Access the Elements of an Array

You refer to an array element by referring to the *index number*.

A. Get the value of the first array item:

```
x = cars[0]
```

B. Modify the value of the first array item:

```
cars[0] = "Toyota"
```

The Length of an Array

Use the `len()` method to return the length of an array (the number of elements in an array).

Example

Return the number of elements in the `cars` array:

```
x = len(cars)
```

Note: The length of an array is always one more than the highest array index.

Printing the whole arrays...

Print each item in the `cars` array:

```
for x in cars:
  print(x)
```

Adding Array Elements

You can use the `append()` method to add an element to an array.

Example

Add one more element to the `cars` array:

```
cars.append("Honda")
```

Removing Array Elements

You can use the `pop()` method to remove an element from the array.

Example

Delete the second element of the `cars` array:

```
cars.pop(1)
```

You can also use the `remove()` method to remove an element from the array.

Example

Delete the element that has the value "Volvo":

```
cars.remove("Volvo")
```

Method	**Description**
append()	Adds an element at the end of the list
clear()	Removes all the elements from the list
copy()	Returns a copy of the list
count()	Returns the number of elements with the specified value
extend()	Add the elements of a list (or any iterable), to the end of the current list
index()	Returns the index of the first element with the specified value
insert()	Adds an element at the specified position
pop()	Removes the element at the specified position
remove()	Removes the first item with the specified value
reverse()	Reverses the order of the list

sort()	Sorts the list

Python Classes/Objects

Python is an object oriented programming language.

Almost everything in Python is an object, with its properties and methods.

A **Class** is like an object constructor, or a "blueprint" for creating objects.

Create a Class

To create a class, use the keyword `class`: Create a class named MyClass, with a property named x:

```
class MyClass:
  x = 5
```

Create Object

Now we can use the class named MyClass to create objects:

Example

Create an object named p1, and print the value of x:

```
p1 = MyClass()
print(p1.x)
```

The __init__() Function

The examples above are classes and objects in their simplest form, and are not really useful in real life applications.

To understand the meaning of classes we have to understand the built-in __init__() function.

All classes have a function called __init__(), which is always executed when the class is being initiated.

Use the __init__() function to assign values to object properties, or other operations that are necessary to do when the object is being created:

Example

Create a class named Person, use the __init__() function to assign values for name and age:

```
class Person:
  def __init__(self, name, age):
    self.name = name
    self.age = age
p1 = Person("John", 36)
```

```
print(p1.name)
print(p1.age)
```

Note: The `__init__()` function is called automatically every time the class is being used to create a new object.

Object Methods

Objects can also contain methods. Methods in objects are functions that belong to the object.

Let us create a method in the Person class:

Example

Insert a function that prints a greeting, and execute it on the p1 object:

```
class Person:
  def __init__(self, name, age):
    self.name = name
    self.age = age
  def myfunc(self):
    print("Hello my name is " + self.name)
p1 = Person("John", 36)
p1.myfunc()
```

Note: The `self` parameter is a reference to the current instance of the class, and is used to access variables that belong to the class.

The self Parameter

The `self` parameter is a reference to the current instance of the class, and is used to access variables that belongs to the class.

It does not have to be named `self` , you can call it whatever you like, but it has to be the first parameter of any function in the class:

Example

Use the words *mysillyobject* and *abc* instead of *self*:

```
class Person:
  def __init__(mysillyobject, name, age):
    mysillyobject.name = name
    mysillyobject.age = age
  def myfunc(abc):
    print("Hello my name is " + abc.name)
p1 = Person("John", 36)
p1.myfunc(
```

Modify Object Properties

Example

Set the age of p1 to 40:

```
p1.age = 40
```

A. Delete Object Properties

You can delete properties on objects by using the `del` keyword:

Example

Delete the age property from the p1 object:

```
del p1.age
```

B. Delete Objects

You can delete objects by using the `del` keyword:

```
del p1
```

C. The pass Statement

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

Example

```
class Person:
  pass
```

Python Inheritance

Inheritance allows us to define a class that inherits all the methods and properties from another class.

Parent class is the class being inherited from, also called base class.

Child class is the class that inherits from another class, also called derived class.

Create a Parent Class

Any class can be a parent class, so the syntax is the same as creating any other class:

Example

Create a class named `Person`, with `firstname` and `lastname` properties, and a `printname` method:

```
class Person:
  def __init__(self, fname, lname):
    self.firstname = fname
    self.lastname = lname

  def printname(self):
    print(self.firstname, self.lastname)

#Use the Person class to create an object, and then execute the printname method:

x = Person("John", "Doe")
x.printname()
```

Create a Child Class

To create a class that inherits the functionality from another class, send the parent class as a parameter when creating the child class:

Example

Create a class named `Student`, which will inherit the properties and methods from the `Person` class:

```
class Student(Person):
  pass
```

Note: Use the `pass` keyword when you do not want to add any other properties or methods to the class.

Now the Student class has the same properties and methods as the Person class.

Example

Use the `Student` class to create an object, and then execute the `printname` method:

```
x = Student("Mike", "Olsen")
x.printname()
```

Add the __init__() Function

So far we have created a child class that inherits the properties and methods from its parent.

We want to add the `__init__()` function to the child class (instead of the `pass` keyword).

Note: The `__init__()` function is called automatically every time the class is being used to create a new object.

Example

Add the `__init__()` function to the `Student` class:

```
class Student(Person):
  def __init__(self, fname, lname):
    #add properties etc.
```

When you add the `__init__()` function, the child class will no longer inherit the parent's `__init__()` function.

Note: The child's `__init__()` function **overrides** the inheritance of the parent's `__init__()` function.

To keep the inheritance of the parent's `__init__()` function, add a call to the parent's `__init__()` function:

Example

```
class Student(Person):
  def __init__(self, fname, lname):
    Person.__init__(self, fname, lname)
```

Now we have successfully added the __init__() function, and kept the inheritance of the parent class, and we are ready to add functionality in the `__init__()` function.

Use the super() Function

Python also has a `super()` function that will make the child class *inherit* all the methods and properties from its parent:

Example

```
class Student(Person):
  def __init__(self, fname, lname):
    super().__init__(fname, lname)
```

By using the `super()` function, you do not have to use the name of the parent element, it will automatically inherit the methods and properties from its parent.

Add Properties

Add a property called `graduationyear` to the `Student` class:

```
class Student(Person):
  def __init__(self, fname, lname):
    super().__init__(fname, lname)
    self.graduationyear = 2019
```

In the example below, the year `2019` should be a variable, and passed into the `Student` class when creating student objects. To do so, add another parameter in the __init__() function:

Add a `year` parameter, and pass the correct year when creating objects:

```
class Student(Person):
  def __init__(self, fname, lname, year):
    super().__init__(fname, lname)
    self.graduationyear = year

x = Student("Mike", "Olsen", 2019)
```

Add a method called `welcome` to the `Student` class:

```
class Student(Person):
  def __init__(self, fname, lname, year):
    super().__init__(fname, lname)
    self.graduationyear = year
  def welcome(self):
    print("Welcome", self.firstname, self.lastname, "to the class of",
self.graduationyear)
```

If you add a method in the child class with the same name as a function in the parent class, the inheritance of the parent method will be overridden.

Python Iterators

An iterator is an object that contains a finite no. of values.

An iterator is an object that can be iterated upon, meaning that you can traverse through all the values.

In Python, an iterator is an object which implements the iterator protocol, which consist of the methods `__iter__()` and `__next__()`.

Iterator vs Iterable

Lists, tuples, dictionaries, and sets are all iterable objects. They are iterable *containers* which you can get an iterator from.

All these objects have a `iter()` method which is used to get an iterator:

Example

Return an iterator from a tuple, and print each value:

```
mytuple = ("apple", "banana", "cherry")
myit = iter(mytuple)

print(next(myit))
print(next(myit))
print(next(myit))
```

Even strings are iterable objects, and can return an iterator:

Example

Strings are also iterable objects, containing a sequence of characters:

```
mystr = "banana"
myit = iter(mystr)

print(next(myit))
print(next(myit))
print(next(myit))
print(next(myit))
print(next(myit))
print(next(myit))
```

Looping Through an Iterator

We can also use a `for` loop to iterate through an iterable object:

Example

Iterate the values of a tuple:

```
mytuple = ("apple", "banana", "cherry")

for x in mytuple:
  print(x)
```

Example

Iterate the characters of a string:

```
mystr = "banana"

for x in mystr:
  print(x)
```

The `for` loop actually creates an iterator object and executes the next() method for each loop.

Create an Iterator

To create an object/class as an iterator you have to implement the methods `__iter__()` and `__next__()` to your object.

As we have seen in the Python(Classes/Objects) topic, all classes have a function called `__init__()`, which allows you do some initializing when the object is being created.

The `__iter__()` method acts similar, you can do operations (initializing etc.), but must always return the iterator object itself.

The `__next__()` method also allows you to do operations, and must return the next item in the sequence.

Example

Create an iterator that returns numbers, starting with 1, and each sequence will increase by one (returning 1,2,3,4,5 etc.):

```
class MyNumbers:
       def __iter__(self):
        self.a = 1
        return self

       def __next__(self):
        x = self.a
        self.a += 1
        return x
```

```
myclass = MyNumbers()
myiter = iter(myclass)


print(next(myiter))
print(next(myiter))
print(next(myiter))
print(next(myiter))
print(next(myiter))
```

StopIteration

The example above would continue forever if you had enough next() statements, or if it was used in a `for` loop.

To prevent the iteration to go on forever, we can use the `StopIteration` statement.

In the `__next__()` method, we can add a terminating condition to raise an error if the iteration is done a specified number of times:

Example

Stop after 20 iterations:

```
class MyNumbers:
      def __iter__(self):
       self.a = 1
       return self

      def __next__(self):
        if self.a <= 20:
         x = self.a
        self.a += 1
        return x
      else:
         raise StopIteration

myclass = MyNumbers()
myiter = iter(myclass)

for x in myiter:
  print(x)
```

PYTHON SCOPE

The python scope are of two types :

A. **Local Scope** (Simply a local variable) : that is a variable declared inside the function.

```
def myfunc():
  x = 300
  print(x)

myfunc()
```

B. Global Scope (Sinply a global variable): that is a variable declared outside the function.

```
x = 300

def myfunc():
  print(x)

myfunc()

print(x)
```

NOTE: *A local variable can be define as global variable using a* ***global*** *keyword.*

```
def myfunc():
  global x
  x = 300

myfunc()

print(x)
```

Python Modules

A Python file containing a set of functions you want to include in your application. This python file May be already inbuild or created by you .

Create a Module

create a file with the file extension `.py`:

Example

Save this code in a file named `mymodule.py`

```
def greeting(name):
  print("Hello, " + name)
```

Use a Module

Now we can use the module we just created, by using the `import` statement:

Example

Import the module named mymodule, and call the greeting function:

```
import mymodule

mymodule.greeting("Jonathan")
```

Note: When using a function from a module, use the syntax: *module_name.function_name*.

Variables in Module

The module can contain functions, as already described, but also variables of all types (arrays, dictionaries, objects etc):

Example

Save this code in the file `mymodule.py`

```
person1 = {
  "name": "John",
  "age": 36,
  "country": "Norway"
}
```

Example

Import the module named mymodule, and access the person1 dictionary:

```
import mymodule

a = mymodule.person1["age"]
print(a)
```

Naming a Module

You can name the module file whatever you like, but it must have the file extension `.py`

Re-naming a Module

You can create an alias when you import a module, by using the `as` keyword:

Example

Create an alias for `mymodule` called `mx`:

```
import mymodule as mx

a = mx.person1["age"]
print(a)
```

Built-in Modules

There are several built-in modules in Python, which you can import whenever you like.

Example

Import and use the `platform` module:

```
import platform
```

```
x = platform.system()
print(x)
```

Using the dir() Function

There is a built-in function to list all the function names (or variable names) in a module. The `dir()` function:

Example

List all the defined names belonging to the platform module:

```
import platform

x = dir(platform)
print(x)
```

Note: The dir() function can be used on *all* modules, also the ones you create yourself.

Import From Module

You can choose to import only parts from a module, by using the `from` keyword.

Example

The module named `mymodule` has one function and one dictionary:

```
def greeting(name):
  print("Hello, " + name)

person1 = {
  "name": "John",
  "age": 36,
  "country": "Norway"
}
```

Example

Import only the person1 dictionary from the module:

```
from mymodule import person1

print (person1["age"])
```

Note: When importing using the `from` keyword, do not use the module name when referring to elements in the module. Example: `person1["age"]`, **not** ~~`mymodule.person1["age"]`~~

Python Dates

A date in Python is not a data type of its own, but we can import a module named `datetime` to work with dates as date objects.

Example

Import the datetime module and display the current date:

```
import datetime

x = datetime.datetime.now()
print(x)
```

Date Output

When we execute the code from the example above the result will be:

```
2020-03-16 14:17:55.548063
```

The date contains year, month, day, hour, minute, second, and microsecond.

The `datetime` module has many methods to return information about the date object.

Here are a few examples:

Example

Return the year and name of weekday:

```
import datetime

x = datetime.datetime.now()

print(x.year)
print(x.strftime("%A"))
```

Creating Date Objects

To create a date, we can use the `datetime()` class (constructor) of the `datetime` module.

The `datetime()` class requires three parameters to create a date: year, month, day.

Example

Create a date object:

```
import datetime

x = datetime.datetime(2020, 5, 17)

print(x)
```

The `datetime()` class also takes parameters for time and timezone (hour, minute, second, microsecond, tzone), but they are optional, and has a default value of `0`, (`None` for timezone).

The strftime() Method

The `datetime` object has a method for formatting date objects into readable strings.

The method is called `strftime()`, and takes one parameter, `format`, to specify the format of the returned string:

Example

Display the name of the month:

```
import datetime

x = datetime.datetime(2018, 6, 1)

print(x.strftime("%B"))
```

Directive	Description	Example
%a	Weekday, short version	Wed
%A	Weekday, full version	Wednesday
%w	Weekday as a number 0-6, 0 is Sunday	3
%d	Day of month 01-31	31
%b	Month name, short version	Dec
%B	Month name, full version	December
%m	Month as a number 01-12	12
%y	Year, short version, without century	18
%Y	Year, full version	2018
%H	Hour 00-23	17
%I	Hour 00-12	05
%p	AM/PM	PM
%M	Minute 00-59	41
%S	Second 00-59	08

%f	Microsecond 000000-999999	548513
%z	UTC offset	+0100
%Z	Timezone	CST
%j	Day number of year 001-366	365
%U	Week number of year, Sunday as the first day of week, 00-53	52
%W	Week number of year, Monday as the first day of week, 00-53	52
%c	Local version of date and time	Mon Dec 31 17:41:00 2018
%x	Local version of date	12/31/18
%X	Local version of time	17:41:00
%%	A % character	%

Python JSON

JSON is a syntax for storing and exchanging data.

JSON is text, written with JavaScript object notation.

Python has a built-in package called `json`, which can be used to work with JSON data.

Example

Import the json module:

```
import json
```

Parse JSON - Convert from JSON to Python

If you have a JSON string, you can parse it by using the `json.loads()` method.

Result will be a Python dictionary.

Example

Convert from JSON to Python:

```python
import json

# some JSON:
x =  '{ "name":"John", "age":30, "city":"New York"}'

# parse x:
y = json.loads(x)

# the result is a Python dictionary:
print(y["age"])
```

Convert from Python to JSON

If you have a Python object, you can convert it into a JSON string by using the `json.dumps()` method.

Example

Convert from Python to JSON:

```python
import json

# a Python object (dict):
x = {
  "name": "John",
  "age": 30,
  "city": "New York"
}

# convert into JSON:
y = json.dumps(x)

# the result is a JSON string:
print(y)
```

You can convert Python objects of the following types, into JSON strings:

- dict
- list
- tuple
- string
- int
- float
- True
- False
- None

Example

Convert Python objects into JSON strings, and print the values:

```python
import json

print(json.dumps({"name": "John", "age": 30}))
print(json.dumps(["apple", "bananas"]))
print(json.dumps(("apple", "bananas")))
print(json.dumps("hello"))
print(json.dumps(42))
print(json.dumps(31.76))
print(json.dumps(True))
print(json.dumps(False))
print(json.dumps(None))
```

When you convert from Python to JSON, Python objects are converted into the JSON (JavaScript) equivalent:

Python	JSON
dict	Object
list	Array
tuple	Array
str	String
int	Number
float	Number
True	true
False	false
None	null

Example

Convert a Python object containing all the legal data types:

```
import json

x = {
  "name": "John",
  "age": 30,
  "married": True,
  "divorced": False,
  "children": ("Ann","Billy"),
  "pets": None,
  "cars": [
    {"model": "BMW 230", "mpg": 27.5},
    {"model": "Ford Edge", "mpg": 24.1}
  ]
}
```

```
print(json.dumps(x))
```

Format the Result

The example above prints a JSON string, but it is not very easy to read, with no indentations and line breaks.

The `json.dumps()` method has parameters to make it easier to read the result:

Example

Use the `indent` parameter to define the numbers of indents:

```
json.dumps(x, indent=4)
```

You can also define the separators, default value is (", ", ": "), which means using a comma and a space to separate each object, and a colon and a space to separate keys from values:

Example

Use the `separators` parameter to change the default separator:

```
json.dumps(x, indent=4, separators=(". ", " = "))
```

Order the Result

The `json.dumps()` method has parameters to order the keys in the result:

Example

Use the `sort_keys` parameter to specify if the result should be sorted or not:

```
json.dumps(x, indent=4, sort_keys=True)
```

Python RegEx

A RegEx, or Regular Expression, is a sequence of characters that forms a search pattern.

RegEx can be used to check if a string contains the specified search pattern.

RegEx Module

Python has a built-in package called `re`, which can be used to work with Regular Expressions.

Import the `re` module:

```
import re
```

RegEx in Python

When you have imported the `re` module, you can start using regular expressions:

Example

Search the string to see if it starts with "The" and ends with "Spain":

```
import re

txt = "The rain in Spain"
x = re.search("^The.*Spain$", txt)
```

RegEx Functions

The `re` module offers a set of functions that allows us to search a string for a match:

Function	Description
findall	Returns a list containing all matches
search	Returns a Match object if there is a match anywhere in the string
split	Returns a list where the string has been split at each match
sub	Replaces one or many matches with a string

Metacharacters

Metacharacters are characters with a special meaning:

Character	Description	Example
[]	A set of characters	"[a-m]"
\	Signals a special sequence (can also be used to escape special characters)	"\d"
.	Any character (except newline character)	"he..o"
^	Starts with	"^hello"
$	Ends with	"world$"
*	Zero or more occurrences	"aix*"
+	One or more occurrences	"aix+"

{}	Exactly the specified number of occurrences	"al{2}"
|	Either or	"falls|stays"

Special Sequences

A special sequence is a `\` followed by one of the characters in the list below, and has a special meaning:

Character	Description	Example
\A	Returns a match if the specified characters are at the beginning of the string	"\AThe"
\b	Returns a match where the specified characters are at the beginning or at the end of a word	r"\bain" r"ain\b"
\B	Returns a match where the specified characters are present, but NOT at the beginning (or at the end) of a word	r"\Bain" r"ain\B"
\d	Returns a match where the string contains digits (numbers from 0-9)	"\d"
\D	Returns a match where the string DOES NOT contain digits	"\D"
\s	Returns a match where the string contains a white space character	"\s"
\S	Returns a match where the string DOES NOT contain a white space character	"\S"
\w	Returns a match where the string contains any word characters (characters from a to Z, digits from 0-9, and the underscore _ character)	"\w"
\W	Returns a match where the string DOES NOT contain any word characters	"\W"
\Z	Returns a match if the specified characters are at the end of the string	"Spain\Z"

Sets

A set is a set of characters inside a pair of square brackets `[]` with a special meaning:

Set	Description
[arn]	Returns a match where one of the specified characters (a, r, or n) are present
[a-n]	Returns a match for any lower case character, alphabetically between a and n
[^arn]	Returns a match for any character EXCEPT a, r, and n

[0123]	Returns a match where any of the specified digits (0, 1, 2, or 3) are present
[0-9]	Returns a match for any digit between 0 and 9
[0-5][0-9]	Returns a match for any two-digit numbers from 00 and 59
[a-zA-Z]	Returns a match for any character alphabetically between a and z, lower case OR upper case
[+]	In sets, +, *, ., |, (), $,{} has no special meaning, so [+] means: return a match for any +

The findall() Function

The `findall()` function returns a list containing all matches.

Example

Print a list of all matches:

```
import re

txt = "The rain in Spain"
x = re.findall("ai", txt)
print(x)
```

The list contains the matches in the order they are found.

If no matches are found, an empty list is returned:

Example

Return an empty list if no match was found:

```
import re

txt = "The rain in Spain"
x = re.findall("Portugal", txt)
print(x)
```

The search() Function

The `search()` function searches the string for a match, and returns a Match object if there is a match.

If there is more than one match, only the first occurrence of the match will be returned:

Example

Search for the first white-space character in the string:

```
import re

txt = "The rain in Spain"
```

```
x = re.search("\s", txt)

print("The first white-space character is located in position:", x.start())
```

If no matches are found, the value `None` is returned:

Example

Make a search that returns no match:

```
import re

txt = "The rain in Spain"
x = re.search("Portugal", txt)
print(x)
```

The split() Function

The `split()` function returns a list where the string has been split at each match:

Example

Split at each white-space character:

```
import re

txt = "The rain in Spain"
x = re.split("\s", txt)
print(x)
```

You can control the number of occurrences by specifying the `maxsplit` parameter:

Example

Split the string only at the first occurrence:

```
import re

txt = "The rain in Spain"
x = re.split("\s", txt, 1)
print(x)
```

The sub() Function

The `sub()` function replaces the matches with the text of your choice:

Example

Replace every white-space character with the number 9:

```
import re

txt = "The rain in Spain"
x = re.sub("\s", "9", txt)
print(x)
```

You can control the number of replacements by specifying the `count` parameter:

Example

Replace the first 2 occurrences:

```
import re

txt = "The rain in Spain"
x = re.sub("\s", "9", txt, 2)
print(x)
```

Match Object

A Match Object is an object containing information about the search and the result.

Note: If there is no match, the value `None` will be returned, instead of the Match Object.

Example

Do a search that will return a Match Object:

```
import re

txt = "The rain in Spain"
x = re.search("ai", txt)
print(x) #this will print an object
```

The Match object has properties and methods used to retrieve information about the search, and the result:

`.span()` returns a tuple containing the start-, and end positions of the match.
`.string` returns the string passed into the function
`.group()` returns the part of the string where there was a match

Example

Print the position (start- and end-position) of the first match occurrence.

The regular expression looks for any words that starts with an upper case "S":

```
import re

txt = "The rain in Spain"
x = re.search(r"\bS\w+", txt)
print(x.span())
```

Example

Print the string passed into the function:

```
import re

txt = "The rain in Spain"
```

```
x = re.search(r"\bS\w+", txt)
print(x.string)
```

Example

Print the part of the string where there was a match.

The regular expression looks for any words that starts with an upper case "S":

```
import re

txt = "The rain in Spain"
x = re.search(r"\bS\w+", txt)
print(x.group())
```

Note: If there is no match, the value `None` will be returned, instead of the Match Object.

Python Try Except

The `try` block lets you test a block of code for errors.

The `except` block lets you handle the error.

The `finally` block lets you execute code, regardless of the result of the try- and except blocks.

Exception Handling

When an error occurs, or exception as we call it, Python will normally stop and generate an error message.

These exceptions can be handled using the `try` statement:

Example

The `try` block will generate an exception, because `x` is not defined:

```
try:
  print(x)
except:
  print("An exception occurred")
```

Since the try block raises an error, the except block will be executed.

Without the try block, the program will crash and raise an error:

Example

This statement will raise an error, because `x` is not defined:

```
print(x)
```

Many Exceptions

You can define as many exception blocks as you want, e.g. if you want to execute a special block of code for a special kind of error:

Example

Print one message if the try block raises a `NameError` and another for other errors:

```
try:
  print(x)
except NameError:
  print("Variable x is not defined")
except:
  print("Something else went wrong")
```

Else

You can use the `else` keyword to define a block of code to be executed if no errors were raised:

Example

In this example, the `try` block does not generate any error:

```
try:
  print("Hello")
except:
  print("Something went wrong")
else:
  print("Nothing went wrong")
```

Finally

The `finally` block, if specified, will be executed regardless if the try block raises an error or not.

Example

```
try:
  print(x)
except:
  print("Something went wrong")
finally:
  print("The 'try except' is finished")
```

This can be useful to close objects and clean up resources:

Example

Try to open and write to a file that is not writable:

```
try:
  f = open("demofile.txt")
  f.write("Lorum Ipsum")
except:
  print("Something went wrong when writing to the file")
finally:
  f.close()
```

The program can continue, without leaving the file object open.

Raise an exception

As a Python developer you can choose to throw an exception if a condition occurs.

To throw (or raise) an exception, use the `raise` keyword.

Example

Raise an error and stop the program if x is lower than 0:

```
x = -1

if x < 0:
  raise Exception("Sorry, no numbers below zero")
```

The `raise` keyword is used to raise an exception.

You can define what kind of error to raise, and the text to print to the user.

Example

Raise a TypeError if x is not an integer:

```
x = "hello"

if not type(x) is int:
  raise TypeError("Only integers are allowed")
```

PythonUser Input

To ask the user for input.

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

Python 3.6 uses the `input()` method.

Python 2.7 uses the `raw_input()` method.

Python 3.6

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

Python 2.7

```
username = raw_input("Enter username:")
print("Username is: " + username)
```

Python String Formatting

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

String format()

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

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

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

Example

Add a placeholder where you want to display the price:

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

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

Example

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

```
txt = "The price is {:.2f} dollars"
```

Check out all formatting types in our String format() Reference.

Multiple Values

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

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

And add more placeholders:

Example

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

Index Numbers

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

Example

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

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

Example

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

Named Indexes

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

Example

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

Python String format() Method

Example

Insert the price inside the placeholder, the price should be in fixed point, two-decimal format:

```
txt = "For only {price:.2f} dollars!"
print(txt.format(price = 49))
```

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: {}. Read more about the placeholders in the Placeholder section below.

The `format()` method returns the formatted string.

Syntax

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

Parameter Values

Parameter	Description
value1, value2...	Required. One or more values that should be formatted and inserted in the string. The values can be A number specifying the position of the element you want to remove. The values are either a list of values separated by commas, a key=value list, or a combination of both. The values can be of any data type.

The Placeholders

The placeholders can be identified using named indexes `{price}`, numbered indexes `{0}`, or even empty placeholders `{}`.

Example

Using different placeholder values:

```
txt1 = "My name is {fname}, I'am {age}".format(fname = "John", age = 36)
txt2 = "My name is {0}, I'am {1}".format("John",36)
txt3 = "My name is {}, I'am {}".format("John",36)
```

Formatting Types

Inside the placeholders you can add a formatting type to format the result:

:<	Left aligns the result (within the available space)
:>	Right aligns the result (within the available space)

:^	Center aligns the result (within the available space)
:=	Places the sign to the left most position
:+	Use a plus sign to indicate if the result is positive or negative
:-	Use a minus sign for negative values only
:	Use a space to insert an extra space before positive numbers (and a minus sign befor negative numbers)
:,	Use a comma as a thousand separator
:_	Use a underscore as a thousand separator
:b	Binary format
:c	Converts the value into the corresponding unicode character
:d	Decimal format
:e	Scientific format, with a lower case e
:E	Scientific format, with an upper case E
:f	Fix point number format
:F	Fix point number format, in uppercase format (show inf and nan as INF and NAN)
:g	General format
:G	General format (using a upper case E for scientific notations)
:o	Octal format
:x	Hex format, lower case
:X	Hex format, upper case
:n	Number format

:%	Percentage format

Python File

File handling is an important part of any web application.

Python has several functions for creating, reading, updating, and deleting files.

File Handling

The key function for working with files in Python is the `open()` function.

The `open()` function takes two parameters; *filename*, and *mode*.

There are four different methods (modes) for opening a file:

`"r"` - Read - Default value. Opens a file for reading, error if the file does not exist

`"a"` - Append - Opens a file for appending, creates the file if it does not exist

`"w"` - Write - Opens a file for writing, creates the file if it does not exist

`"x"` - Create - Creates the specified file, returns an error if the file exists

In addition you can specify if the file should be handled as binary or text mode

`"t"` - Text - Default value. Text mode

`"b"` - Binary - Binary mode (e.g. images)

Syntax

To open a file for reading it is enough to specify the name of the file:

```
f = open("demofile.txt")
```

The code above is the same as:

```
f = open("demofile.txt", "rt")
```

Because `"r"` for read, and `"t"` for text are the default values, you do not need to specify them.

Note: Make sure the file exists, or else you will get an error.

Open a File on the Server

Assume we have the following file, located in the same folder as Python:

```
demofile.txt
```

```
Hello! Welcome to demofile.txt
This file is for testing purposes.
Good Luck!
```

To open the file, use the built-in `open()` function.

The `open()` function returns a file object, which has a `read()` method for reading the content of the file:

Example

```
f = open("demofile.txt", "r")
print(f.read())
```

Read Only Parts of the File

By default the `read()` method returns the whole text, but you can also specify how many characters you want to return:

Example

Return the 5 first characters of the file:

```
f = open("demofile.txt", "r")
print(f.read(5))
```

Read Lines

You can return one line by using the `readline()` method:

Example

Read one line of the file:

```
f = open("demofile.txt", "r")
print(f.readline())
```

By calling `readline()` two times, you can read the two first lines:

Example

Read two lines of the file:

```
f = open("demofile.txt", "r")
print(f.readline())
print(f.readline())
```

By looping through the lines of the file, you can read the whole file, line by line:

Example

Loop through the file line by line:

```
f = open("demofile.txt", "r")
for x in f:
  print(x)
```

Close Files

It is a good practice to always close the file when you are done with it.

Example

Close the file when you are finish with it:

```
f = open("demofile.txt", "r")
print(f.readline())
f.close()
```

Note: You should always close your files, in some cases, due to buffering, changes made to a file may not show until you close the file.

Python File Write

Write to an Existing File

To write to an existing file, you must add a parameter to the `open()` function:

`"a"` - Append - will append to the end of the file

`"w"` - Write - will overwrite any existing content

Example

Open the file "demofile2.txt" and append content to the file:

```
f = open("demofile2.txt", "a")
f.write("Now the file has more content!")
f.close()

#open and read the file after the appending:
f = open("demofile2.txt", "r")
print(f.read())
```

Example

Open the file "demofile3.txt" and overwrite the content:

```
f = open("demofile3.txt", "w")
f.write("Woops! I have deleted the content!")
f.close()

#open and read the file after the appending:
f = open("demofile3.txt", "r")
print(f.read())
```

Note: the "w" method will overwrite the entire file.

Create a New File

To create a new file in Python, use the `open()` method, with one of the following parameters:

`"x"` - Create - will create a file, returns an error if the file exist

`"a"` - Append - will create a file if the specified file does not exist

`"w"` - Write - will create a file if the specified file does not exist

Example

Create a file called "myfile.txt":

```
f = open("myfile.txt", "x")
```

Result: a new empty file is created!

Example

Create a new file if it does not exist:

```
f = open("myfile.txt", "w")
```

Delete a File

To delete a file, you must import the OS module, and run its `os.remove()` function:

Example

Remove the file "demofile.txt":

```
import os
os.remove("demofile.txt")
```

Check if File exist:

To avoid getting an error, you might want to check if the file exists before you try to delete it:

Example

Check if file exists, *then* delete it:

```
import os
if os.path.exists("demofile.txt"):
  os.remove("demofile.txt")
else:
  print("The file does not exist")
```

Delete Folder

To delete an entire folder, use the `os.rmdir()` method:

Example

Remove the folder "myfolder":

```
import os
os.rmdir("myfolder")
```

Note: You can only remove *empty* folders.