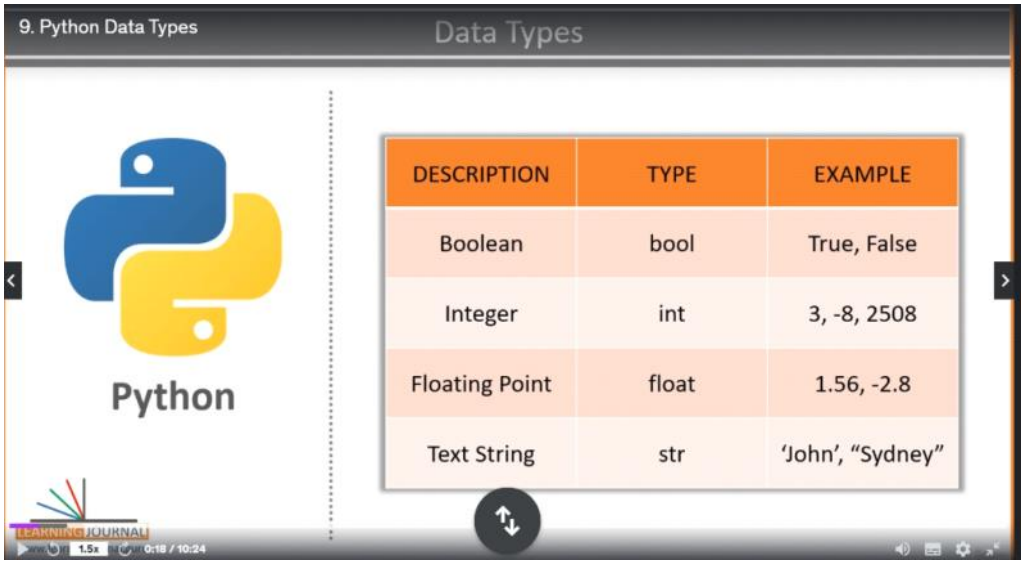
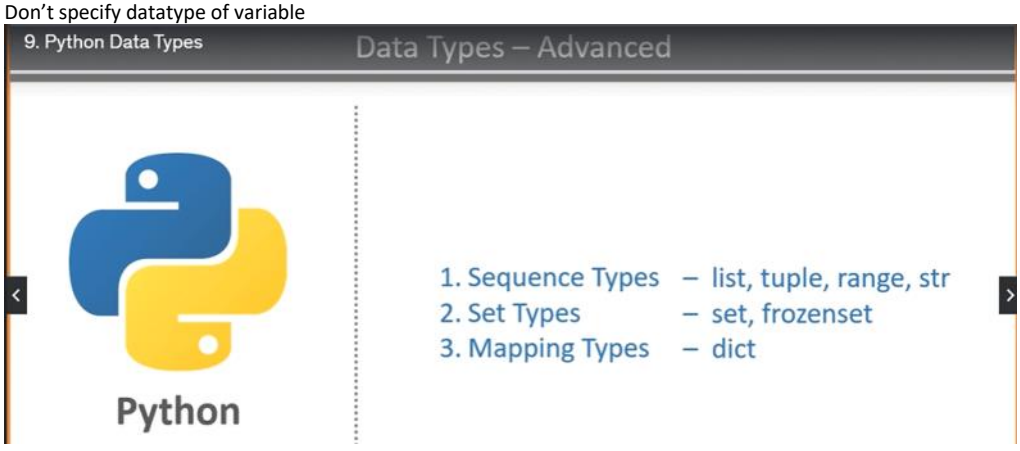
Python

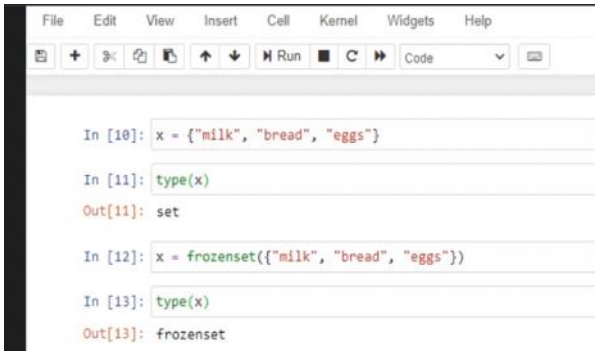
Thursday, September 5, 2024 8:14 PM

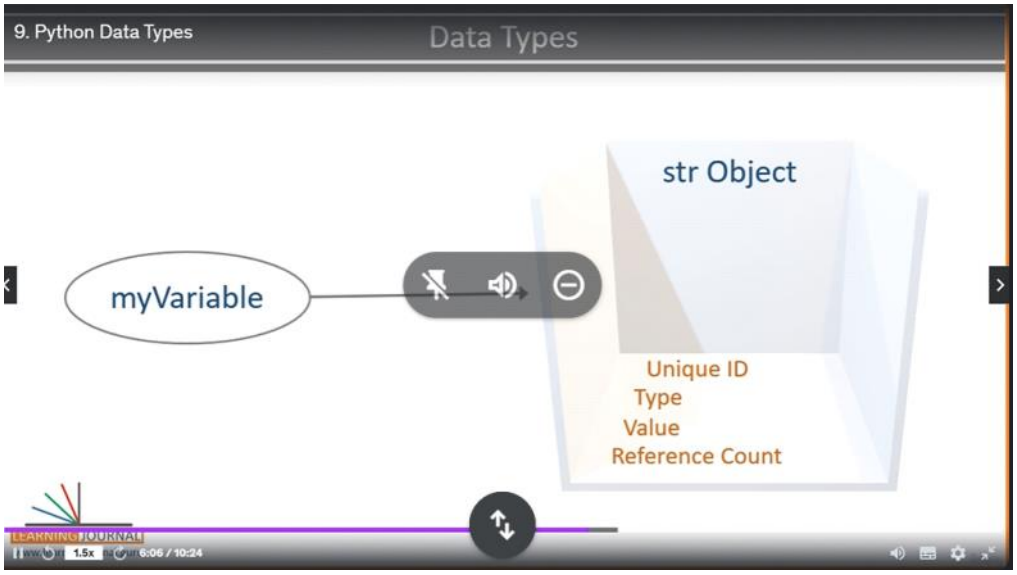
- Download anaconda navigator from "Anaconda Distribution Download"
- Jupyter - notebook - most used notebook - Localhost:8888/tree
- .Ipynb extension gets created when you create a new notebook. It's name is - Ipython notebook file
- Jupyter has three types of cells - "code", "raw" and "markdown". Raw is to store any code you don't want to run. Raw cells wont be evaluated by notebook

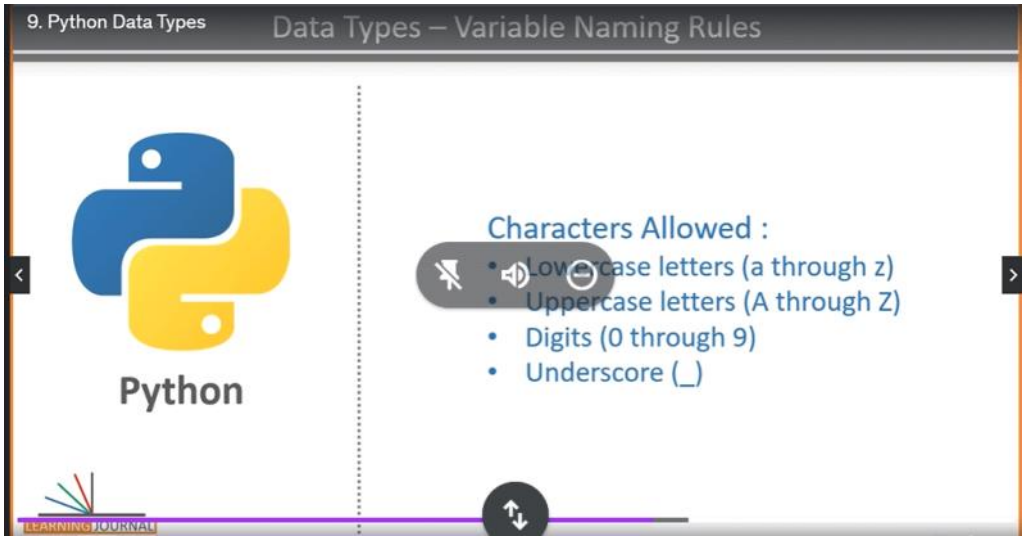


Everything is object in python programming
Don't specify datatype of variable

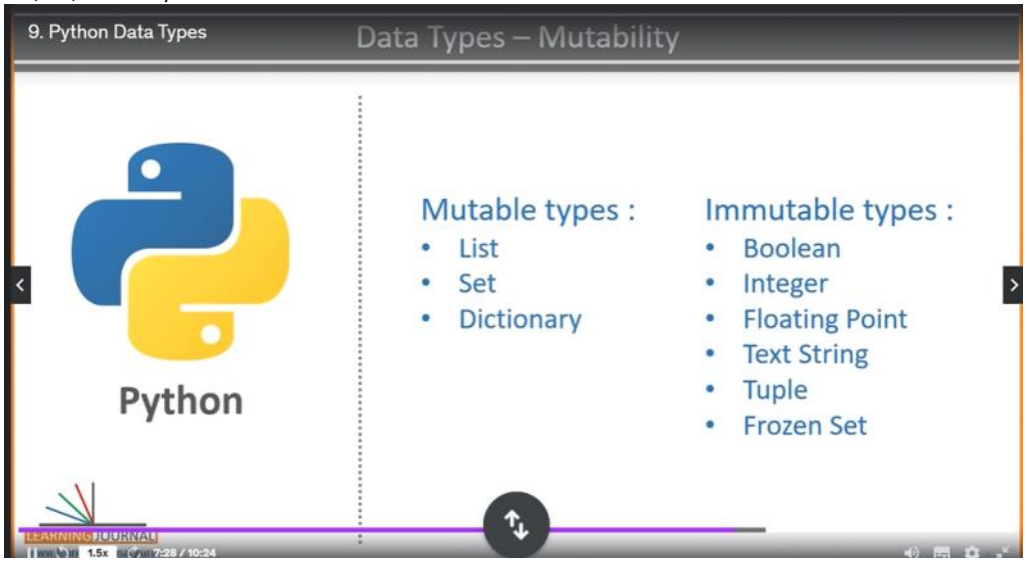




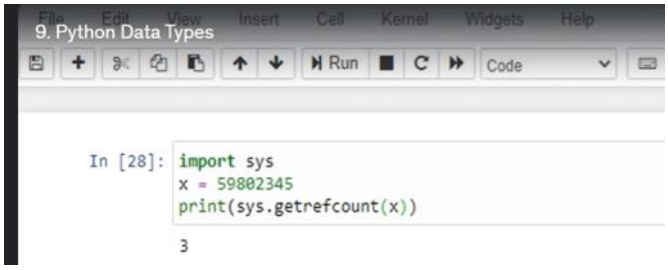


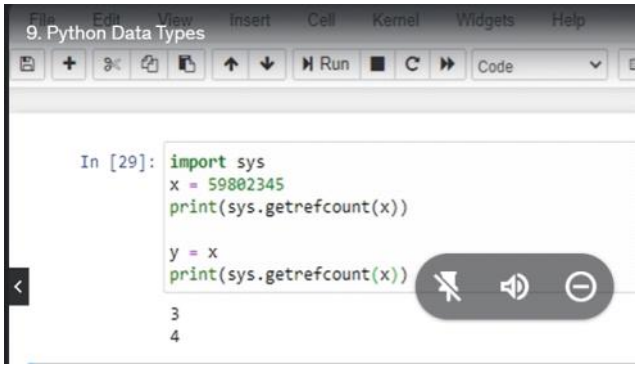


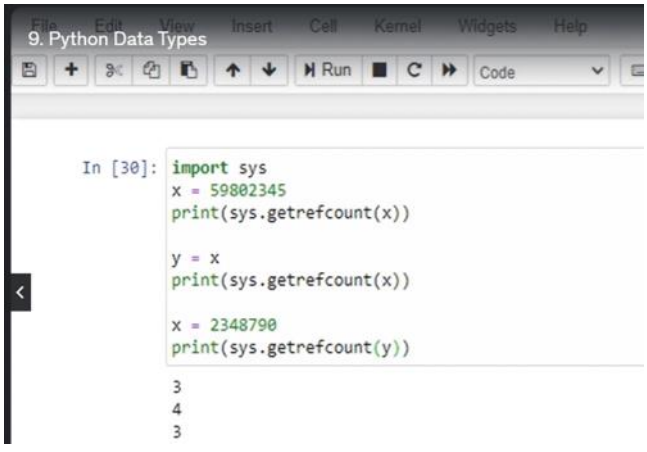
Mutable vs immutable -
Int, str, float, bool, tuple, frozenset are all immutable
List, set, dictionary are all mutable



```
In [24]: help('keywords')

Here is a list of the Python keywords.  Enter any keyword to get more help.

False               class               from                or
None                continue            global              pass
True                def                 if                  raise
and                 del                 import              return
as                  elif                in                  try
assert              else                is                  while
async               except              lambda              with
await               finally             nonlocal            yield
break               for                 not
```







When reference count of the object becomes zero, the object is ready to be garbage collected.

Mathematical Operators

Python

Types of Operations:

- Mathematical
- Logical
- Relational
- Comparisons

Mathematical Operators

DESCRIPTION	OPERATOR	EXAMPLE
Addition	+	5 + 2 = 7
Subtraction	-	5 - 2 = 3
Multiplication	*	5 * 2 = 10
Floating-point Division	/	5 / 2 = 2.5
Integer Truncate Division	//	5 // 2 = 2
Modulus	%	5 % 2 = 1
Exponent	**	5 ** 2 = 25

```
In [15]: x = 3
         y = 5

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

```
8
```

```
In [16]: x = 3
         y = 5

         x += y
         print(x)
```

```
8
```

File Edit View Insert Cell Kernel Widgets Help

Run Code

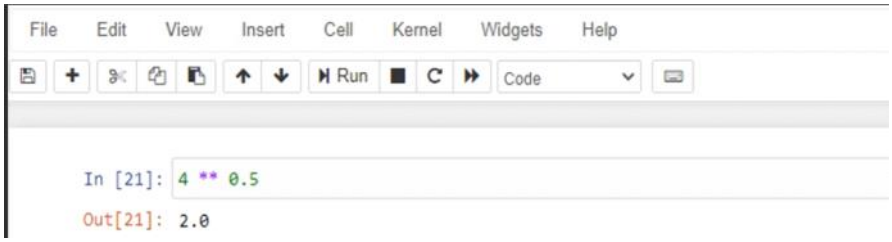
```
In [17]: x = 3
         y = 5

         y /= x
         print(y)
```

```
1.6666666666666667
```

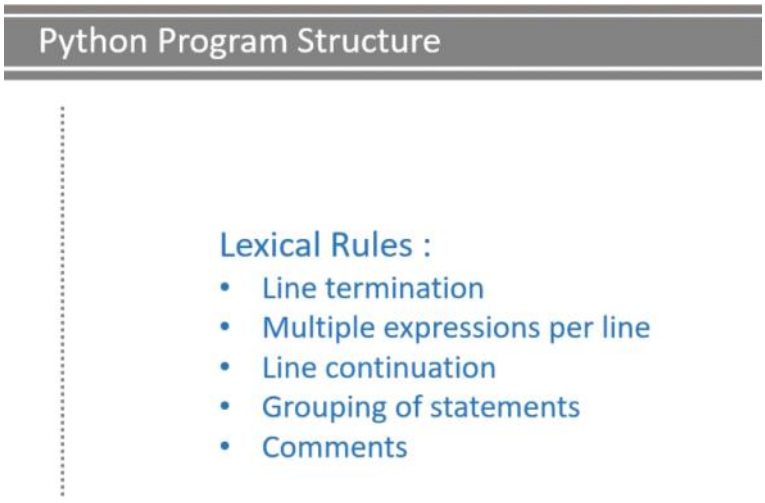
```
In [18]: x = 3
         y = 5

         y = y / x
         print(y)
```

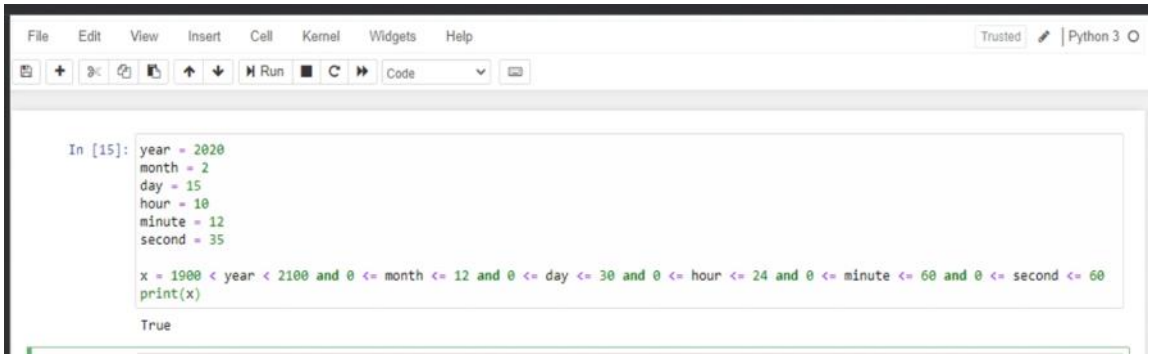
```
1.6666666666666667
```

- Python also follows BODMAS rule
- Python is case sensitive
- Python will broaden the data type when the math is done. For ex: here the data type is broadened to float

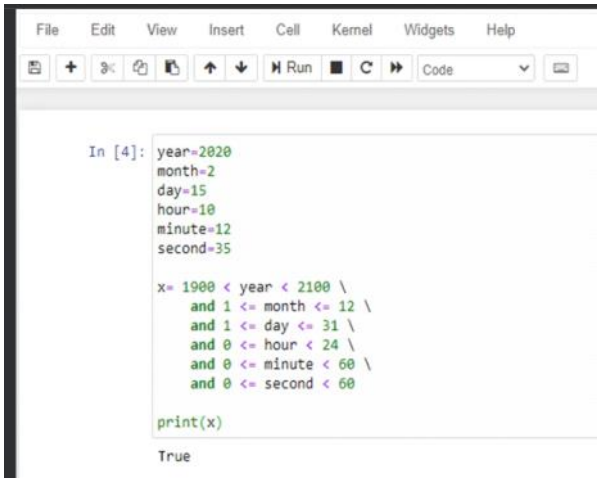


- In python there is no need of semi colon to end the line. Each lines new line character is understood as line
- And each line is considered as command

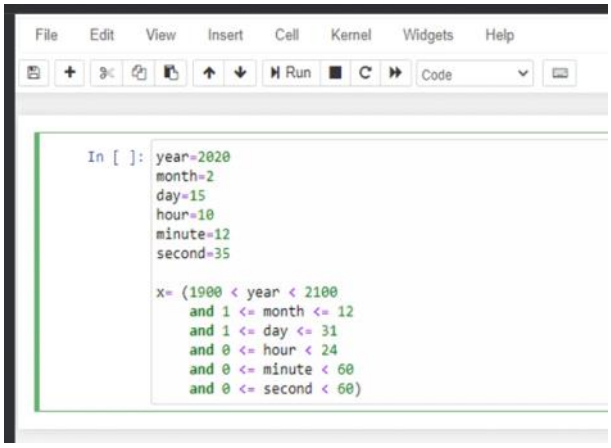


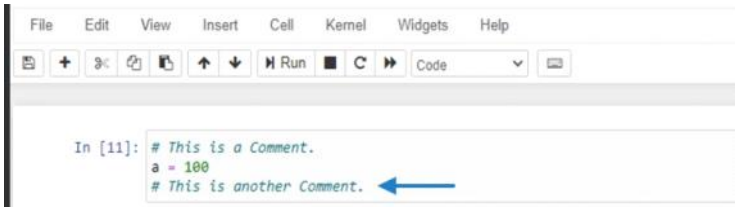


For better readability of the above statements, you can use this by ending it with **backslash** -

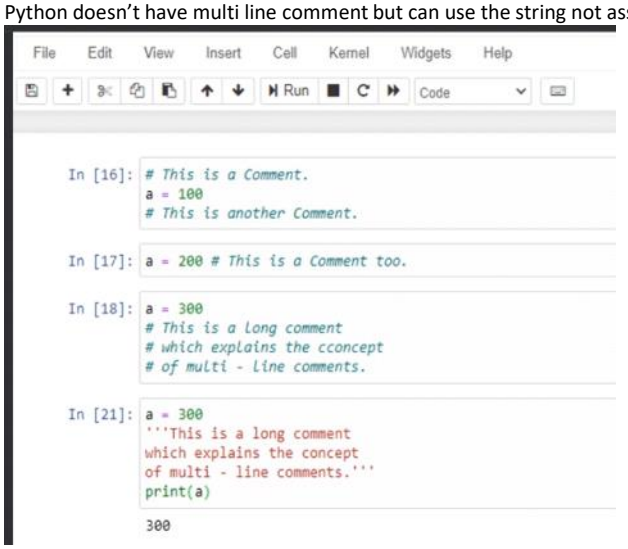


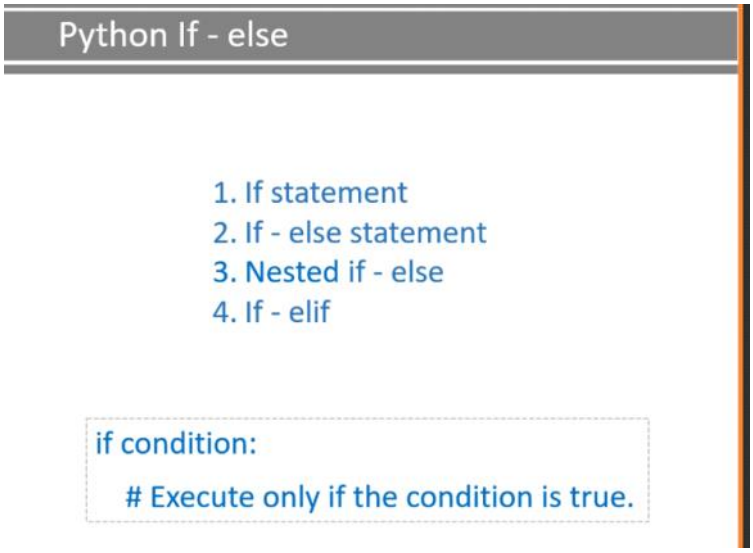
Also you can start with the open bracket so that python understands it is not end of the line until it finds the closed bracket





Python doesn't have multi line comment but can use the string not assigned





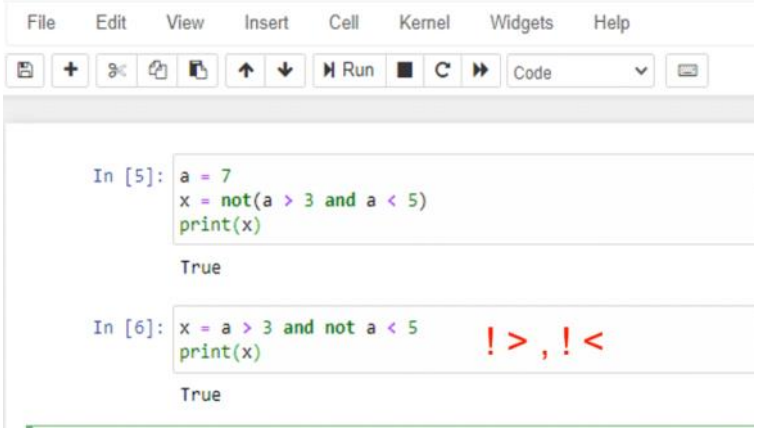
Comparison Operators

DESCRIPTION	OPERATOR
Equality	==
Inequality	!=
Less than	<
Less than or equal	<=
Greater than	>
Greater than or equal	>=

Logical Operators

OPERATOR	DESCRIPTION
and	if and only if both the expressions evaluate to true
or	if either side of the expression evaluates to true
not	reverses the state of its operand

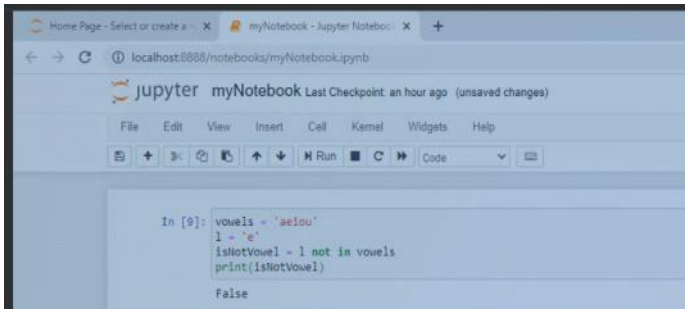
These are not present in python.



```
In [5]: a = 7
        x = not(a > 3 and a < 5)
        print(x)

        True

In [6]: x = a > 3 and not a < 5
        print(x)

        True
```

In operator -

```
In [7]: l = 'e'
        isVowel = l == 'a' or l == 'e' or l == 'i' or l == 'o' or l == 'u'
        print(isVowel)

        True

In [8]: vowels = 'aeiou'
        l = 'e'
        isVowel = l in vowels
        print(isVowel)

        True
```



Python Sequence Types

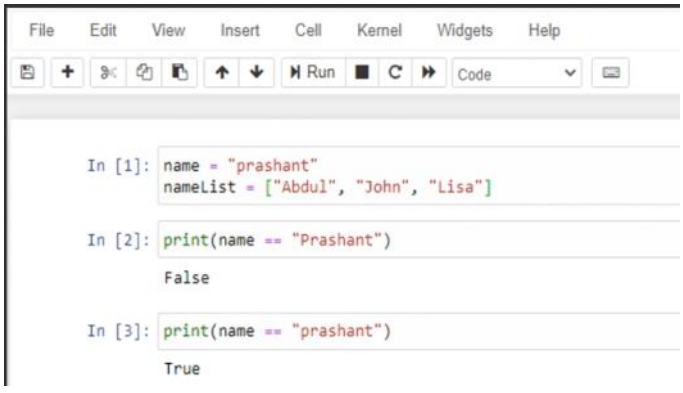
If sequence type is mutable, you can change the content and if the type is immutable then you cannot change the content.

SEQUENCE TYPE	MUTABILITY
List	Mutable
Tuple	Immutable
Range	Immutable
Str	Immutable

Sequence Operations:

1. Comparison
2. Containment Testing
3. Concatenation and Repetition
4. Element Extraction and Slicing
5. Element Index and Count

Sequence is considered same if the type, order and length and elements in the sequence should be same to be marked same.



Containment testing -
Using in or not in operator

```
In [1]: name = "prashant"
        nameList = ["Abdul", "John", "Lisa"]

In [2]: print('h' in name)

        True

In [3]: print("Abdul" in nameList)

        True
```

This kind of search is called as subsequence search -

```
In [1]: name = "prashant"
        nameList = ["Abdul", "John", "Lisa"]

In [2]: print('ash' in name)

        True
```

Subsequence search only works in

```
In [1]: name = "prashant"
        nameList = ["Abdul", "John", "Lisa"]

In [2]: print('ash' in name)

        True

In [3]: print(["Abdul", "John"] in nameList)

        False
```

Concatenation - which means combining two sequences of same type using + operator

File Edit View Insert Cell Kernel Widgets Help

Run Code

```
In [1]: name = "prashant"
        nameList = ["Abdul", "John", "Lisa"]

In [7]: print(name + " pandey")

        prashant pandey

In [8]: print(nameList + name)

        ---------------------------------------------------------------------------
        TypeError                                 Traceback (most recent call last)
        <ipython-input-8-3213dc4cb423> in <module>
        ----> 1 print(nameList + name)

        TypeError: can only concatenate list (not "str") to list
```

```
In [1]: name = "prashant"
        nameList = ["Abdul", "John", "Lisa"]

In [7]: print(name + " pandey")

        prashant pandey

In [9]: print(nameList + [name])

        ['Abdul', 'John', 'Lisa', 'prashant']
```

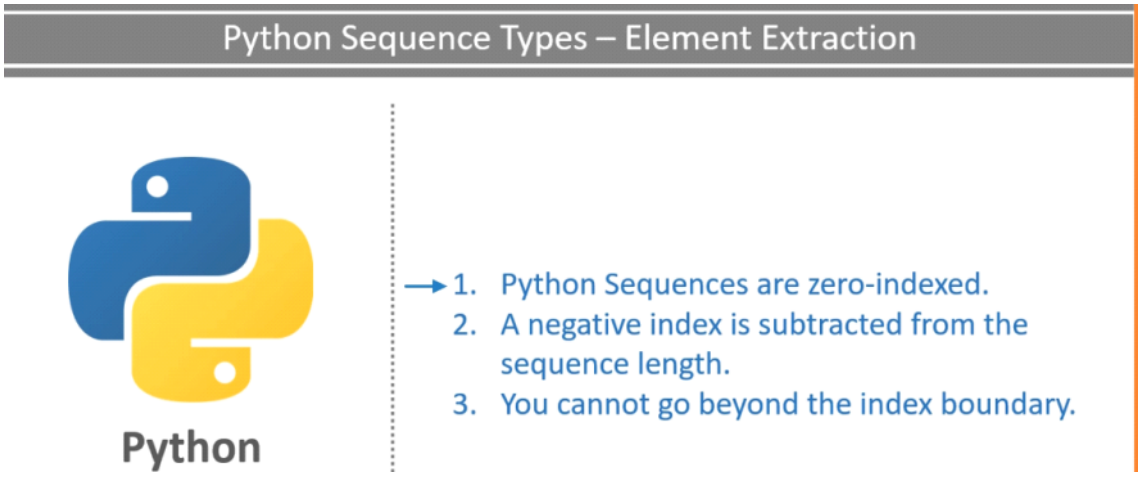
Repetition -

```
In [1]: name = "prashant"
        nameList = ["Abdul", "John", "Lisa"]

In [2]: repeatedName = (name + " ") * 3
        print("Old Name: " + name)
        print("New Name: " + repeatedName)

        Old Name: prashant
        New Name: prashant prashant prashant
```

```
In [3]: repeatedList = nameList * 2
        print("Old List: " + str(nameList))
        print("New List: " + str(repeatedList))

        Old List: ['Abdul', 'John', 'Lisa']
        New List: ['Abdul', 'John', 'Lisa', 'Abdul', 'John', 'Lisa']
```

Concatenation and repetition are not applicable to range sequences.

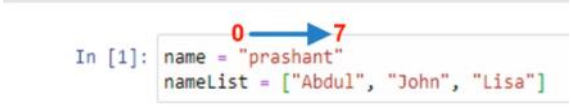
Extraction and slicing -



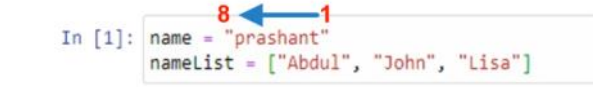
When you use 2 it is the index 2 we are trying to fetch from the left

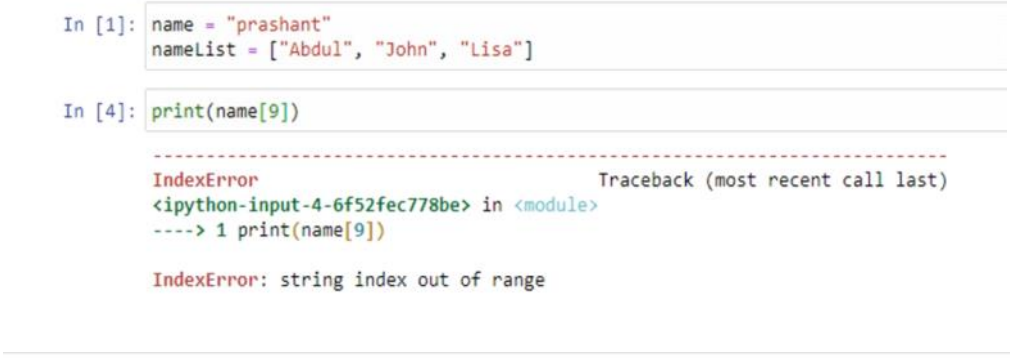
Similarly when we use -2, we are trying to fetch the second index from last index element.

Counting from the left starts with 0 -

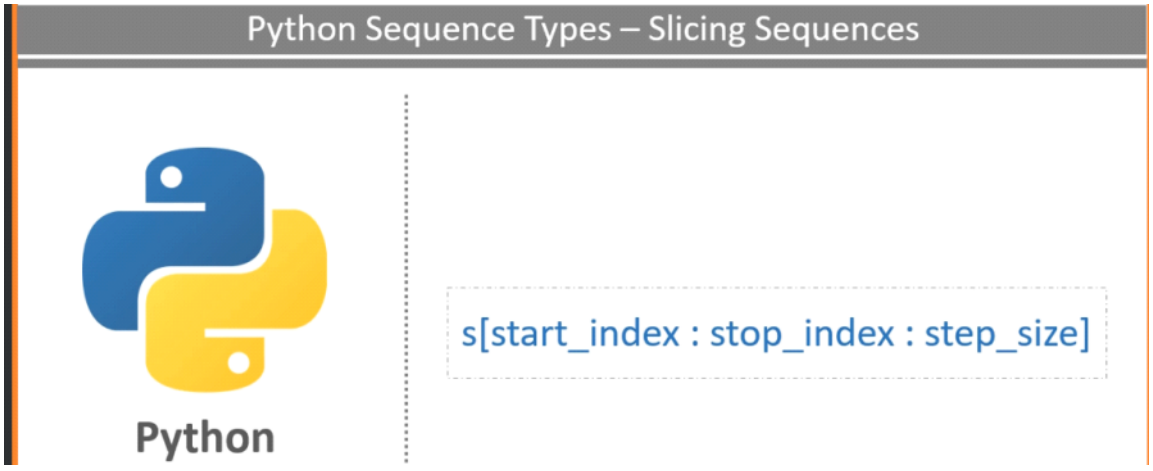


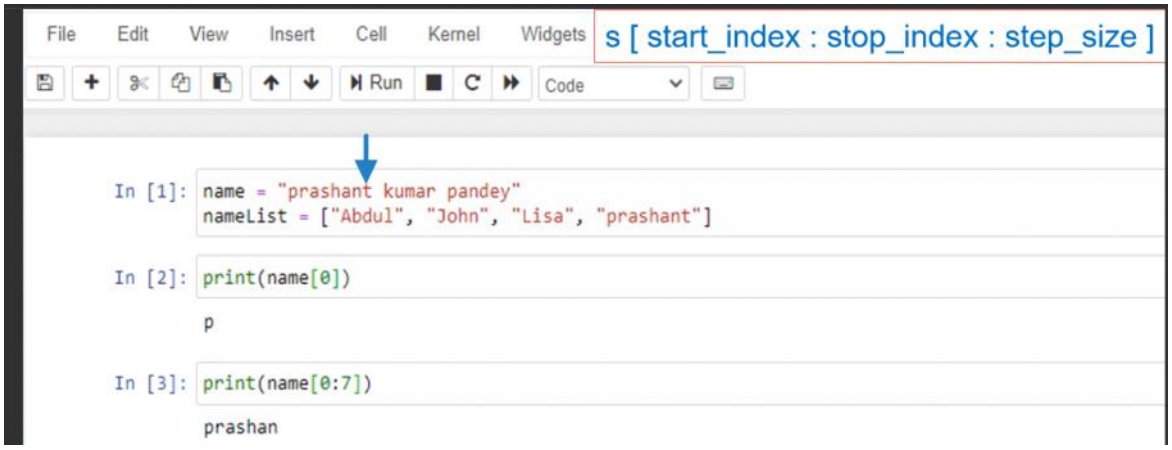
Counting from the right starts with 1 -

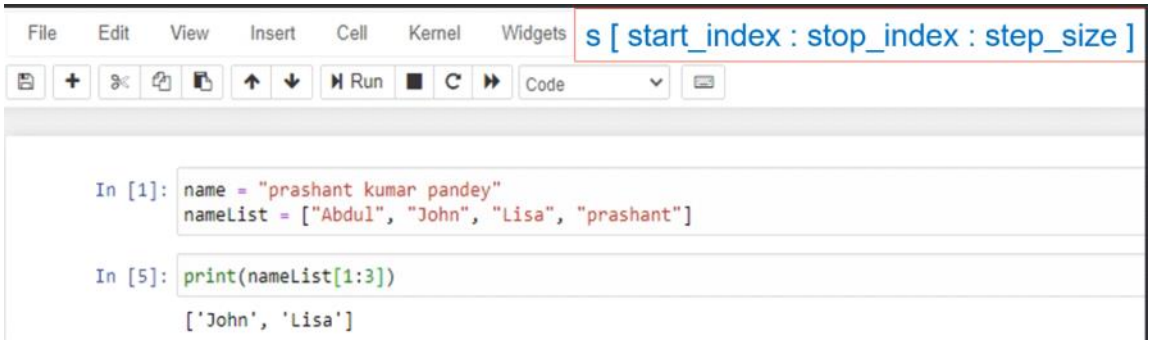




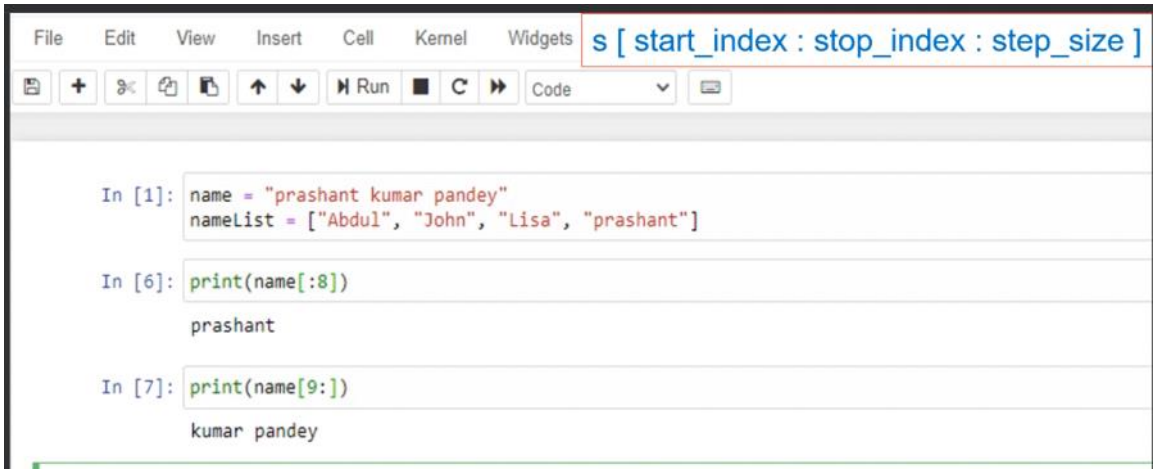
So far we did extraction of single element, if we want to extract multiple characters we can use slicing -
While slicing, the stop index is not included -





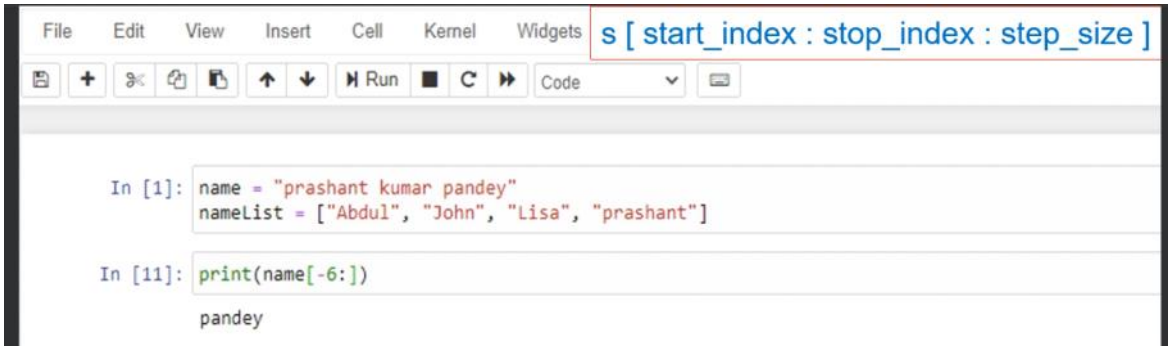


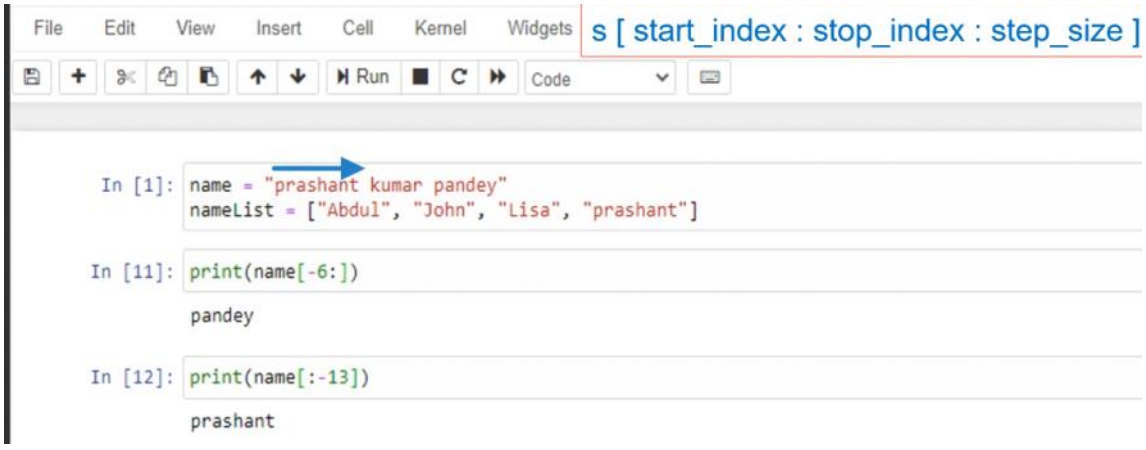
If you don't include the start or stop index, python assumes 0 and full length respectively -

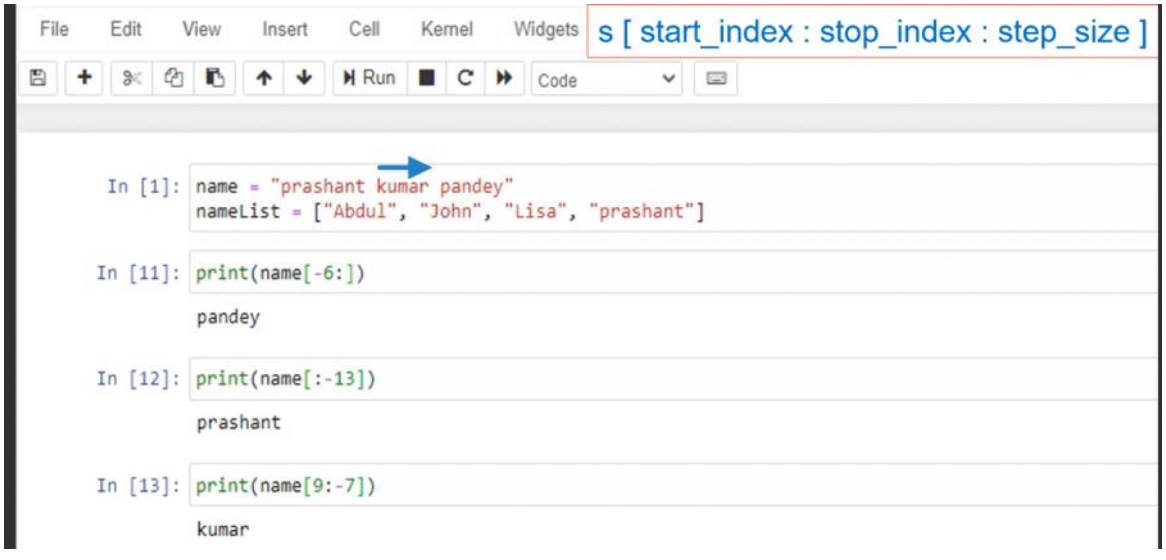


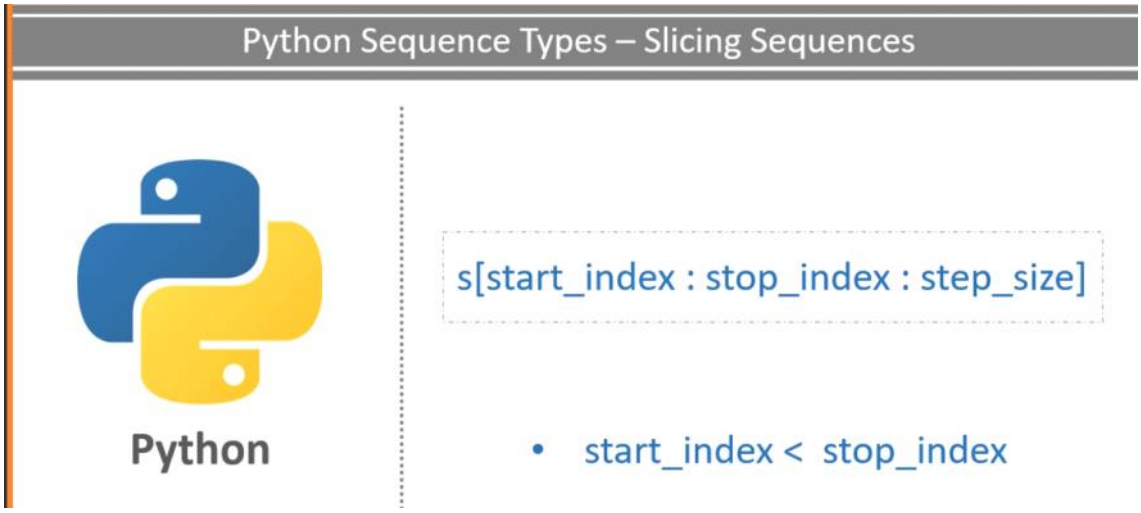
If start and stop both are skipped, it gives entire sequence -

```
In [8]: print(name[:])
        prashant kumar pandey
```

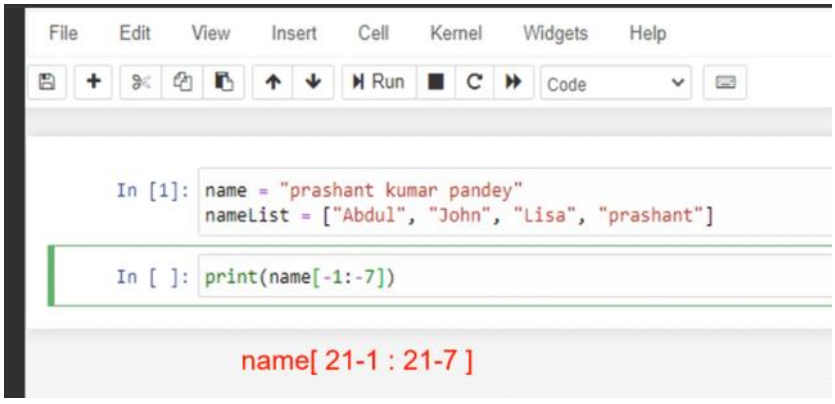








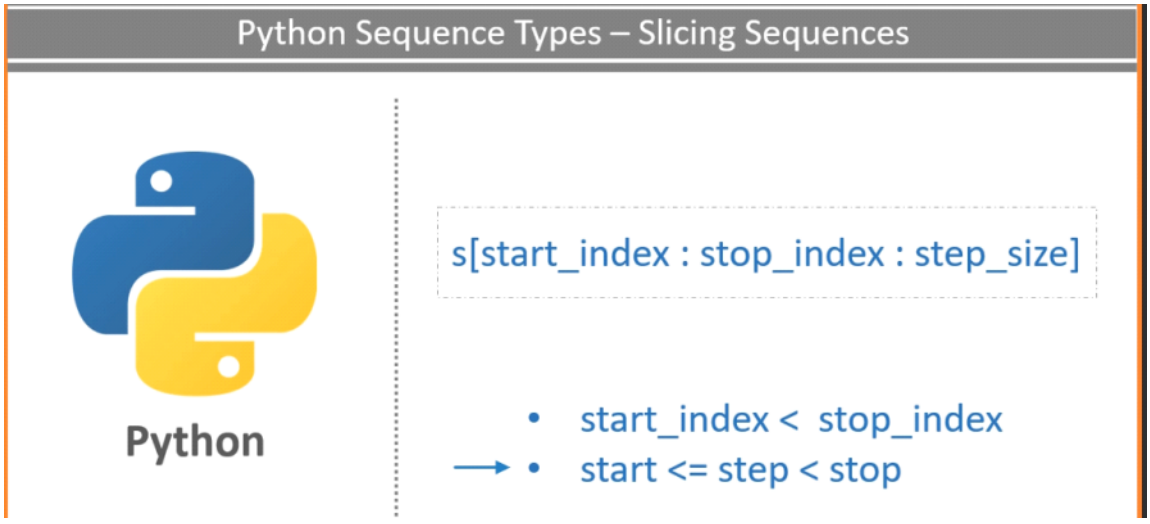
We can check the equivalent position by subtracting the index position from the length -



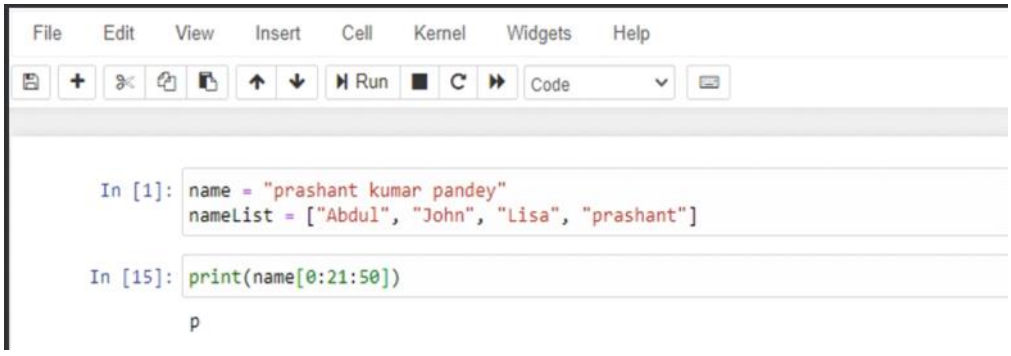
j

So this is not possible -
Output isn't printed. You will get null in the output. No exception

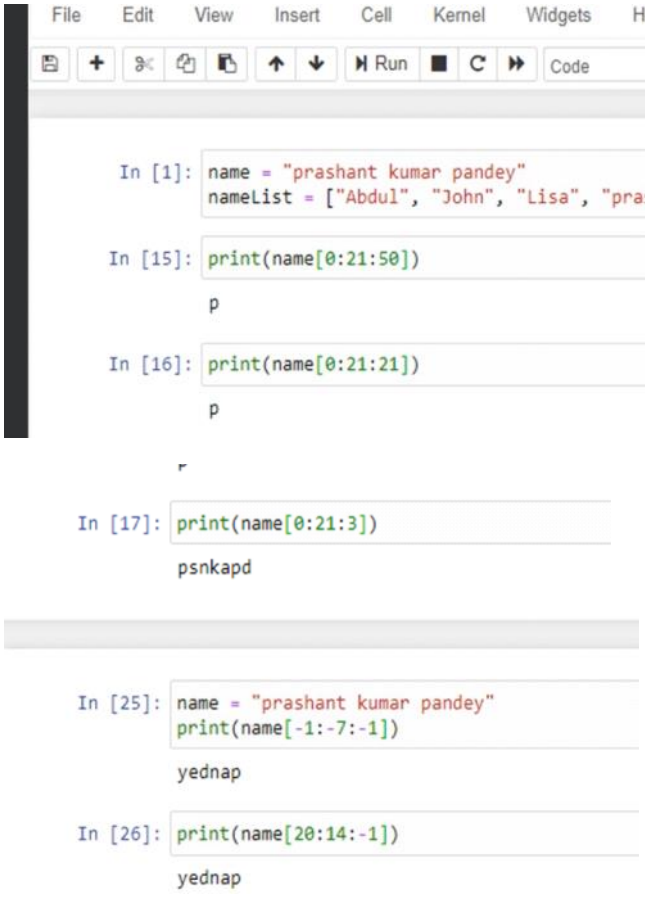
When the step size is not passed, python assumes default as 1.



IMP Slicing doesn't raise exception -



Equivalent -



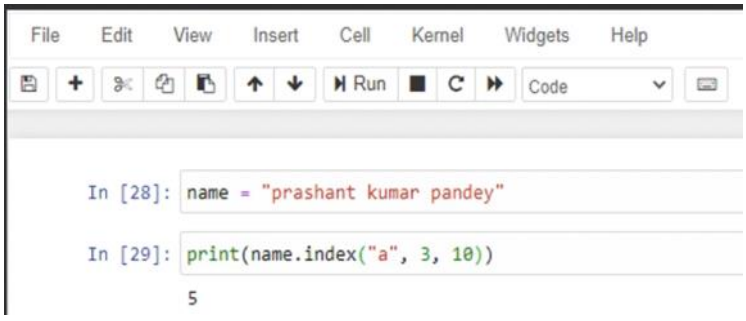
Step being negative has changed the notion of the rule start < = step < stop. Because traversal happens in reverse.

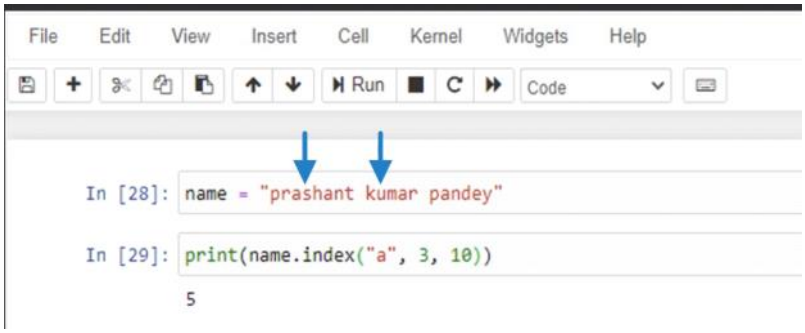
So far we are able to pass the index and do the extraction. What if we want to search the index and then perform the extraction. So indexing helps.
This looks for the first occurrence of x in s. It begins the search at start_index and stops at stop_index. Stop_index is again non inclusive. Start and stop are optional.

Python Sequence Types – Index Function

Python

s.index(x[, start_index[, stop_index]])





Working with Python String

1. String Literals
2. String Functions
3. String Formatting

```
In [1]: quote1 = 'Limit your "Always" and your "Nevers."'
        quote2 = "Time isn't the main thing. It's the only thing."

        print(quote1)
        print(quote2)

Limit your "Always" and your "Nevers."
Time isn't the main thing. It's the only thing.
```

All the spaces are retained when using the multi line string literal

```
In [2]: msg = """Hi!
            How are you doing today?
        When can we meet?"""

        print(msg)

Hi!
    How are you doing today?
When can we meet?
```

```
In [7]: 'Don\'t run'
Out[7]: "Don't run"

In [8]: 'Don't run'
  File "<ipython-input-8-331173d60e9c>", line 1
    'Don't run'
         ^
SyntaxError: invalid syntax
```

Functions in string -

```
In [9]: name = "Learning Journal"

In [11]: len(name)
Out[11]: 16
```

```
In [9]: name = "Learning Journal"

In [12]: name.split()
Out[12]: ['Learning', 'Journal']
```

```
In [1]: name = "Big Data, Machine Learning, Artificial Intelligence"
        name.split(',')
Out[1]: ['Big Data', ' Machine Learning', ' Artificial Intelligence']
```

Join function is opposite of split function -

```
In [2]: nameList = ["Big Data", "Machine Learning", "Artificial Intelligence"]
        nameString = ','.join(nameList)
        print(nameString)

        Big Data,Machine Learning,Artificial Intelligence
```

Replace function -

```
In [3]: msg = 'Hey there! I am going to the park.'
        print(msg.replace('park', 'zoo'))
        print(msg)

        Hey there! I am going to the zoo.
        Hey there! I am going to the park.
```

```
In [7]: name = "   Learning Journal   "

In [8]: name.strip()

Out[8]: 'Learning Journal'
```

Lstrip and rstrip

```
In [7]: name = "   Learning Journal   "

In [8]: name.strip()
Out[8]: 'Learning Journal'

In [9]: name.rstrip()
Out[9]: '   Learning Journal'

In [10]: name.lstrip()
Out[10]: 'Learning Journal   '

In [ ]:
```

```
In [14]: name = "John"
         age = "25"

In [15]: info = "Hey! It's " + name + ", and I am " + age + " years old."
         print(info)

         Hey! It's John, and I am 25 years old.
```

{} and format in combination can perform the concatenation cleanly -

```
In [14]: name = "John"
         age = "25"

In [17]: info = "Hey! It's {}, and I am {} years old.".format(name, age)
         print(info)

         Hey! It's John, and I am 25 years old.
```

String formatting -

```
In [14]: name = "John"
         age = "25"

In [20]: info = f"Hey! It's {name}, and I am {age} years old."
         print(info)

         Hey! It's John, and I am 25 years old.
```

Working with Python List and Tuple

Tuple – (0, 1, 2, 3)

List – [0, 1, 2, 3]

Tuple – (0, 1, 2, 3) : Immutable

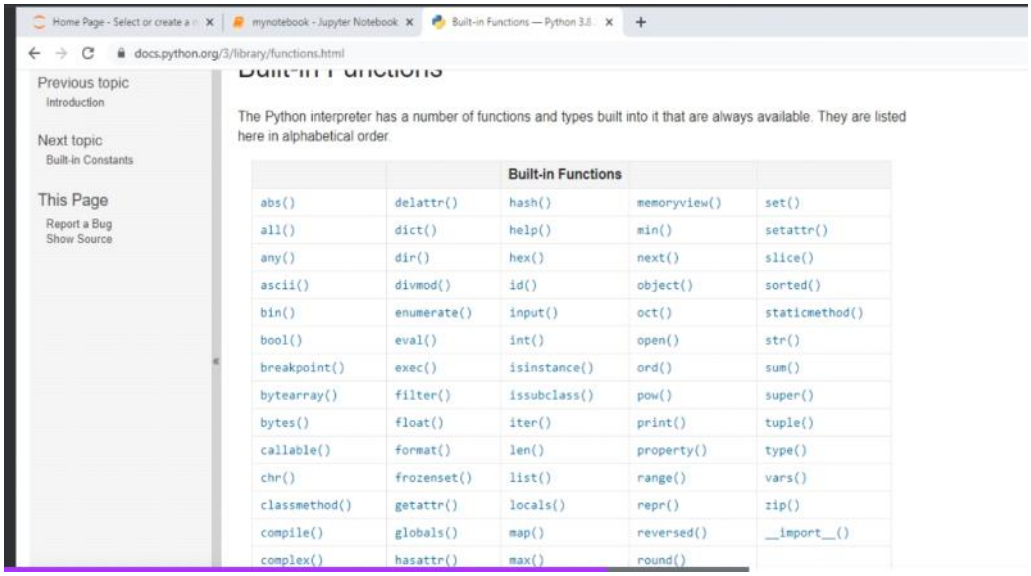
List – [0, 1, 2, 3] : Mutable

```
In [1]: myTuple = ('Big Data', 'Machine Learning')
        myList = ['Artificial Intelligence', 'Data Analytics']
        print(myTuple)
        print(myList)

        ('Big Data', 'Machine Learning')
        ['Artificial Intelligence', 'Data Analytics']

In [2]: myList2 = ['Artificial Intelligence', 'Data Analytics', 2, 3.6]
        print(myList2)

        ['Artificial Intelligence', 'Data Analytics', 2, 3.6]
```

We can use append function to add elements to the list.

```
In [3]: myTuple = ('Big Data', 'Machine Learning')

In [4]: myTuple.append('Data Science')

---------------------------------------------------------------------------
AttributeError                            Traceback (most recent call last)
<ipython-input-4-c62fb5822749> in <module>
----> 1 myTuple.append('Data Science')

AttributeError: 'tuple' object has no attribute 'append'
```

We can use list of different functions that can be applied to variety of datatypes.




```
In [1]: myTuple = ('Big Data', 'Machine Learning')
        myList = ['Artificial Intelligence', 'Data Analytics', 'Data Science']
        print(len(myTuple))
        print(len(myList))

        2
        3
```

```
In [1]: list1 = [23, 48, 3, 17]
        tuple1 = (25, 52, 7, 12)
        print(max(list1))
        print(min(list1))
        print(max(tuple1))
        print(min(tuple1))

        48
        3
        52
        7
```

```
In [1]: list1 = [23, 48, 3, 17]

In [2]: list1.pop()
Out[2]: 17

In [3]: list1
Out[3]: [23, 48, 3]

In [4]: list1.append(8)
        print(list1)

        [23, 48, 3, 8]
```

```
In [5]: list1.insert(0, 11)
        list1
Out[5]: [11, 23, 48, 3, 8]
```

Python Loops, Iterators and Range

1. While Loops
2. For Loops

1. While Loop
2. For Loop
3. List Comprehension

Includes break and continue -

```
In [1]: a = 0

        while a < 5:
            print(a)
            a += 1
```

```
0
1
2
3
4
```

```
In [2]: name = "Learning Journal"
        i = 0

        while True:
            if name[i] == 'J':
                break
            print(name[i])
            i += 1

        print("Outside While Loop.")
```

```
L
e
a
r
n
i
n
g

Outside While Loop.
```

```
In [3]: num = 5

        while num > 0:
            num -= 1
            if num == 2:
                continue
            print(num)

        print("Outside While Loop.")
```

```
4
3
1
0
Outside While Loop.
```

```
In [4]: grocery_list = ['eggs', 'milk', 'bread', 'veggies']

        for food in grocery_list:
            print(food)
```

```
eggs
milk
bread
veggies
```

```
In [7]: myRange = range(10)

In [8]: print(myRange)
```

```
range(0, 10)
```

Start is always inclusive and endpoint is exclusive.

```
In [9]: for i in myRange:
            print(i)
```

```
0
1
2
3
4
5
6
7
8
9
```

```
In [10]: for i in range(5, 10):
             print(i)
```

```
5
6
7
8
9
```

You can use step in range and slice.
You can use step size too -

```
In [11]: for i in range(5, 15, 2):
             print(i)
```

```
5
7
9
11
13
```

Can also use negative step size too -

```
In [12]: for i in range(15, 5, -2):
             print(i)

15
13
11
9
7
```

List comprehension -

We have to create a new list by transforming existing list.

```
In [14]: rectangles = [(15, 10), (3, 5), (5, 6)]
```

(l, b)

```
In [14]: rectangles = [(15, 10), (3, 5), (5, 6)]

In [17]: areas = [150, 15, 30]

In [18]: rectangle_areas = [(15, 10, 150), (3, 5, 15), (5, 6, 30)]
```

(l, b, l x b)

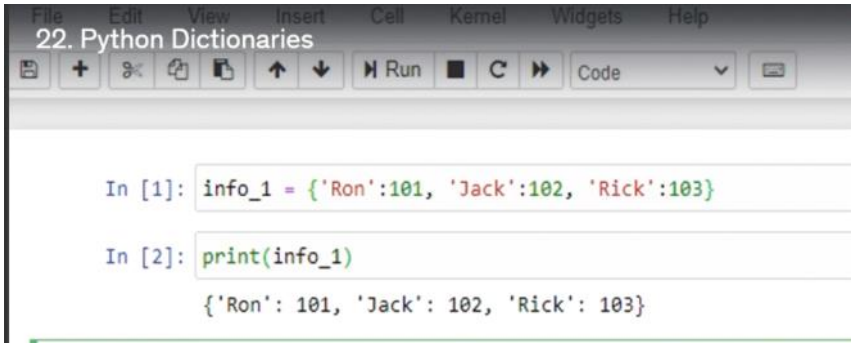
Traditional approach using for loop -

```
In [19]: rectangles = [(15,10), (3,5), (5,6)]

In [20]: areas = []

         for (x, y) in rectangles:
             areas.append(x*y)

         print(areas)

[150, 15, 30]
```

```
In [26]: rectangles = [(15,10), (3,5), (5,6)]

In [27]: rectangle_areas = [ (x, y, x*y) for (x, y) in rectangles]

In [28]: print(rectangle_areas)

[(15, 10, 150), (3, 5, 15), (5, 6, 30)]
```

Python Dictionaries

{Key : Value}




```
In [3]: info_3 = dict(Ron = 101, Jack = 102, Rick = 103)

In [4]: print(info_3)
        {'Ron': 101, 'Jack': 102, 'Rick': 103}
```

Usually dict function is used to convert the list or tuple with key, value pair to dictionary.

```
[41]: mydict = dict(abc = 101, ade = 102, alla=149)
      print(mydict)
      {'abc': 101, 'ade': 102, 'alla': 149}
```

```
In [7]: my_tuple = (('Tom', 104), ('John', 105))

In [8]: info_5 = dict(my_tuple)

        print(info_5)
        {'Tom': 104, 'John': 105}
```

We can notice that the value associated with the Ron got updated. As well we can add the item to the dictionary too.

```
In [10]: info_1 = {'Ron':101, 'Jack':102, 'Rick':103}

In [11]: info_1['Jack']
Out[11]: 102

In [12]: info_1['Ron'] = 108

         print(info_1)
         {'Ron': 108, 'Jack': 102, 'Rick': 103}

In [13]: info_1['Siri'] = 110

         print(info_1)
         {'Ron': 108, 'Jack': 102, 'Rick': 103, 'Siri': 110}
```

Keys, values, items methods can be used to access the keys, values and the key.value pairs i.e. items from the dictionary.

```
In [15]: info_1.keys()
Out[15]: dict_keys(['Ron', 'Jack', 'Rick', 'Siri'])

In [16]: info_1.values()
Out[16]: dict_values([108, 102, 103, 110])

In [17]: info_1.items()
Out[17]: dict_items([('Ron', 108), ('Jack', 102), ('Rick', 103), ('Siri', 110)])
```

```
In [8]: for i, j in info_1.items():
            print(i, j)
        Ron 108
        Jack 102
        Rick 103
        Siri 110
```

We can combine two dictionaries using the double asterisk on each of the dictionary.

```
In [9]: info_1 = {'Ron': 101, 'John': 102, 'Rick': 103}
        info_2 = {'Tom': 104, 'Harry': 105, 'Rick': 105}

In [10]: info_1_2 = {**info_1, **info_2}

         print(info_1_2)
         {'Ron': 101, 'John': 102, 'Rick': 105, 'Tom': 104, 'Harry': 105}
```

We can use update function to update the current dictionary with latest from dictionary 2.

```
In [9]: info_1 = {'Ron': 101, 'John': 102, 'Rick': 103}
        info_2 = {'Tom': 104, 'Harry': 105, 'Rick': 105}

In [12]: info_1.update(info_2)

In [13]: print(info_1)
         {'Ron': 101, 'John': 102, 'Rick': 105, 'Tom': 104, 'Harry': 105}
```

We can delete certain elements in the dictionary by using del function.

```
In [14]: info_1 = {'Ron': 101, 'John': 102, 'Rick': 103}

In [16]: len(info_1)
Out[16]: 3

In [17]: del info_1['Ron']

In [18]: info_1
Out[18]: {'John': 102, 'Rick': 103}
```

You can delete the dictionary -

```
In [21]: info_1 = {'Ron': 101, 'John': 102, 'Rick': 103}

In [22]: del info_1

In [23]: info_1
         ---------------------------------------------------------------------------
         NameError                                 Traceback (most recent call last)
         <ipython-input-23-83eaab0eeb3b> in <module>
         ----> 1 info_1

         NameError: name 'info_1' is not defined
```

If you don’t want to delete the dictionary where as want to clear all the elements in the dictionary, you can use dict.clear() function

```
In [24]: info_1 = {'Ron': 101, 'John': 102, 'Rick': 103}

In [25]: info_1.clear()

In [26]: info_1
Out[26]: {}
```

In operator checks keys in dictionary -

```
In [30]: info_1 = {'Ron': 101, 'John': 102, 'Rick': 103}

In [31]: 'John' in info_1
Out[31]: True

In [32]: 'Harry' not in info_1
Out[32]: True
```

```
In [33]: info_1 = {'Ron': 101, 'John': 102, 'Rick': 103}
         info_2 = {'Ron': 101, 'John': 102, 'Rick': 103}

In [34]: info_1 == info_2
Out[34]: True

In [35]: info_1 != info_2
Out[35]: False
```

Shallow copy of the dictionary to another -

```
In [37]: info_1 = {'Ron': 101, 'John': 102, 'Rick': 103}

In [38]: info = info_1.copy()

         print(info)

         {'Ron': 101, 'John': 102, 'Rick': 103}
```

```
In [40]: msg = {'A':'Sleep', 'B':'Eat', 'X':['Play', 'Study']}

In [42]: inform = msg.copy()

         print(inform)
         print(msg)

         {'A': 'Sleep', 'B': 'Eat', 'X': ['Play', 'Study']}
         {'A': 'Sleep', 'B': 'Eat', 'X': ['Play', 'Study']}

In [43]: inform ['X'][1] = 'Cook'

         print(inform)

         {'A': 'Sleep', 'B': 'Eat', 'X': ['Play', 'Cook']}

In [44]: print(msg)

         {'A': 'Sleep', 'B': 'Eat', 'X': ['Play', 'Cook']}
```

If we want to utilize the functionality of deep copy, we can do so by using the copy module. This will not affect changes made to cloned dictionary

```
In [48]: import copy

         inform = copy.deepcopy(msg)

         print(inform)
         print(msg)

         {'A': 'Sleep', 'B': 'Eat', 'X': ['Play', 'Study']}
         {'A': 'Sleep', 'B': 'Eat', 'X': ['Play', 'Study']}

In [49]: inform['X'][1] = 'Cook'

         print(inform)

         {'A': 'Sleep', 'B': 'Eat', 'X': ['Play', 'Cook']}

In [50]: print(msg)

         {'A': 'Sleep', 'B': 'Eat', 'X': ['Play', 'Study']}
```

Dictionary comprehension -
We know that the comprehension is used to transform an iterable object to another iterable object.

```
In [51]: square = {x : x**2 for x in range(0, 5)}
         print(square)

         {0: 0, 1: 1, 2: 4, 3: 9, 4: 16}
```

Python sets -

Set is an unordered collection of elements.
You can think of set as dictionary with only keys and no values.

```
In [1]: mySet = {0, 1, 2, 3}

In [2]: print(mySet)

        {0, 1, 2, 3}
```

Primary objective of set is to eliminate duplicate elements or test for the membership.

```
In [1]: mySet = {0, 1, 2, 3}

In [2]: print(mySet)
        {0, 1, 2, 3}

In [3]: mySet = {0, 0, 1, 2, 2, 2}

        print(mySet)
        {0, 1, 2}
```

```
In [4]: myList = ['Ram', 'Mohan', 'Abdul', 'John', 'Ram']

        print(myList)

        ['Ram', 'Mohan', 'Abdul', 'John', 'Ram']
```

You can convert the list to set using set function.

Side note - Single asterisk can be used to unpack the list, tuple.

```
In [4]: myList = ['Ram', 'Mohan', 'Abdul', 'John', 'Ram']
        print(myList)
        ['Ram', 'Mohan', 'Abdul', 'John', 'Ram']

In [5]: mySet = set(myList)
        print(mySet)
        {'Ram', 'Mohan', 'Abdul', 'John'}
```

We have created a non empty set of set. How to create an empty set of set. It is not curly braces. Because we create dictionary using empty curly braces.

```
In [5]: mySet = {0, 0, 1, 2, 2}

In [6]: myEmptySet = {}

In [7]: type(myEmptySet)
Out[7]: dict
```

```
In [8]: myEmptySet = set()

In [9]: type(myEmptySet)
Out[9]: set
```

Major use of using set is to eliminate duplicates. We were just able to create a set by having both upper and lower case letters. But if we want to eliminate duplicates, we will have to either upper / lower case the letters first before applying the set on it.

```
In [10]: set('Learning Journal')
Out[10]: {' ', 'J', 'L', 'a', 'e', 'g', 'i', 'l', 'n', 'o', 'r', 'u'}
```

```
In [10]: set('Learning Journal')
Out[10]: {' ', 'J', 'L', 'a', 'e', 'g', 'i', 'l', 'n', 'o', 'r', 'u'}

In [11]: set('Learning Journal'.lower())
Out[11]: {' ', 'a', 'e', 'g', 'i', 'j', 'l', 'n', 'o', 'r', 'u'}
```

Converting different data structures to set -
Notice the dictionary conversion just printing its values.

```
In [12]: set(['Literature', 'Science', 'Maths'])
Out[12]: {'Literature', 'Maths', 'Science'}

In [13]: set(('Eat', 'Sleep', 'Repeat'))
Out[13]: {'Eat', 'Repeat', 'Sleep'}

In [14]: set({1:'East', 2:'South', 3:'North', 4:'West'})
Out[14]: {1, 2, 3, 4}
```

Set has add function -
However, it can just add one element to the add function

```
In [15]: mySet = {0, 1, 2, 3, 4, 5}

In [17]: mySet.add(6)

In [18]: mySet
Out[18]: {0, 1, 2, 3, 4, 5, 6}
```

If we want to add list to the set, then we can use the update method -

```
In [15]: mySet = {0, 1, 2, 3, 4, 5}

In [20]: mySet.update([7, 8, 9])

In [21]: mySet
Out[21]: {0, 1, 2, 3, 4, 5, 6, 7, 8, 9}
```

You can also remove element from the set -

```
In [22]: mySet
Out[22]: {0, 1, 2, 3, 4, 5, 6, 7, 8, 9}

In [23]: mySet.remove(4)

In [24]: mySet
Out[24]: {0, 1, 2, 3, 5, 6, 7, 8, 9}
```

You can also perform union, intersection and

```
In [25]: set1 = {0, 1, 2}
         set2 = {2, 3, 4, 5}

In [26]: set1.union(set2)
Out[26]: {0, 1, 2, 3, 4, 5}

In [27]: set1 | set2
Out[27]: {0, 1, 2, 3, 4, 5}
```

Intersection can be performed using below. Also can use ampersand -

```
In [25]: set1 = {0, 1, 2}
         set2 = {2, 3, 4, 5}

In [28]: set1.intersection(set2)
Out[28]: {2}

In [29]: set1 & set2
Out[29]: {2}
```

Also perform difference -

```
In [25]: set1 = {0, 1, 2}
         set2 = {2, 3, 4, 5}

In [32]: set1.difference(set2)
Out[32]: {0, 1}

In [33]: set2.difference(set1)
Out[33]: {3, 4, 5}

In [34]: set1 - set2
Out[34]: {0, 1}

In [35]: set2 - set1
Out[35]: {3, 4, 5}
```

You can also use symmetric difference. Present in set1, set2 but not in both - Anything other than overlap

```
In [25]: set1 = {0, 1, 2}
         set2 = {2, 3, 4, 5}

In [36]: set1.symmetric_difference(set2)
Out[36]: {0, 1, 3, 4, 5}

In [37]: set1 ^ set2
Out[37]: {0, 1, 3, 4, 5}
```

```
In [38]: mySet
Out[38]: {0, 1, 2, 3, 5, 6, 7, 8, 9}

In [39]: 5 in mySet
Out[39]: True

In [40]: 4 in mySet
Out[40]: False

In [41]: 101 not in mySet
Out[41]: True
```

```
In [42]: set1 = {0, 1}
         set2 = {0, 1, 2, 3}

In [43]: set1.issubset(set2)
Out[43]: True

In [44]: set1 <= set2
Out[44]: True
```

```
In [42]: set1 = {0, 1}
         set2 = {0, 1, 2, 3}

In [45]: set2.issuperset(set1)
Out[45]: True

In [46]: set2 >= set1
Out[46]: True
```

Think of set as mathematical set to perform it's operations -

```
In [3]: mySet = {1, 3, 5, 8}

In [4]: mySet{2}
  File "<ipython-input-4-bca429599148>", line 1
    mySet{2}
         ^
SyntaxError: invalid syntax
```

If you want to access elements in the set like in case of tuple or list like below -

```
In [3]: mySet = {1, 3, 5, 8}

In [4]: mySet{2}
  File "<ipython-input-4-bca429599148>", line 1
    mySet{2}
         ^
SyntaxError: invalid syntax
```

*** So extraction and slicing can't be performed on the set as it is an unordered structure.

You can access using iterator though. Notice unordered retrieval of elements -

```
In [1]: mySet = {1,3,5,8}

In [2]: for i in mySet:
            print(i)

8
1
3
5
```

To create a frozen set. i.e. immutable set.

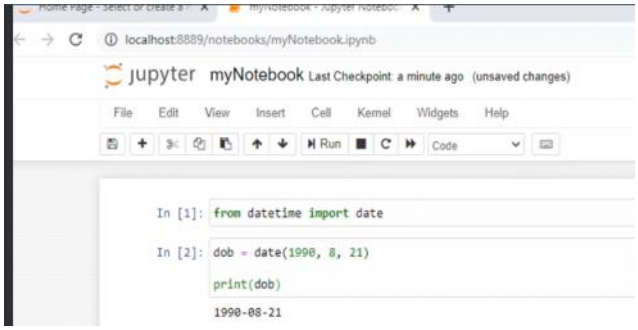
```
In [3]: myFrozenSet = frozenset((0, 2, 4))

In [4]: print(myFrozenSet)
frozenset({0, 2, 4})

In [5]: myFrozenSet.add(6)
---------------------------------------------------------------------------
AttributeError                            Traceback (most recent call last)
<ipython-input-5-6d977a8eb510> in <module>
----> 1 myFrozenSet.add(6)

AttributeError: 'frozenset' object has no attribute 'add'
```

Python doesn't have a standard module for date and time. We must import the datetime module from python library.

Datetime module offers primarily the below classes. All the objects of this class are immutable. However you can manipulate them and create a new object

Python Datetime Module

1. date
2. time
3. datetime
4. timedelta



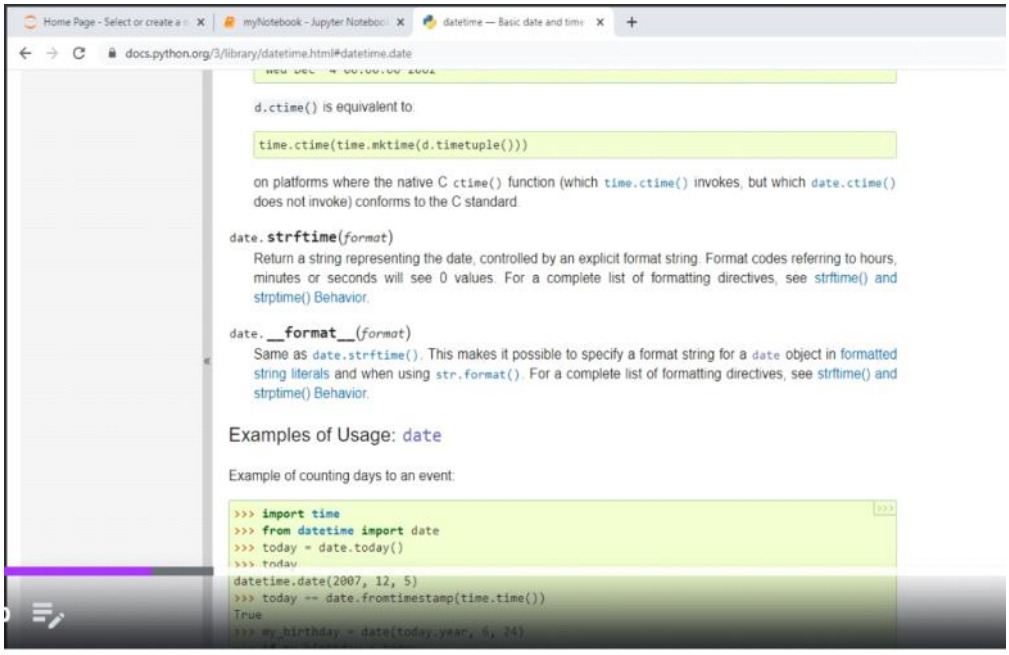

```
In [1]: from datetime import date

In [4]: date(1990, 3, 31)
Out[4]: datetime.date(1990, 3, 31)

In [5]: date(1990, 4, 31)
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
<ipython-input-5-9dc9cceb8a5d> in <module>
----> 1 date(1990, 4, 31)

ValueError: day is out of range for month
```

```
In [1]: from datetime import date

In [6]: date.today()
Out[6]: datetime.date(2020, 10, 7)
```

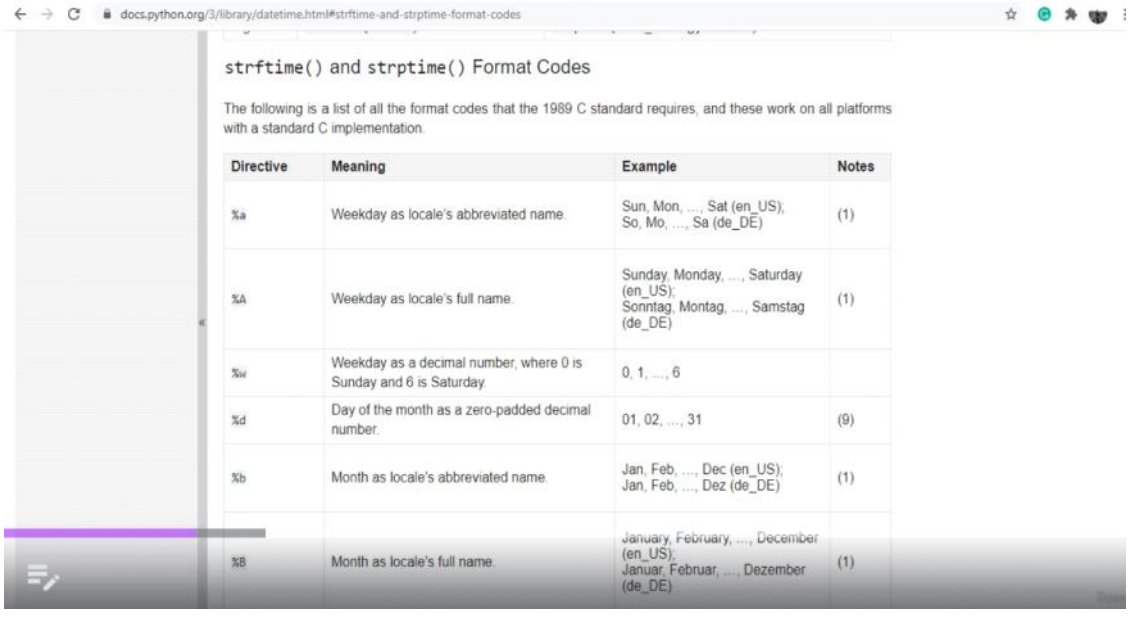
```
In [1]: from datetime import date

In [7]: dob = date(1990, 8, 21)

In [8]: print(dob.day)
21

In [9]: print(dob.month)
8

In [10]: print(dob.year)
1990
```

Explore these methods -

- weekday()
- replace()
- strftime()




```
In [1]: from datetime import date

In [12]: dob = date(1990, 8, 21)

In [13]: dob.strftime("%A %d - %b %Y")
Out[13]: 'Tuesday 21 - Aug 1990'
```

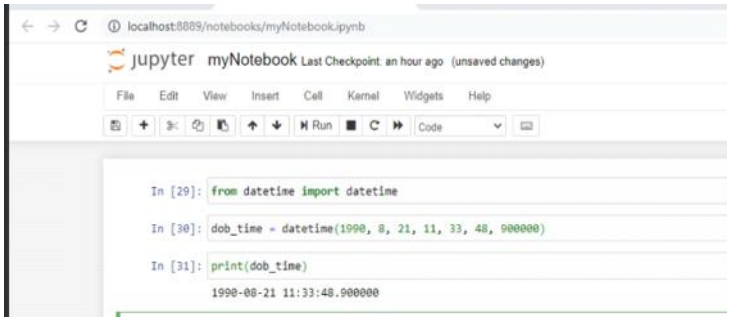



```
In [16]: from datetime import time

In [17]: meet = time(11, 33, 48, 900000)

In [18]: print(meet)
         11:33:48.900000
```

It does validation of the values supplied -

```
In [16]: from datetime import time

In [19]: meet = time(24, 33, 48, 900000)

---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
<ipython-input-19-cd970a5f1059> in <module>
----> 1 meet = time(24, 33, 48, 900000)

ValueError: hour must be in 0..23
```

```
In [16]: from datetime import time

In [21]: print(meet)
         23:33:48.900000

In [25]: print(meet.hour)
         23

In [26]: print(meet.minute)
         33

In [27]: print(meet.second)
         48
```



Python Datetime Module – datetime function

1. year
2. month
3. date
4. hour
5. minute
6. second
7. microsecond

```
In [29]: from datetime import datetime

In [31]: print(dob_time)
         1990-08-21 11:33:48.900000

In [35]: print(dob_time.month)
         8

In [36]: print(dob_time.day)
         21

In [37]: print(dob_time.hour)
         11
```

```
In [39]: from datetime import timedelta

In [40]: duration = timedelta(days = 2, hours = 3, minutes = 45)

In [41]: print(duration)
         2 days, 3:45:00
```

Time addition doesn't make sense -

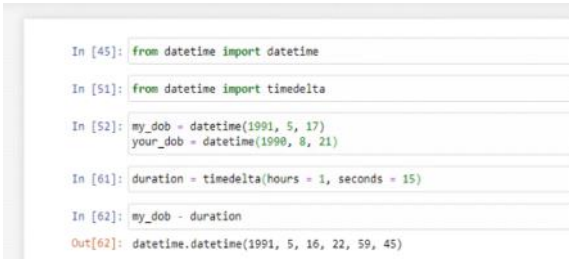
```
In [45]: from datetime import datetime

In [46]: my_dob = datetime(1991, 5, 17)
         your_dob = datetime(1990, 8, 21)

In [47]: my_dob + your_dob
         ---------------------------------------------------------------------------
         TypeError                                 Traceback (most recent call last)
         <ipython-input-47-6b4d4a9273a4> in <module>
         ----> 1 my_dob + your_dob

         TypeError: unsupported operand type(s) for +: 'datetime.datetime' and 'datetime.datetime'
```

Date subtraction can show age differences -

```
In [45]: from datetime import datetime

In [46]: my_dob = datetime(1991, 5, 17)
         your_dob = datetime(1990, 8, 21)

In [48]: my_dob - your_dob
Out[48]: datetime.timedelta(days=269)
```

If you still want to add the date, then we can use duration and add it to date.

```
In [45]: from datetime import datetime

In [51]: from datetime import timedelta

In [52]: my_dob = datetime(1991, 5, 17)
         your_dob = datetime(1990, 8, 21)

In [53]: duration = timedelta(days = 2)

In [54]: my_dob + duration
Out[54]: datetime.datetime(1991, 5, 19, 0, 0)
```



datetime + datetime = Not allowed
datetime - datetime = datetime
datetime + timedelta = datetime
datetime - timedelta = datetime

```
In [68]: from datetime import time

In [69]: my_time = time(8, 15, 10)
         your_time = time(11, 33, 48)

In [70]: my_time - your_time
---------------------------------------------------------------------------
TypeError                                 Traceback (most recent call last)
<ipython-input-70-291014de0b9f> in <module>
----> 1 my_time - your_time

TypeError: unsupported operand type(s) for -: 'datetime.time' and 'datetime.time'
```

```
In [1]: from datetime import time, timedelta

In [8]: my_time = time(10, 0)
        duration = timedelta(hours = 1)

In [10]: my_time - duration
---------------------------------------------------------------------------
TypeError                                 Traceback (most recent call last)
<ipython-input-10-1eb5252eb978> in <module>
----> 1 my_time - duration

TypeError: unsupported operand type(s) for -: 'datetime.time' and 'datetime.timedelta'
```

This is not allowed because, time is always associated with date. If there isn't date associated with time, there isn't reason for adding duration

time + timedelta = Not allowed
time - timedelta = Not allowed
time + time = Not allowed
time - time = Not allowed

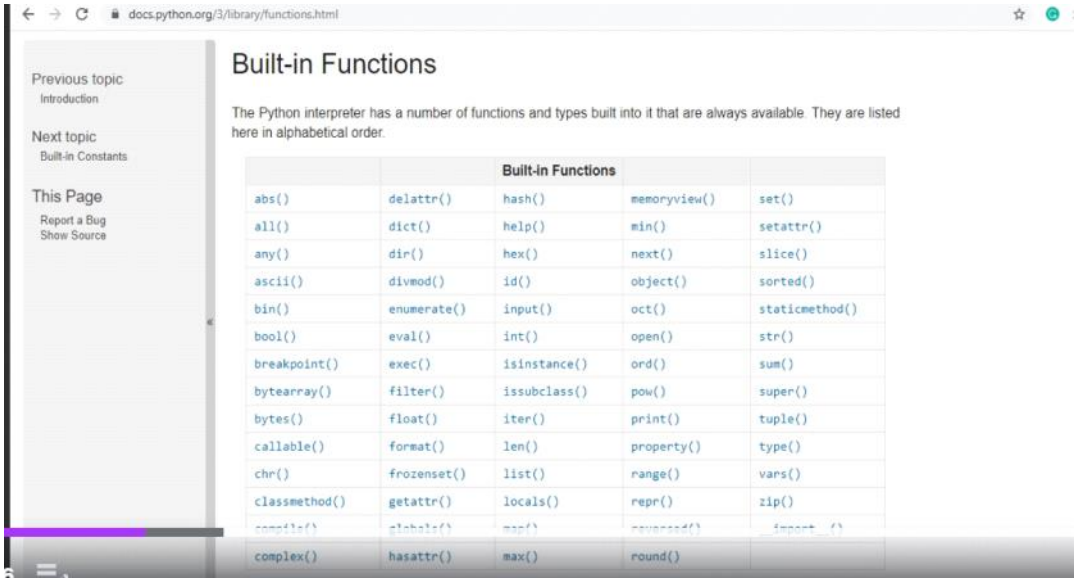
Date BUT NO Time → date()

Date AND Time → datetime()

Functions -
Functions are either built in or user defined.

Some of the built in are as below -

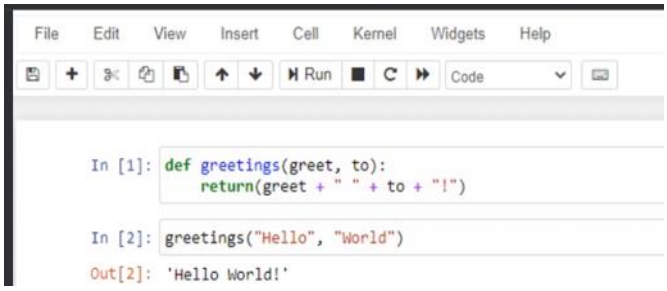
```
In [1]: tuple_1 = (5, 10, 15, 20)

In [2]: min(tuple_1)
Out[2]: 5

In [3]: max(tuple_1)
Out[3]: 20

In [4]: len(tuple_1)
Out[4]: 4

In [5]: print(tuple_1)
        (5, 10, 15, 20)
```




```
def function_name (parameter_1, parameter_2, ..) :
        statements
        ....
```

```
In [1]: def even_or_odd(a):
            if a % 2 == 0:
                print('Even')
            else:
                print('Odd')

In [2]: even_or_odd(5)
        Odd
```

```
In [3]: def even_or_odd(a):
            if a % 2 == 0:
                return('Even')
            else:
                return('Odd')
```

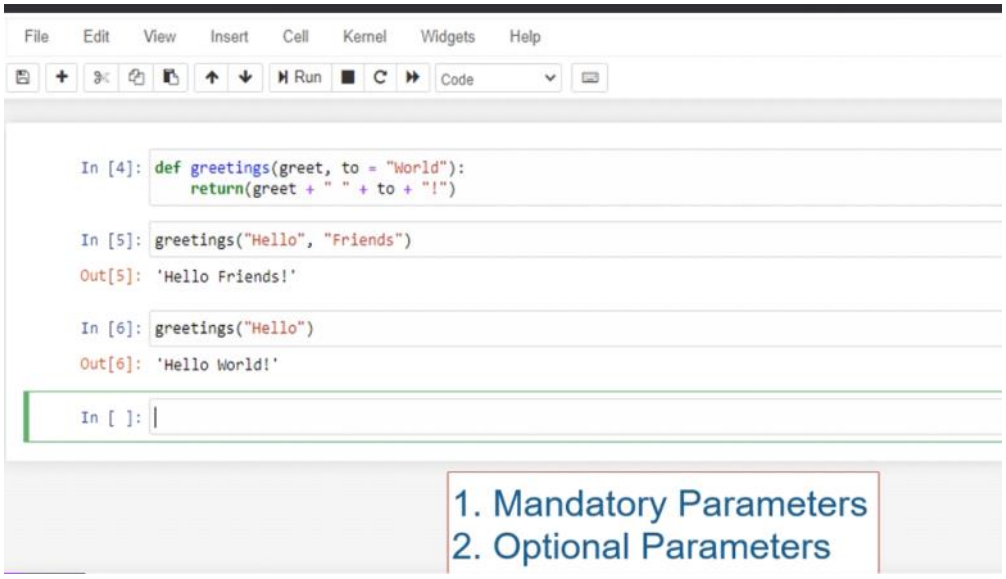


If you send more than the given number of parameters to the function or any less it will give an error missing 1 required positional argument -

```
In [1]: def greetings(greet, to):
            return(greet + " " + to + "!")

In [2]: greetings("Hello", "World")
Out[2]: 'Hello World!'

In [3]: greetings("Hello")
        ---------------------------------------------------------------------------
        TypeError                                 Traceback (most recent call last)
        <ipython-input-3-90cba574d163> in <module>
        ----> 1 greetings("Hello")

        TypeError: greetings() missing 1 required positional argument: 'to'
```

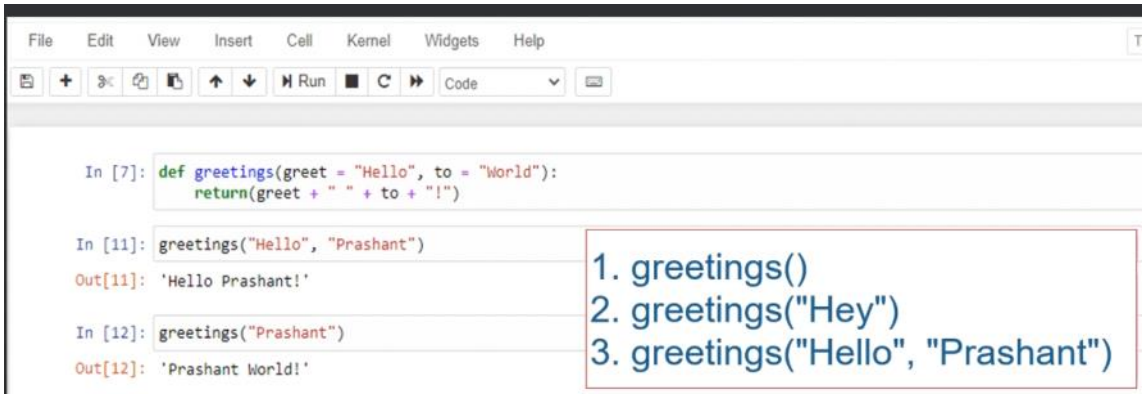
We should have a feasibility to allow python to perform this -

```
In [4]: def greetings(greet, to = "World"):
            return(greet + " " + to + "!")

In [5]: greetings("Hello", "Friends")
Out[5]: 'Hello Friends!'

In [6]: greetings("Hello")
Out[6]: 'Hello World!'
```

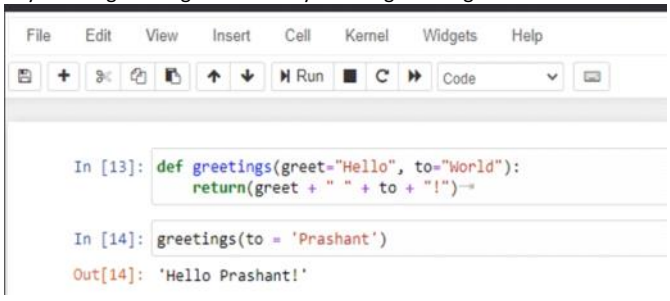


Parameters are either mandatory or optional. If you want to make it optional, you need to provide a default value to it.

You cannot just pass the second argument alone thinking first argument already defaults. To fix this problem we have keyword argument passing.



Keyword argument gives flexibility to change the arguments order

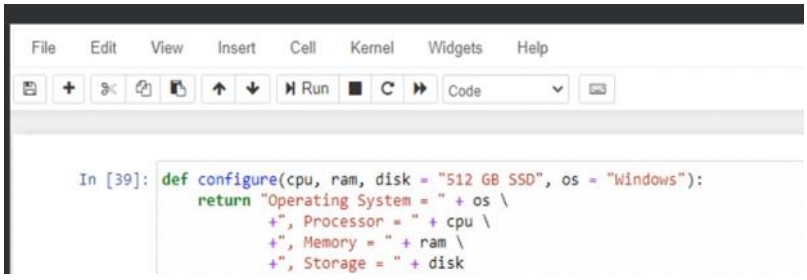


```
In [13]: def greetings(greet="Hello", to="World"):
             return(greet + " " + to + "!")

In [15]: greetings(to = 'Prashant', greet = 'Hi')
Out[15]: 'Hi Prashant!'

In [ ]:
```

1. Mandatory Parameter
2. Optional Parameter
3. Keyword Parameter

You can't have the mandatory arguments followed by optional arguments.

```
In [37]: def configure(os = "Windows", cpu, ram, disk):
             return "Operating System = " + os \
                    +", Processor = " + cpu \
                    +", Memory = " + ram \
                    +", Storage = " + disk
  File "<ipython-input-37-cf167e1abcdf>", line 1
    def configure(os = "Windows", cpu, ram, disk):
                                  ^
SyntaxError: non-default argument follows default argument
```



While calling all the keyword arguments should be at the end

```
In [39]: def configure(cpu, ram, disk = "512 GB SSD", os = "Windows"):
             return "Operating System = " + os \
                    +", Processor = " + cpu \
                    +", Memory = " + ram \
                    +", Storage = " + disk

In [40]: configure("i5", "8GB")
Out[40]: 'Operating System = Windows, Processor = i5, Memory = 8GB, Storage = 512 GB SSD'

In [41]: configure(cpu = "i5", "8GB")
  File "<ipython-input-41-b2b567a1d793>", line 1
    configure(cpu = "i5", "8GB")
                          ^
SyntaxError: positional argument follows keyword argument
```

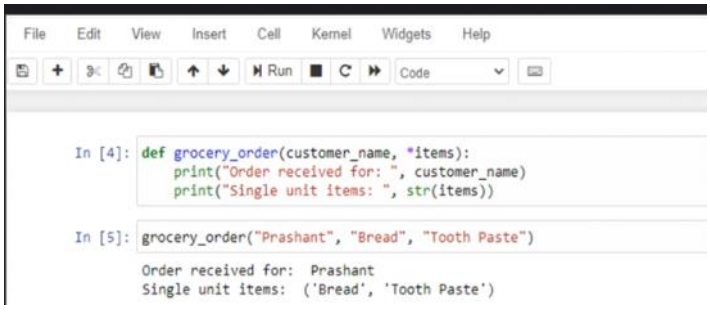
```
In [39]: def configure(cpu, ram, disk = "512 GB SSD", os = "Windows"):
             return "Operating System = " + os \
                    +", Processor = " + cpu \
                    +", Memory = " + ram \
                    +", Storage = " + disk

In [42]: configure(cpu = "i5", ram = "8GB")
Out[42]: 'Operating System = Windows, Processor = i5, Memory = 8GB, Storage = 512 GB SSD'
```

```
In [39]: def configure(cpu, ram, disk = "512 GB SSD", os = "Windows"):
             return "Operating System = " + os \
                    +", Processor = " + cpu \
                    +", Memory = " + ram \
                    +", Storage = " + disk

In [45]: configure("i5", ram = "8GB", "256GB SSD")
           File "<ipython-input-45-512a401a480a>", line 1
             configure("i5", ram = "8GB", "256GB SSD")
                                                  ^
         SyntaxError: positional argument follows keyword argument
```

So everything after this ram, has to be a key, value pair.

```
In [1]: def grocery_order(customer_name, items):
            print("Order received for: ", customer_name)
            print("Single unit items: ", str(items))

In [3]: grocery_order("Prashant", ["Bread", "Tooth Paste"])
        Order received for:  Prashant
        Single unit items:  ['Bread', 'Tooth Paste']
```

Keeping star in front of a list will make it accept the rest of the arguments after the mandatory argument



Default arguments can also be used -
** Always keep the default value arguments to the end.

```
In [6]: def grocery_order(customer_name, *items, delivery_type = "Home"):
            print("Order received for: ", customer_name)
            print("Single unit items: ", str(items))
            print("Delivery Type: ", delivery_type)

In [7]:  grocery_order("Prashant", "Bread", "Tooth Paste")
         Order received for:  Prashant
         Single unit items:  ('Bread', 'Tooth Paste')
         Delivery Type:  Home
```

If the order changes, it will complain about the keyword argument -

```
In [9]: def grocery_order(customer_name, delivery_type = "Home", *items):
            print("Order received for: ", customer_name)
            print("Single unit items: ", str(items))
            print("Delivery Type: ", delivery_type)

In [11]: grocery_order("Prashant", delivery_type = "Home", "Bread", "Tooth Paste")
           File "<ipython-input-11-e269160f1f2e>", line 1
             grocery_order("Prashant", delivery_type = "Home", "Bread", "Tooth Paste")
                                                               ^
         SyntaxError: positional argument follows keyword argument
```

*** So always keep the default values to the end.

You want something like below which accepts the customer name, item and it's quantity, those which are single items might not need number passed.

```
grocery_order("Prashant", "Bread", "Tooth Paste", "eggs" = 12, "milk" = "1 ltr")
```

*** This way of syntax is wrong. Because after prashant, it will expect the other arguments as variable length arguments. It can't understand that the dict goes to items_with_qty.

```
In [16]: def grocery_order(customer_name, *items, items_with_qty, delivery_type = "Home"):
             print("Order received for: ", customer_name)
             print("Single unit items: ", str(items))
             print("Other Items: ", str(items_with_qty))
             print("Delivery Type: ", delivery_type)

             if 'eggs' in items_with_qty:
                 print("Note: Handle with care.")
```

```
In [19]: grocery_order("Prashant", "Bread", "Tooth Paste", dict(eggs = 12, milk = "1 ltr"))
```

```
---------------------------------------------------------------------------
TypeError                                 Traceback (most recent call last)
<ipython-input-19-f0700d5ddd2c> in <module>
----> 1 grocery_order("Prashant", "Bread", "Tooth Paste", dict(eggs = 12, milk = "1 ltr"))

TypeError: grocery_order() missing 1 required keyword-only argument: 'items_with_qty'
```

Using Key/Value syntax, will eliminate the problem.

```
In [16]: def grocery_order(customer_name, *items, items_with_qty, delivery_type = "Home"):
             print("Order received for: ", customer_name)
             print("Single unit items: ", str(items))
             print("Other Items: ", str(items_with_qty))
             print("Delivery Type: ", delivery_type)

             if 'eggs' in items_with_qty:
                 print("Note: Handle with care.")
```

```
In [20]: grocery_order("Prashant", "Bread", "Tooth Paste", items_with_qty = dict(eggs = 12, milk = "1 ltr"))
```

```
Order received for:  Prashant
Single unit items:  ('Bread', 'Tooth Paste')
Other Items:  {'eggs': 12, 'milk': '1 ltr'}
Delivery Type:  Home
Note: Handle with care.
```

If there are no items passed you can mark that argument as "None"

```
In [21]: def grocery_order(customer_name, *items, items_with_qty = None, delivery_type = "Home"):
             print("Order received for: ", customer_name)
             print("Single unit items: ", str(items))
             print("Other Items: ",  str(items_with_qty))
             print("Delivery Type: ", delivery_type)
```

```
In [22]: grocery_order("Prashant", "Bread", "Tooth Paste")
```

```
Order received for:  Prashant
Single unit items:  ('Bread', 'Tooth Paste')
Other Items:  None
Delivery Type:  Home
```

Passing the dictionary argument can be easily be resolved using this syntax -
You have to make the double asterisk as the last argument of your function. This double asterisk variable will be able to receive dictionary.

```
In [24]: def grocery_order(customer_name, *items, delivery_type = "Home",  **items_with_qty):
             print("Order received for: ", customer_name)
             print("Single unit items: ", str(items))
             print("Other Items: ",  str(items_with_qty))
             print("Delivery Type: ", delivery_type)

             if 'eggs' in items_with_qty:
                 print("Note: Handle with care")
```

Now we are not passing the keyword name of the argument, instead we are passing the comma separated values of key/value pairs. Python will pack these key/value pairs into the dictionary.

```
In [24]: def grocery_order(customer_name, *items, delivery_type = "Home",  **items_with_qty):
             print("Order received for: ", customer_name)
             print("Single unit items: ", str(items))
             print("Other Items: ",  str(items_with_qty))
             print("Delivery Type: ", delivery_type)

             if 'eggs' in items_with_qty:
                 print("Note: Handle with care")

In [25]: grocery_order("Prashant", "Bread", "Tooth Paste", eggs = 12, milk = "1 ltr", delivery_type = "Pickup")

         Order received for:  Prashant
         Single unit items:  ('Bread', 'Tooth Paste')
         Other Items:  {'eggs': 12, 'milk': '1 ltr'}
         Delivery Type:  Pickup
         Note: Handle with care
```

- Python will accept the variable length tuple and variable length dictionary

```
: def grocery_order(customer_name, *items, delivery_type = "Home",  **items_with_qty):
      print("Order received for: ", customer_name)
      print("Single unit items: ", str(items))
      print("Other Items: ",  str(items_with_qty))
      print("Delivery Type: ", delivery_type)

      if 'eggs' in items_with_qty:
          print("Note: Handle with care")

: grocery_order("Prashant", "Bread", "Tooth Paste", eggs = 12, milk = "1 ltr", delivery_type = "Pickup")

  Order received for:  Prashant
  Single unit items:  ('Bread', 'Tooth Paste')
  Other Items:  {'eggs': 12, 'milk': '1 ltr'}
  Delivery Type:  Pickup
  Note: Handle with care
```

1. Variable Length - Tuple
2. Variable Length - Dictionary

You can place the tuple argument anywhere in the method, where as you need the dictionary type argument to be passed as the last argument.

What if you have this function and you need to pass the array to the *items parameter. Then we can first unpack the list of items to comma separated values and then pass it as an argument.

```
[5]: def book_groceries(customer, *items, type="Delivery", **item_dict):
         print("customer", customer)
         print("items", items)
         print("type", type)
         print("item_dict", item_dict)

     item_args = ["Curd", "Milk"]

     book_groceries("Vishnu",*item_args,type="Pickup", soaps=2, brushes = 5)
```

```
customer Vishnu
items ('Curd', 'Milk')
type Pickup
item_dict {'soaps': 2, 'brushes': 5}
```

```
def book_groceries(customer, *items, type="Delivery", **item_dict):
    print("customer", customer)
    print("items", items)
    print("type", type)
    print("item_dict", item_dict)

item_args = ["Curd", "Milk"]
dict_args = dict(soap=2,brushes=5)

book_groceries("Vishnu",*item_args,type="Pickup", **dict_args)
```

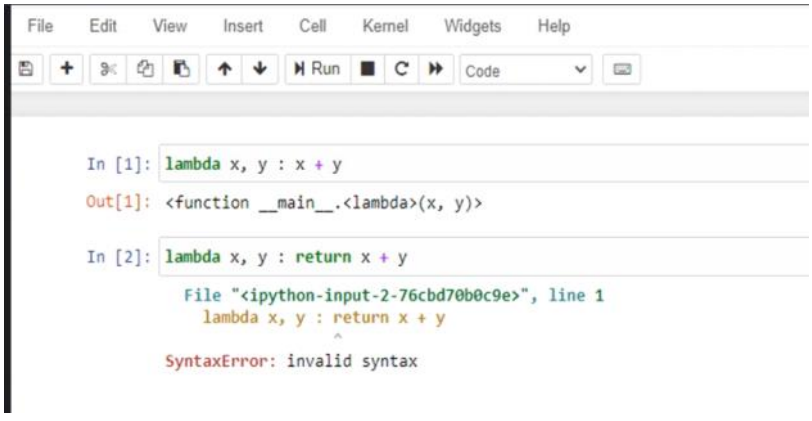
```
customer Vishnu
items ('Curd', 'Milk')
type Pickup
item_dict {'soap': 2, 'brushes': 5}
```

We can also pass the dictionary first followed by optional arguments too.

```
def book_groceries(customer, *items, type="Delivery", **item_dict):
    print("customer", customer)
    print("items", items)
    print("type", type)
    print("item_dict", item_dict)

item_args = ["Curd", "Milk"]
dict_args = dict(soap=2,brushes=5)

book_groceries("Vishnu",*item_args, **dict_args, type="Pickup")
```

```
customer Vishnu
items ('Curd', 'Milk')
type Pickup
item_dict {'soap': 2, 'brushes': 5}
```

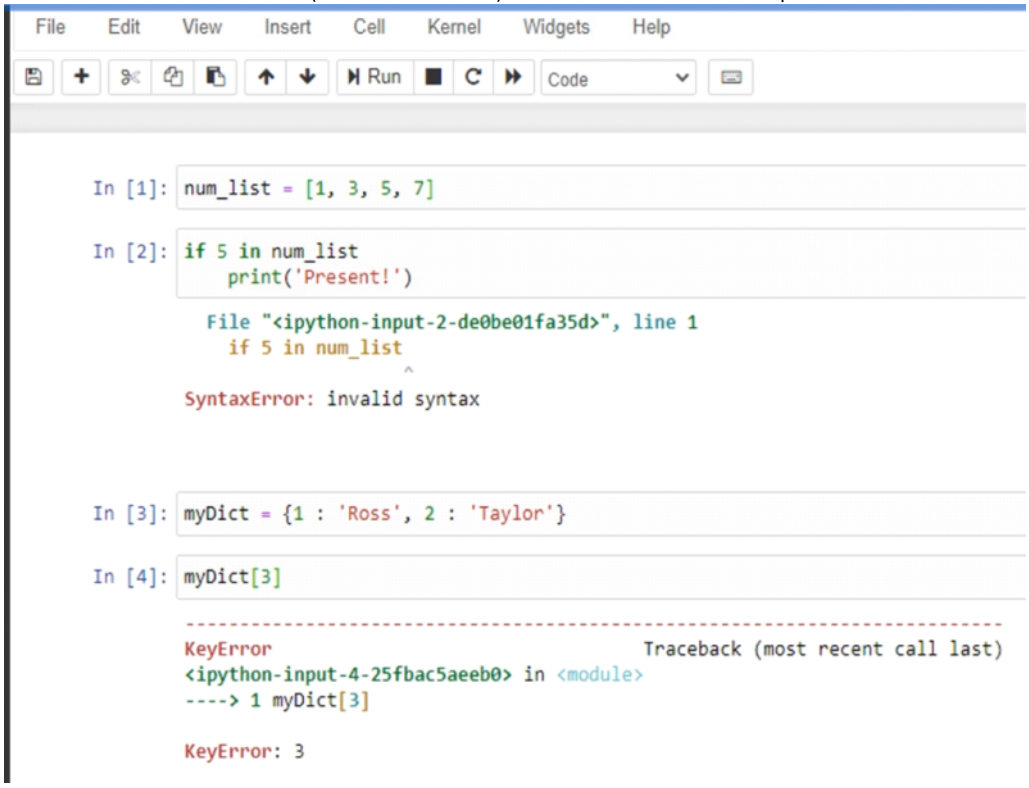
Lambda functions -



```
In [6]: def apply_ops(*args, ops):
            return ops(args)

In [7]: apply_ops(2, 3, 7, 9, ops = sum)
Out[7]: 21
```

Errors -

In first error there is no traceback (most recent call last). Where as in second error it is present -



Errors are classified into two -

1. Syntax errors
2. Exceptions

```
In [8]: a = 3
        b = 2

        print(a / b))
  File "<ipython-input-8-031d60405199>", line 4
    print(a / b))
SyntaxError: unmatched ')'
```

Syntax errors are clearly shown as where and what we missed.

These logical errors are known as exceptions. This doesn't have syntax error on the error it showed. This exception is called zero divison error

```
In [8]: a = 3
        b = 0

        print(a / b)
```

```
---------------------------------------------------------------------------
ZeroDivisionError                         Traceback (most recent call last)
<ipython-input-8-a7d9afa154f8> in <module>
      2 b = 0
      3
----> 4 print(a / b)

ZeroDivisionError: division by zero
```

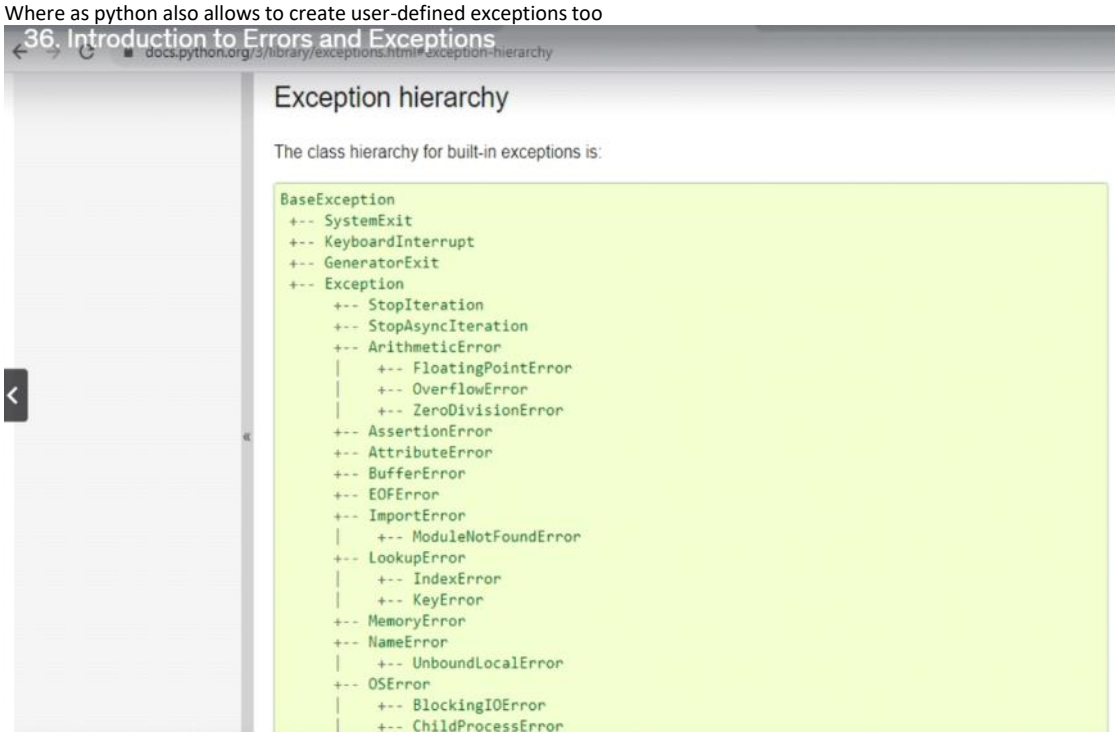
```
In [9]: a = 2
        b = "Hi"

        print(a + b)
```

```
---------------------------------------------------------------------------
TypeError                                 Traceback (most recent call last)
<ipython-input-9-ab830ab2ec8e> in <module>
      2 b = "Hi"
      3
----> 4 print(a + b)

TypeError: unsupported operand type(s) for +: 'int' and 'str'
```

There are two types of Exceptions -

1. Built-in Exception
2. User-defined Exception

These are predefined/ built in exceptions
Where as python also allows to create user-defined exceptions too



Now this is the exception that is not something caused by me. But this is coming because of passing incorrectly passing string a instead of numbers.

```
In [3]: n = int(input('Please enter a number: '))

        print('You entered: ' + str(n))

        Please enter a number: a

        ---------------------------------------------------------------------------
        ValueError                                Traceback (most recent call last)
        <ipython-input-3-6e62128bde98> in <module>
        ----> 1 n = int(input('Please enter a number: '))
              2
              3 print('You entered: ' + str(n))

        ValueError: invalid literal for int() with base 10: 'a'
```

Try except blocks are good to take care of any unexpected exceptions. This approach is called exception handling.

```
In [9]: my_file = open('A:\demo\myfile.txt', "r")

        for line in my_file:
            print(line)

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```

1. Open the file and read the numbers given in the file.
2. Divide each number with the divisor and sum the result.
3. Finally, return the sum in the end.

```
In [1]: def file_divide(file, divisor):
            my_file = open(file, "r")
            sum = 0

            for num in my_file:
                sum += int(num)/divisor

            my_file.close()
            return sum
```

```
In [1]: def file_divide(file, divisor):
            my_file = open(file, "r")
            sum = 0

            for num in my_file:
                sum += int(num)/divisor

            my_file.close()
            return sum

In [2]: file_divide('A:\demo\data.txt', 10)

Out[2]: 3.0
```

1. What if the file does not exist at a given location?
2. What if the caller passed a zero for the divisor?
3. What if the data file contains some non-numeric values?

Always have a wildcard exception to the end of the exception order -
Finally always gets executed

```
def file_divide(file, divisor):
    try:
        my_file = open(file, "r")
    except FileNotFoundError:
        print("File not found - Make sure to place " + file)
        return

    sum = 0
    try:
        for num in my_file:
            sum += int(num)/divisor
    except ZeroDivisionError:
        print('Cannot divide by zero.')
        return
    except ValueError:
        print('Invalid value! Check your data file.')
        return
    except:
        print('Something went wrong!')
        return
    finally:
        my_file.close()
    return sum
```

```
In [1]: def advance_by(die_input):
            print('move you by ' + str(die_input))

In [2]: advance_by(7)

        move you by 7
```

```
In [3]: def advance_by(die_input):
            if die_input <= 0:
                print('Not a valid number. Enter a number greater than 0.')
            elif die_input > 6:
                print('Not a valid number. Enter a number less than or equal to 6.')
            else:
                print('moved you by ' + str(die_input))
```

If we do the return, then the caller will have hard time to compare the possible outcomes and determine what is the exception.

```
In [7]: def advance_by(die_input):
            if die_input <= 0:
                return('Not a valid number. Enter a number greater than 0.')
            elif die_input > 6:
                return('Not a valid number. Enter a number less than or equal to 6.')
            else:
                print('moved you by ' + str(die_input))
```


```
In [7]: def advance_by(die_input):
            if die_input <= 0:
                return('Not a valid number. Enter a number greater than 0.')
            elif die_input > 6:
                return('Not a valid number. Enter a number less than or equal to 6.')
            else:
                print('moved you by ' + str(die_input))
```


```
In [8]: result = advance_by(7)

        if result == 'Not a valid number. Enter a number greater than 0.':
            print('die cannot give <= 0')
        elif result == 'Not a valid number. Enter a number less than or equal to 6.':
            print('die cannot give > 6')
```

```
die cannot give > 6
```

This is good, however if this application is being developed and this error has to be communicated to the caller, then we need to prepare a customized exception so the caller can manage these errors using exception handling. So it is better we handle these errors using try, except block -

```
In [9]: def advance_by(die_input):
            if die_input <= 0:
                raise ValueError('Not a valid number. Enter a number greater than 0.')
            elif die_input > 6:
                raise ValueError('Not a valid number. Enter a number less than or equal to 6.')
            else:
                print("moved you by " + str(die_input))
```

```
In [10]: try:
             advance_by(7)
         except ValueError:
             print('die cannot give <= 0 or > 6')
```

```
die cannot give <= 0 or > 6
```

```
In [9]: def advance_by(die_input):
            if die_input <= 0:
                raise ValueError('Not a valid number. Enter a number greater than 0.')
            elif die_input > 6:
                raise ValueError('Not a valid number. Enter a number less than or equal to 6.')
            else:
                print('moved you by ' + str(die_input))
```

```
In [11]: try:
             advance_by(7)
         except ValueError as err:
             print(str(err))
```

```
Not a valid number. Enter a number less than or equal to 6.
```

In this case, we are raising same valueerror exception to identify whether the number > 0 or <=6

We defined base class as DieInputError and extended it from base class Exception.

```
class DieInputError(Exception):
    pass

class DieInputLowerBoundError(DieInputError):
    pass

class DieInputUpperBoundError(DieInputError):
    pass
```

```
In [1]: class DieInputError(Exception):
            pass

        class DieInputLowerBoundError(DieInputError):
            pass

        class DieInputUpperBoundError(DieInputError):
            pass
```

```
In [2]: def advance_by(die_input):
            if die_input <= 0:
                raise DieInputLowerBoundError('Not a valid number. Enter a number greater than 0.')
            elif die_input > 6:
                raise DieInputUpperBoundError('Not a valid number. Enter a number less than or equal to 6.')
            else:
                print('moved you by ' + str(die_input))
```

```
In [3]: try:
            advance_by(0)
        except DieInputLowerBoundError:
            print('Value <= 0')
        except DieInputUpperBoundError:
            print('Value > 6')

        Value <= 0
```

Classes -

```
In [1]: class MyClass:
            my_num = 1234
            def say_hello(name):
                print('Hello ' + name)
```

```
In [1]: class MyClass:
            my_num = 1234
            def say_hello(name):
                print('Hello ' + name)

In [2]: MyClass.my_num

Out[2]: 1234

In [3]: MyClass.my_num = 4567

In [4]: MyClass.my_num

Out[4]: 4567

In [5]: MyClass.say_hello('Prashant')

        Hello Prashant
```

```
class class_name:
    # Class Body
```

__init__ is the constructor and it should have first argument as "self". Primary purpose of the constructor is to create an object and set the initial state of object.

```
In [1]: class Car:
            def __init__(self, name, brand):
                self.model_name = name
                self.model_brand = brand

            def launch(self):
                print(f"{self.model_name} by {self.model_brand} launched.")
```

```
In [ ]:
```

1. Initializer or Constructor
2. Instance Variables
3. Class Methods

```
In [1]: class Car:
            def __init__(self, name, brand):
                self.model_name = name
                self.model_brand = brand

            def launch(self):
                print(f"{self.model_name} by {self.model_brand} launched.")
```

```
In [2]: car1 = Car('Hector', 'MG')
```

```
In [3]: car1.model_name
```

```
Out[3]: 'Hector'
```

```
In [1]: class Car:
            def __init__(self, name, brand):
                self.model_name = name
                self.model_brand = brand

            def launch(self):
                print(f"{self.model_name} by {self.model_brand} launched.")
```

```
In [2]: car1 = Car('Hector', 'MG')
```

```
In [5]: car1.model_name = 'Hector Plus'
```

```
In [6]: car1.model_name
```

```
Out[6]: 'Hector Plus'
```

```
In [1]: class Car:
            def __init__(self, name, brand):
                self.model_name = name
                self.model_brand = brand

            def launch(self):
                print(f"{self.model_name} by {self.model_brand} launched.")

In [2]: car1 = Car('Hector', 'MG')

In [7]: car2 = Car('i10', 'Hyundai')

In [10]: car1.model_name

Out[10]: 'Hector Plus'

In [11]: car2.model_name

Out[11]: 'i10'
```

First argument is always self for all the instance methods.

```
In [1]: class Car:
            def __init__(self, name, brand):
                self.model_name = name
                self.model_brand = brand

            def launch(self):
                print(f"{self.model_name} by {self.model_brand} launched.")

In [2]: car1 = Car('Hector', 'MG')

In [7]: car2 = Car('i10', 'Hyundai')

In [12]: car1.launch()

         Hector Plus by MG launched.

In [13]: car2.launch()

         i10 by Hyundai launched.
```

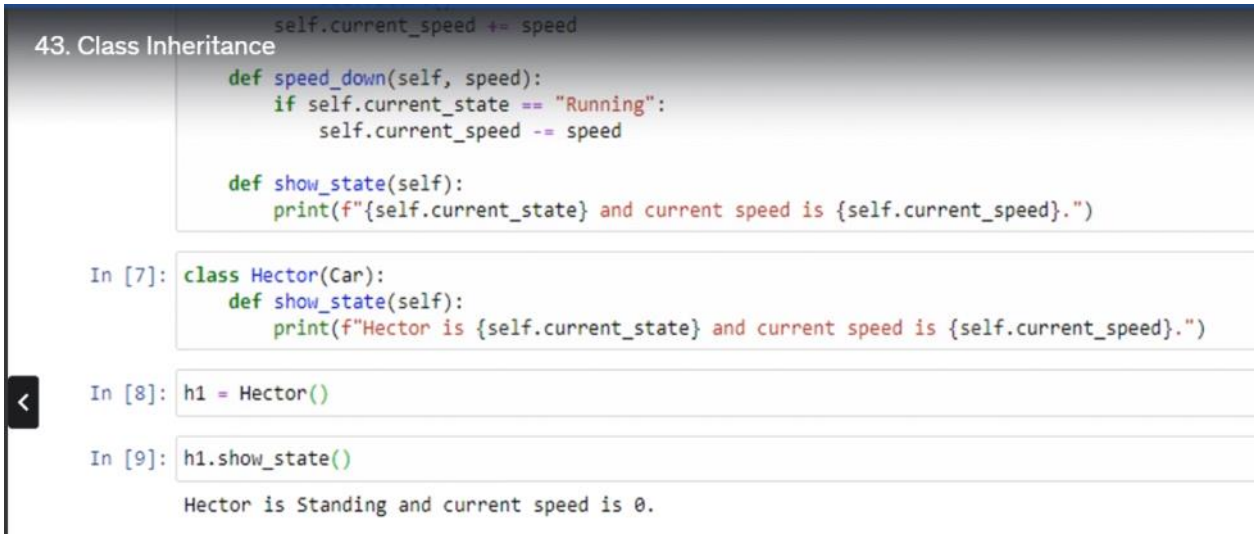
Python will accept any other name instead of self. Like in below -

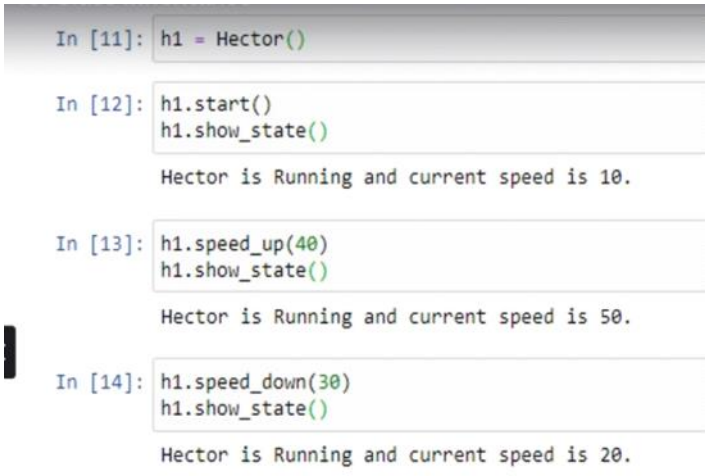
```
In [13]: class Car:
             def __init__(self, name, brand):
                 self.model_name = name
                 self.model_brand = brand

             def launch(this):
                 print(f"{this.model_name} by {this.model_brand} launched.")
```

```
class Car:
    def __init__(self):
        self.current_state = "Standing"
        self.current_speed = 0

    def start(self):
        self.current_state = "Running"
        self.current_speed = 10

    def stop(self):
        self.current_state = "Standing"
        self.current_speed = 0

    def speed_up(self, speed):
        if self.current_state == "Standing":
            self.start()
        self.current_speed += speed

    def speed_down(self, speed):
        if self.current_state == "Running":
            self.current_speed -= speed

    def show_state(self):
        print(f"{self.current_state} and current speed is {self.current_speed}.")
```

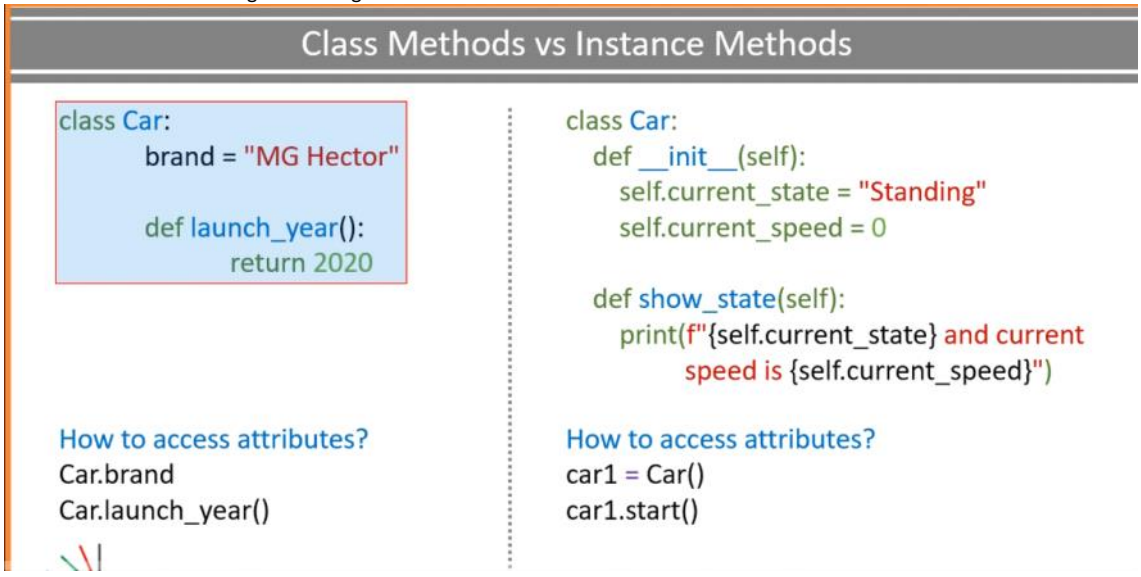
```
In [4]: class Hector(Car):
            pass

In [5]: h1 = Hector()

In [6]: h1.show_state()
        Standing and current speed is 0.
```

```
    def stop(self):
        self.current_state = "Standing"
        self.current_speed = 0

    def speed_up(self, speed):
        if self.current_state == "Standing":
            self.start()
        self.current_speed += speed

    def speed_down(self, speed):
        if self.current_state == "Running":
            self.current_speed -= speed

    def show_state(self):
        print(f"{self.current_state} and current speed is {self.current_speed}.")

In [7]: class Hector(Car):
        def show_state(self):
            print(f"Hector is {self.current_state} and current speed is {self.current_speed}.")
```

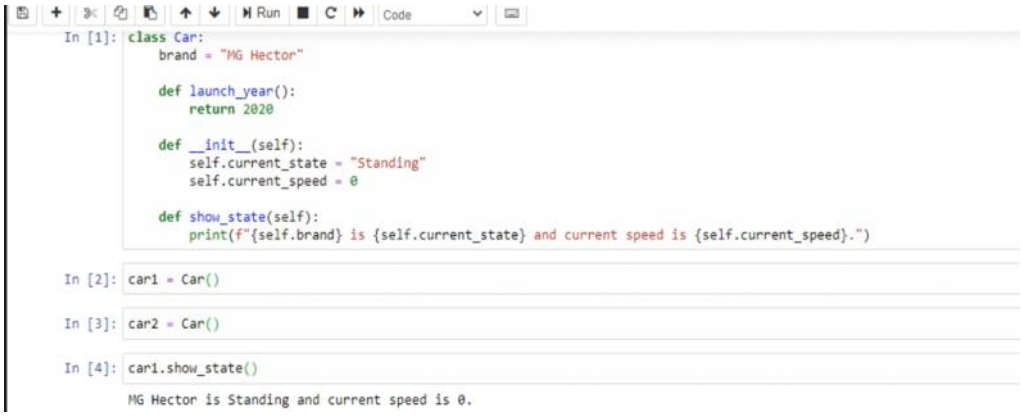




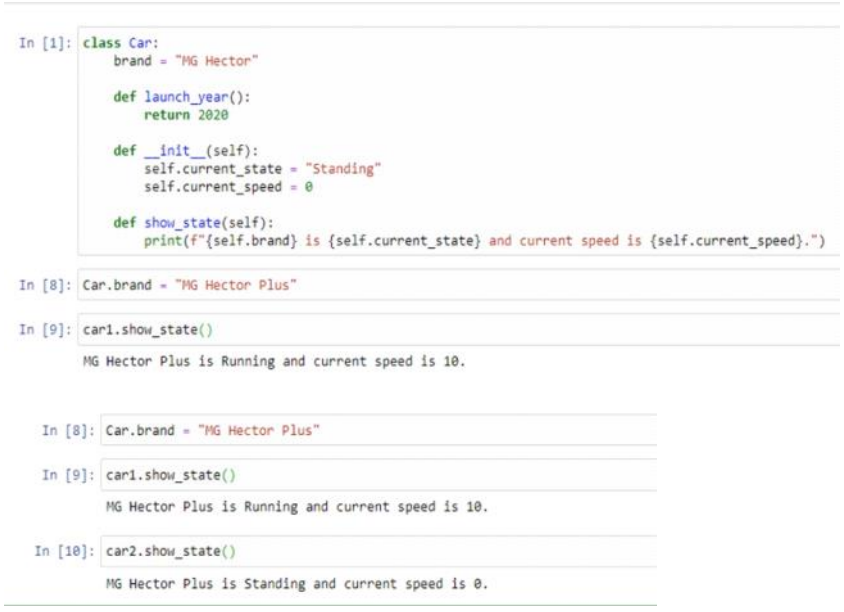
Left part is Class variable and Class Methods where as right ones are instance variables and instance methods as we are referring them using self.



```
In [1]: class Car:
            brand = "MG Hector"

            def launch_year():
                return 2020

            def __init__(self):
                self.current_state = "Standing"
                self.current_speed = 0

            def show_state(self):
                print(f"{self.brand} is {self.current_state} and current speed is {self.current_speed}.")
```



```
In [1]: class Car:
            brand = "MG Hector"

            def launch_year():
                return 2020

            def __init__(self):
                self.current_state = "Standing"
                self.current_speed = 0

            def show_state(self):
                print(f"{self.brand} is {self.current_state} and current speed is {self.current_speed}.")

In [2]: car1 = Car()

In [3]: car2 = Car()

In [4]: car1.show_state()
        MG Hector is Standing and current speed is 0.
```



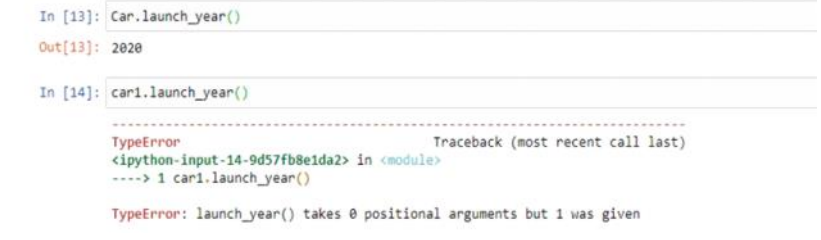
```
In [1]: class Car:
            brand = "MG Hector"

            def launch_year():
                return 2020

            def __init__(self):
                self.current_state = "Standing"
                self.current_speed = 0

            def show_state(self):
                print(f"{self.brand} is {self.current_state} and current speed is {self.current_speed}.")

In [8]: Car.brand = "MG Hector Plus"

In [9]: car1.show_state()
        MG Hector Plus is Running and current speed is 10.
```



```
In [8]: Car.brand = "MG Hector Plus"

In [9]: car1.show_state()
        MG Hector Plus is Running and current speed is 10.

In [10]: car2.show_state()
         MG Hector Plus is Standing and current speed is 0.
```

Don't try to change the class variable using object. It is not the right way to change.

You can call the class variable using the object where as not the class method.



```
In [13]: Car.launch_year()
Out[13]: 2020

In [14]: car1.launch_year()
         ---------------------------------------------------------------------------
         TypeError                                 Traceback (most recent call last)
         <ipython-input-14-9d57fb8e1da2> in <module>
         ----> 1 car1.launch_year()

         TypeError: launch_year() takes 0 positional arguments but 1 was given
```

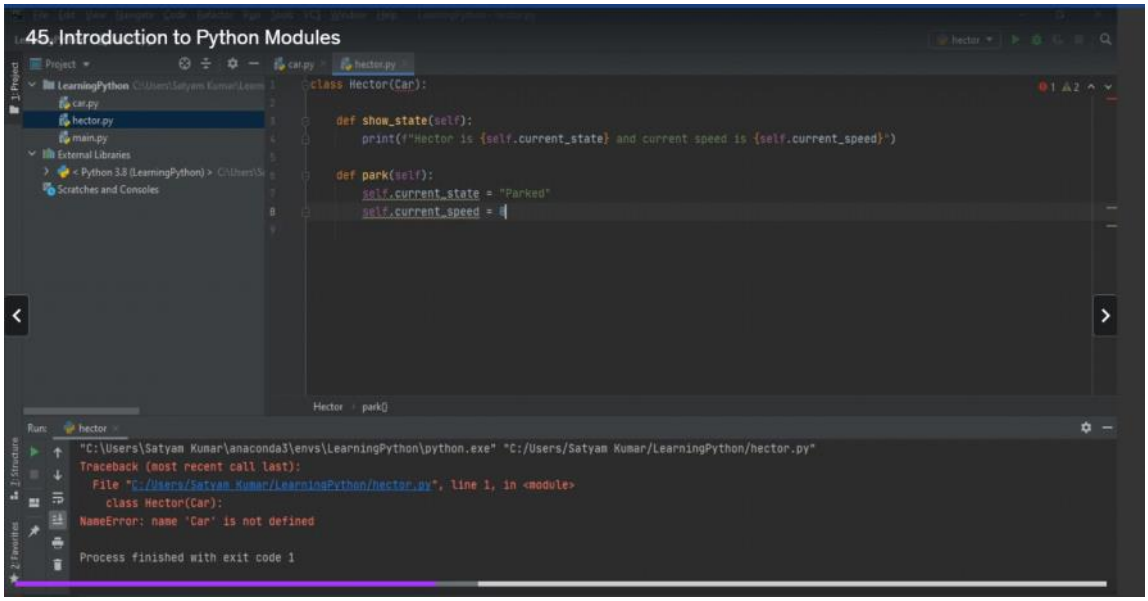
However you can achieve calling the method using the object by decorating the method with @classmethod and passing the cls argument. Cls argument is similar to self in instance methods.

```
In [15]: class Car:
             brand = "MG Hector"

             @classmethod
             def launch_year(cls):
                 return 2020

             def __init__(self):
                 self.current_state = "Standing"
                 self.current_speed = 0

             def show_state(self):
                 print(f"{self.brand} is {self.current_state} and current speed is {self.current_speed}.")
```

```
             brand = "MG Hector"

             @classmethod
             def launch_year(cls):
                 return 2020

             def __init__(self):
                 self.current_state = "Standing"
                 self.current_speed = 0

             def show_state(self):
                 print(f"{self.brand} is {self.current_state} and current speed is {self.current_speed}.")

In [16]: Car.launch_year()
Out[16]: 2020

In [18]: car1.launch_year()
Out[18]: 2020
```

Python modules -

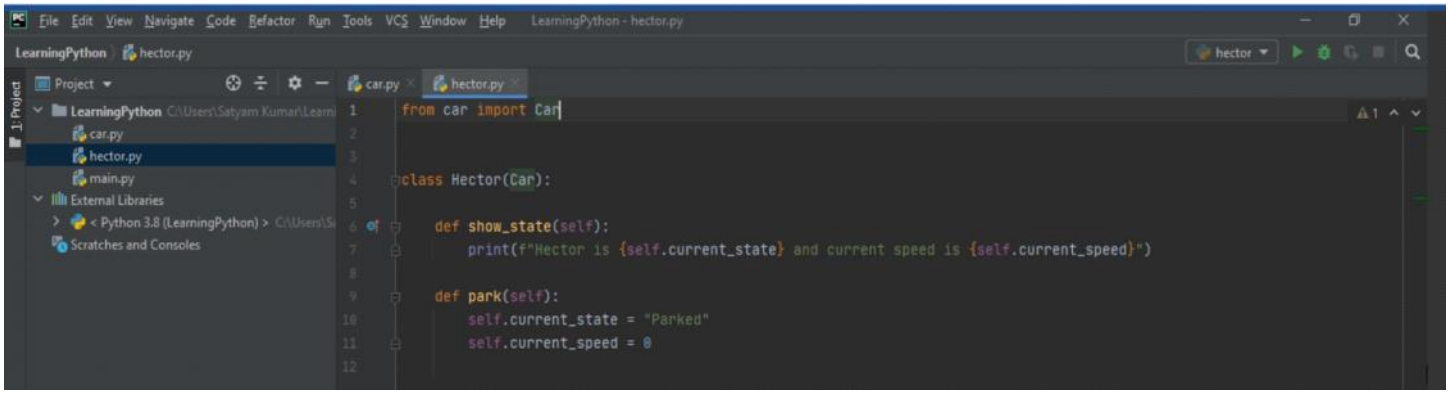
We can see the Hector class is not able to figure out the Car class as the Car class is defined in different file.

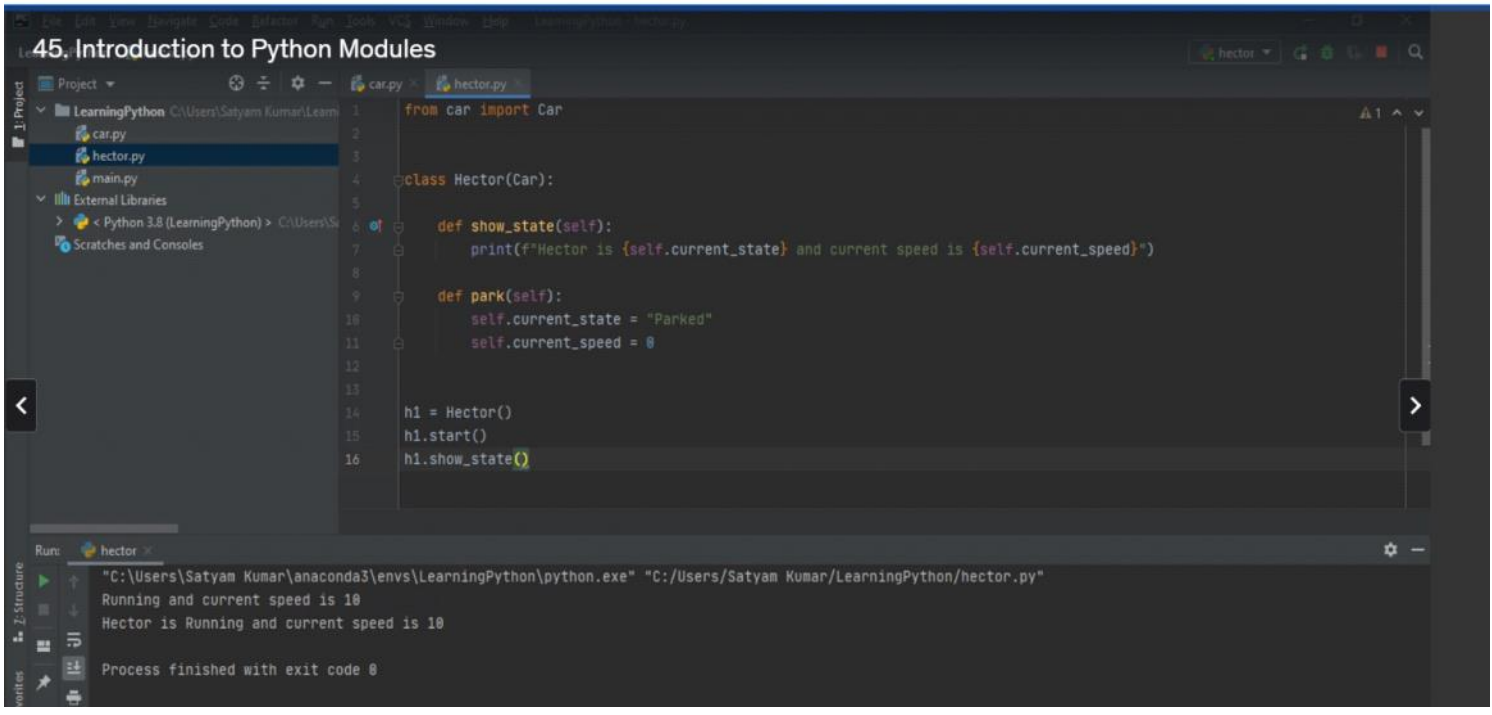


After adding from car import Car it started working

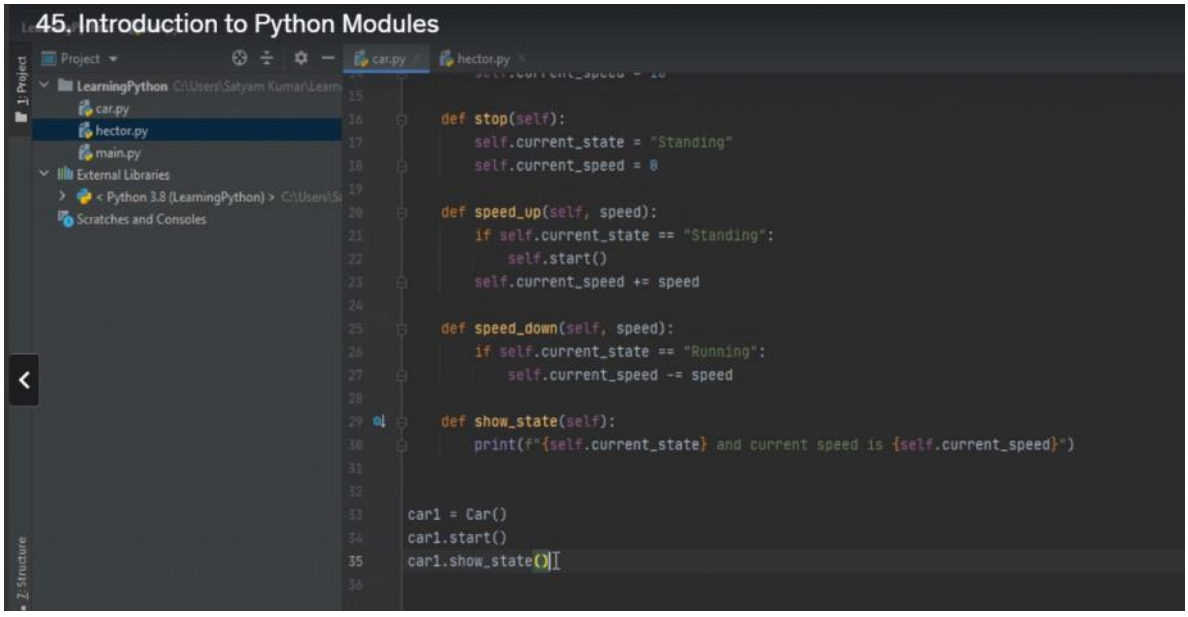
```python
from car import Car


class Hector(Car):

    def show_state(self):
        print(f"Hector is {self.current_state} and current speed is {self.current_speed}")

    def park(self):
        self.current_state = "Parked"
        self.current_speed = 0
```

Each .py file in python is also called as python module.
We can notice after importing Car class from car module (car.py file). It started working.

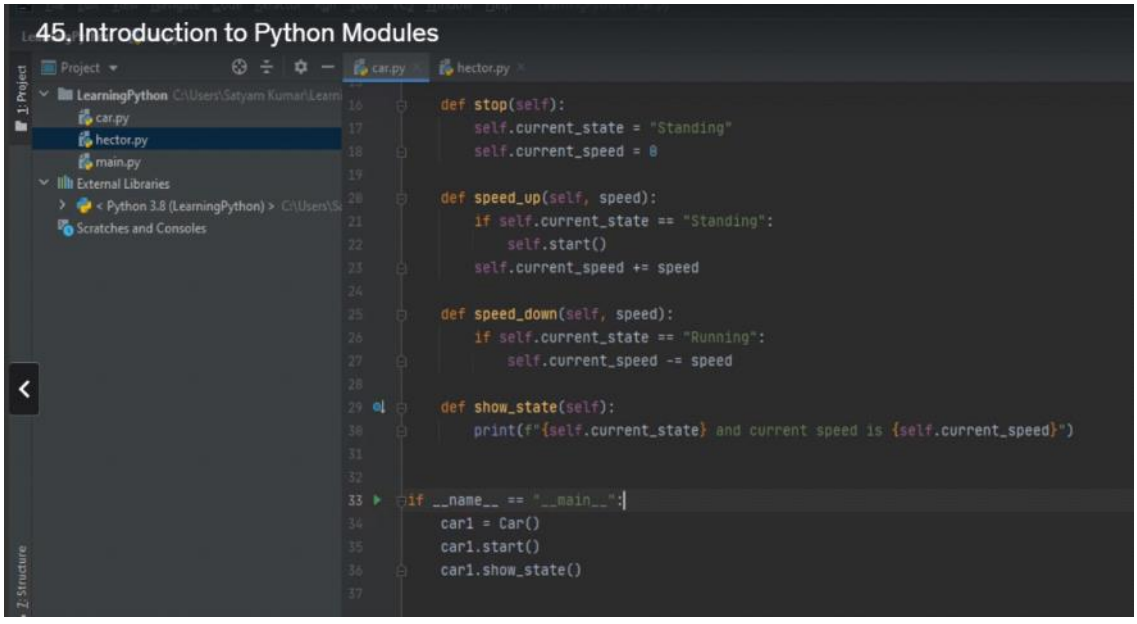




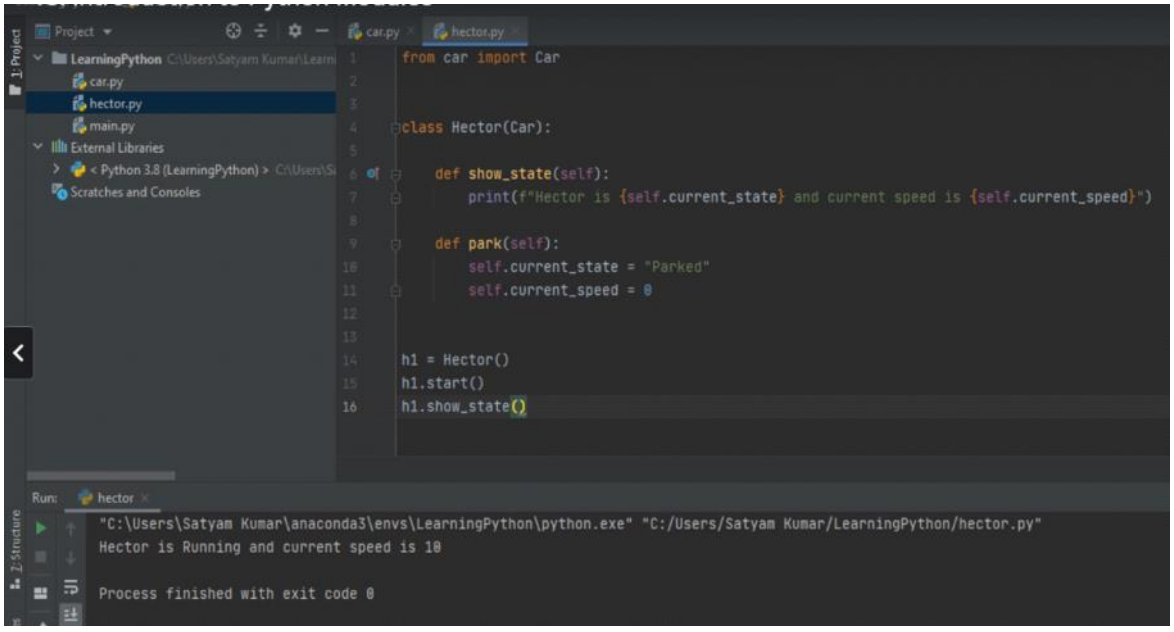
We can see in addition to the hector code, we are also seeing the code from Car module is also getting executed -

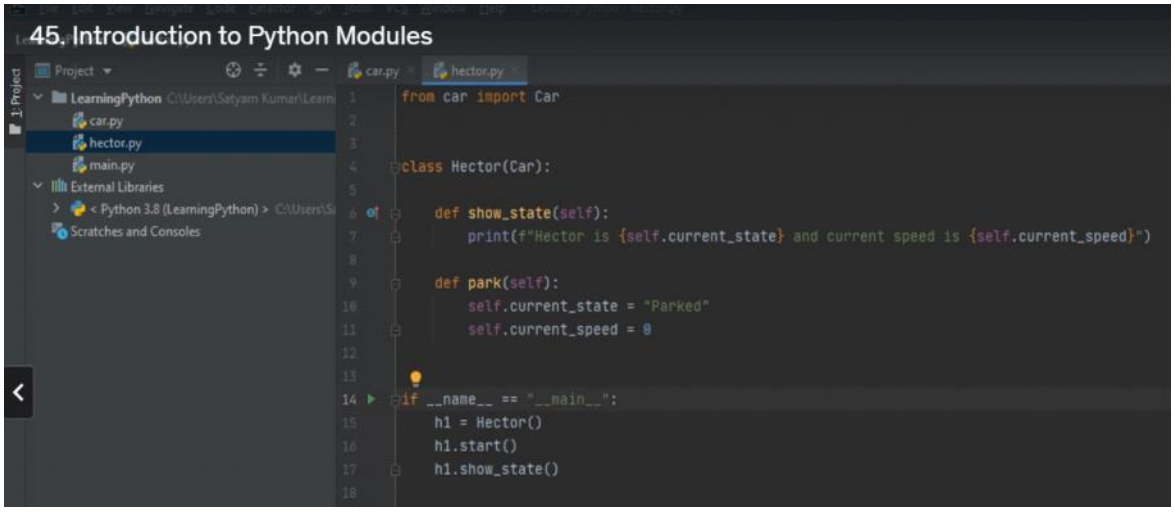


__name__ is set to __main__ when the module is run from inside of the module.

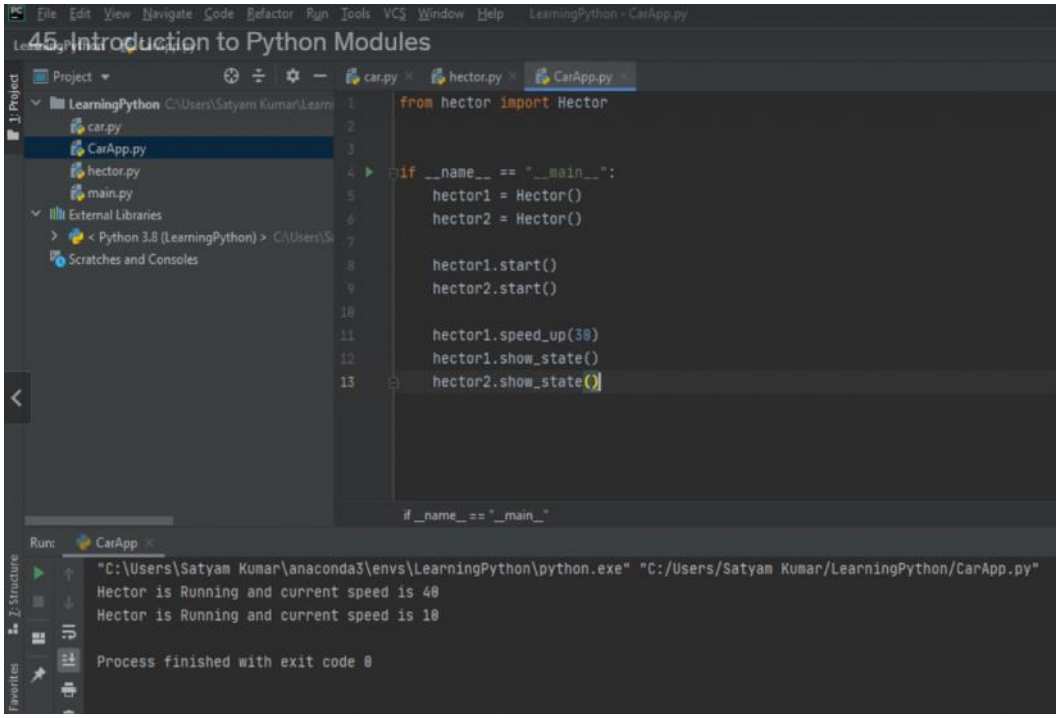


Now after the change, lets run hector module -



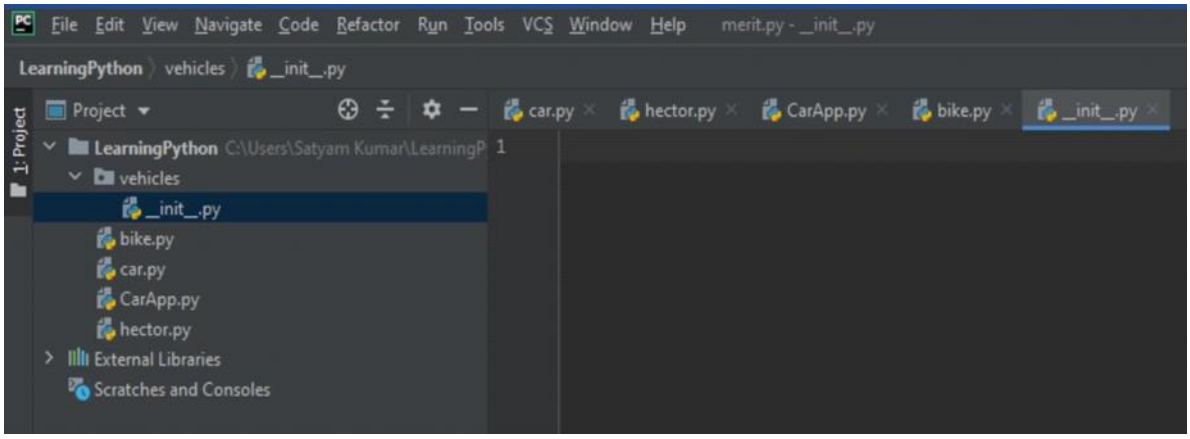


We can have another py (module) to create the objects and run from there. So classes exist in individual classes where as the exection happens from this main module

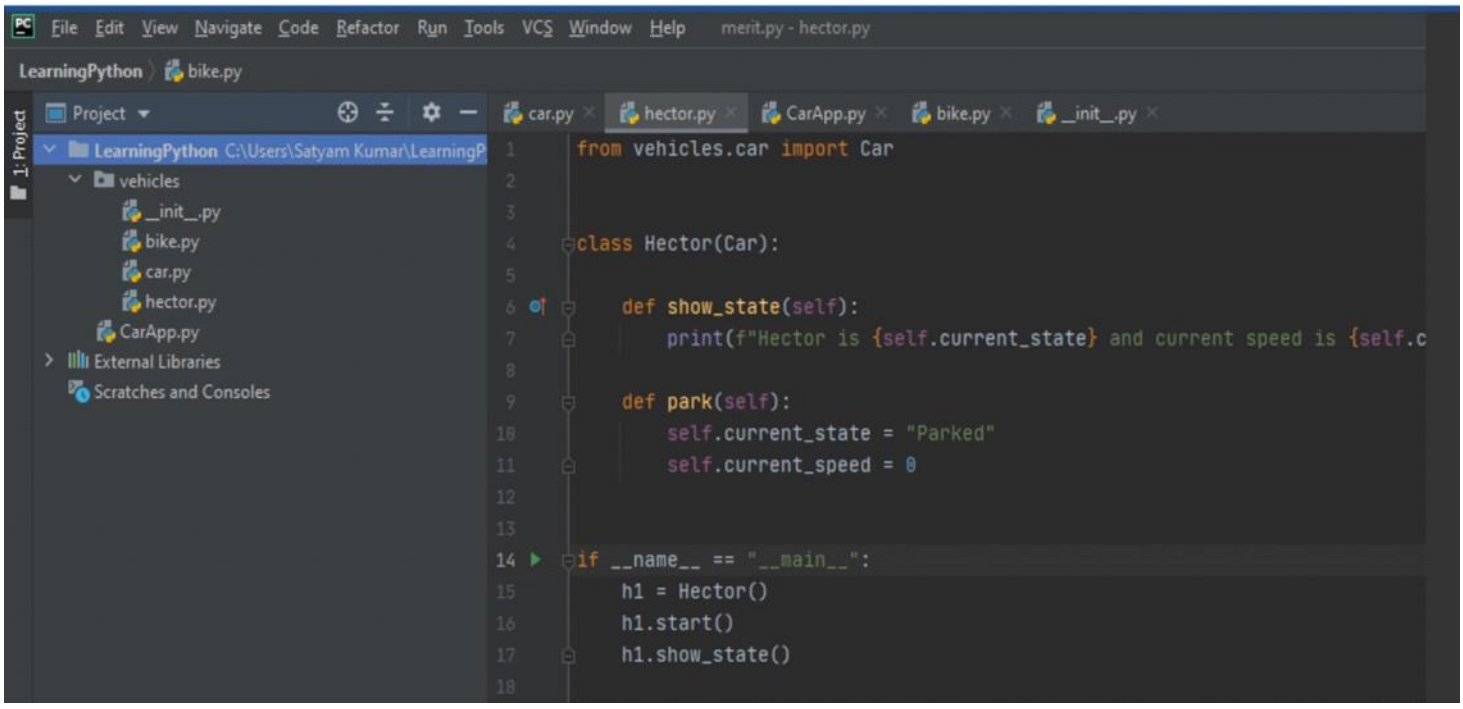


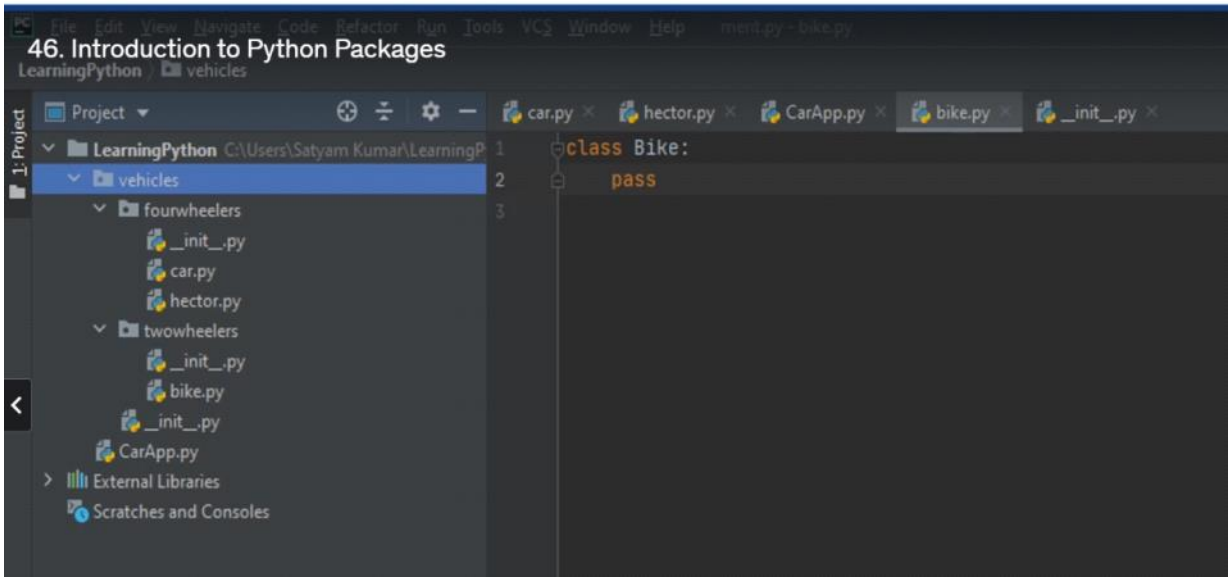
Python enables to club hundred's of modules into one module

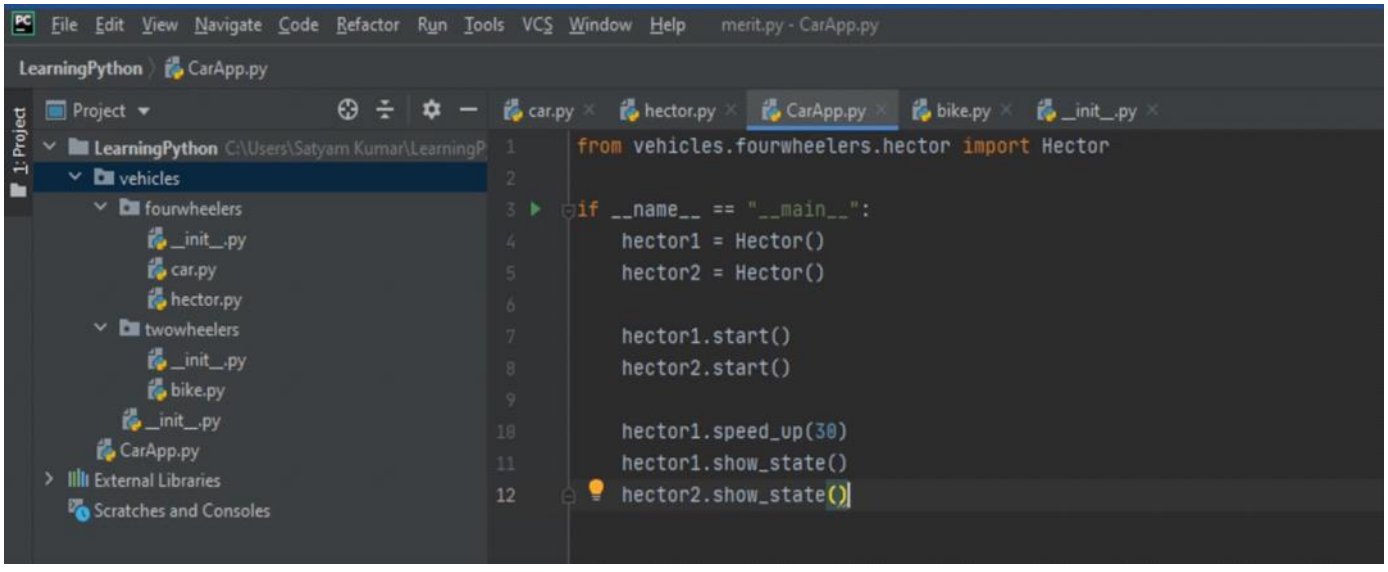
Create a package and organize the modules (py files) init. A module is a directory with a __init__.py file
init.



I'll leave the main module in the project root and rest of the files will be moved under "vehicles" folder.


File Edit View Navigate Code Refactor Run Tools VCS Window Help merit.py - hector.py
LearningPython bike.py
Project
car.py hector.py CarApp.py bike.py _init_.py
LearningPython C:\Users\Satyam Kumar\LearningP
vehicles
init.py
bike.py
car.py
hector.py
CarApp.py
External Libraries
Scratches and Consoles
from vehicles.car import Car
class Hector(Car):
def show_state(self):
print(f"Hector is {self.current_state} and current speed is {self.c
def park(self):
self.current_state = "Parked"
self.current_speed = 0
if __name__ == "__main__":
h1 = Hector()
h1.start()
h1.show_state()


46. Introduction to Python Packages
LearningPython vehicles
Project
car.py hector.py CarApp.py bike.py _init_.py
LearningPython C:\Users\Satyam Kumar\LearningP
vehicles
fourwheelers
init.py
car.py
hector.py
twowheelers
init.py
bike.py
init.py
CarApp.py
External Libraries
Scratches and Consoles
class Bike:
pass


File Edit View Navigate Code Refactor Run Tools VCS Window Help merit.py - CarApp.py
LearningPython CarApp.py
Project
car.py hector.py CarApp.py bike.py _init_.py
LearningPython C:\Users\Satyam Kumar\LearningP
vehicles
fourwheelers
init.py
car.py
hector.py
twowheelers
init.py
bike.py
init.py
CarApp.py
External Libraries
Scratches and Consoles
from vehicles.fourwheelers.hector import Hector
if __name__ == "__main__":
hector1 = Hector()
hector2 = Hector()
hector1.start()
hector2.start()
hector1.speed_up(30)
hector1.show_state()
hector2.show_state()

You can import like below -