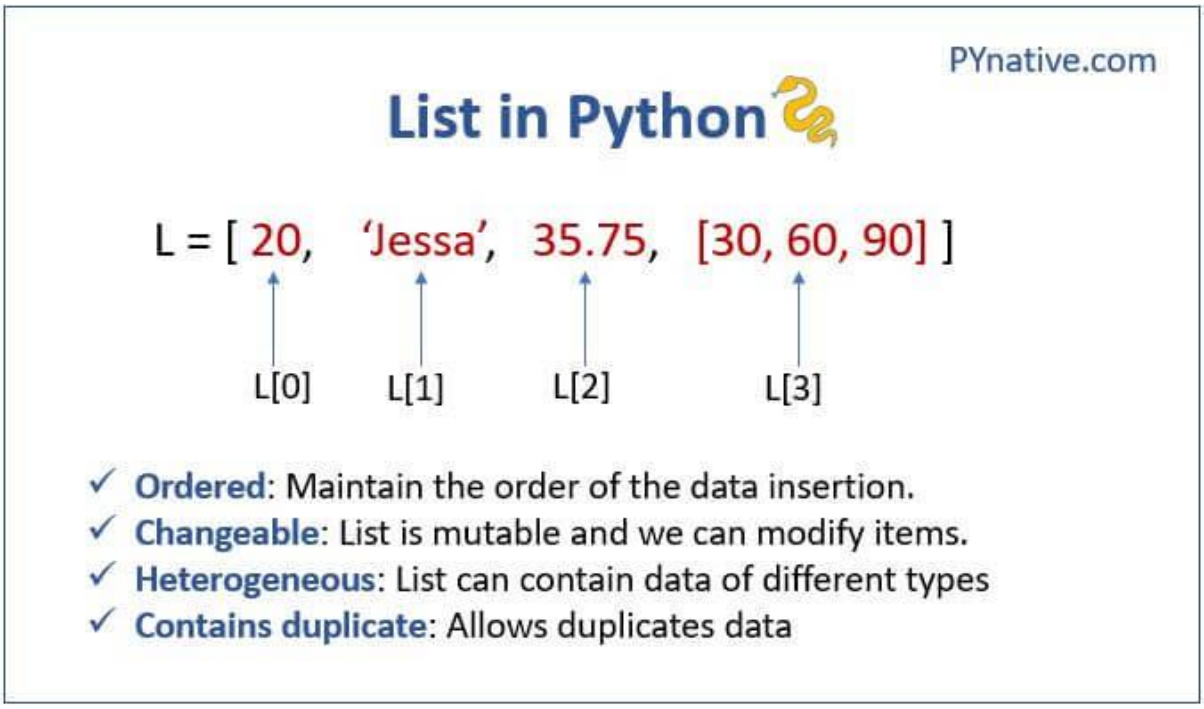
Python Lists

Python list is an ordered sequence of items.

In this article you will learn the different methods of creating a list, adding, modifying, and deleting elements in the list. Also, learn how to iterate the list and access the elements in the list in detail. Nested Lists and List Comprehension are also discussed in detail with examples.



The following are the **properties of a list**.

- **Mutable:** The elements of the list can be modified. We can add or remove items to the list after it has been created.
- **Ordered:** The items in the lists are ordered. Each item has a unique index value. The new items will be added to the end of the list.
- **Heterogenous**: The list can contain different kinds of elements i.e.; they can contain elements of string, integer, Boolean, or any type.
- **Duplicates:** The list can contain duplicates i.e.; lists can have two items with the same values.

Why uses a list?

- The list data structure is very flexible It has many unique inbuilt functionalities like `pop ()`, `append ()`, etc which makes it easier, where the data keeps changing.
- Also, the list can contain duplicate elements i.e., two or more items can have the same values.
- Lists are Heterogeneous i.e., different kinds of objects/elements can be added
- As Lists are mutable it is used in applications where the values of the items change frequently.

Creating a Python list

The list can be created using either the list constructor or using square brackets `[]`.

- **Using `list ()` constructor:** In general, the constructor of a class has its class name. Similarly, create a list by passing the comma-separated values inside the `list ()`.
- **Using square bracket (`[]`)**: In this method, we can create a list simply by enclosing the items inside the square brackets.

Let us see examples for creating the list using the above methods

```
# Using list constructor
my_list1 = list ((1, 2, 3))
print(my_list1)
# Output [1, 2, 3]

# Using square brackets []
my_list2 = [1, 2, 3]
print(my_list2)
# Output [1, 2, 3]

# with heterogeneous items
my_list3 = [1.0, 'Jessa', 3]
print(my_list3)
# Output [1.0, 'Jessa', 3]

# empty list using list()
```

```
my_list4 = list ()
print(my_list4)
# Output []

# empty list using []
my_list5 = []
print(my_list4)
# Output []
```


Length of a List

In order to find the number of items present in a list, we can use the `len()` function.

```
my_list = [1, 2, 3]
print(len(my_list))
# output 3
```

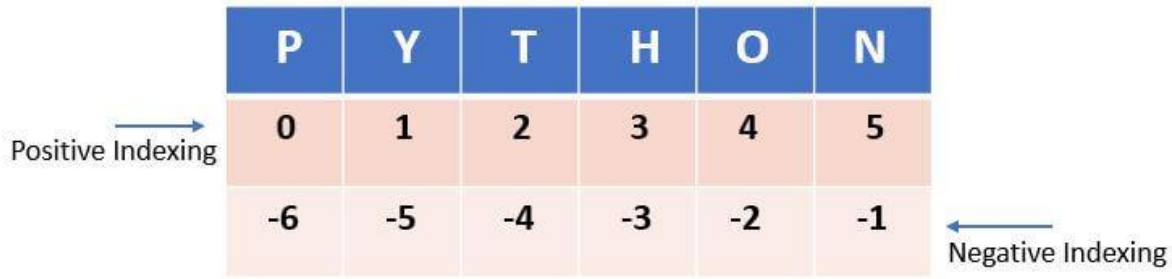
Accessing items of a List

The items in a list can be accessed through indexing and slicing. This section will guide you by accessing the list using the following two ways

- **Using indexing**, we can access any item from a list using its index number
- **Using slicing**, we can access a range of items from a list

Indexing

The list elements can be accessed using the “indexing” technique. Lists are ordered collections with unique indexes for each item. We can access the items in the list using this index number.



Python Positive and Negative indexing

To access the elements in the list from left to right, the index value starts from **zero** to **(length of the list-1)** can be used. For example, if we want to access the 3rd element, we need to use 2 since the index value starts from 0.

Note:

- As Lists are ordered sequences of items, the index values start from 0 to the Lists length.
- Whenever we try to access an item with an index more than the Lists length, it will throw the `'Index Error'`.
- Similarly, the index values are always an integer. If we give any other type, then it will throw `Type Error`.

Example

```
my_list = [10, 20, 'Jessa', 12.50, 'Emma']
# accessing 2nd element of the list
print(my_list[1])  # 20
# accessing 5th element of the list
print(my_list[4])  # 'Emma'
```

As seen in the above example we accessed the second element in the list by passing the index value as 1. Similarly, we passed index 4 to access the 5th element in the list.

Negative Indexing

The elements in the list can be accessed from right to left by using **negative indexing**. The negative value starts from -1 to -length of the list. It indicates that the list is indexed from the reverse/backward.


```
my_list = [10, 20, 'Jessa', 12.50, 'Emma']
# accessing last element of the list
print(my_list[-1])
# output 'Emma'

# accessing second last element of the list
print(my_list[-2])
# output 12.5

# accessing 4th element from last
print(my_list[-4])
# output 20
```

As seen in the above example to access the 4th element from the last (right to left) we pass '-4' in the index value.

List Slicing

Slicing a list implies, accessing a range of elements in a list. For example, if we want to get the elements in the position from 3 to 7, we can use the slicing method. We can even modify the values in a range by using this slicing technique.

The below is the syntax for list slicing.

```
listname[start_index : end_index : step]
```

- The `start_index` denotes the index position from where the slicing should begin and the `end_index` parameter denotes the index positions till which the slicing should be done.
- The `step` allows you to take each nth-element within a `start_index:end_index` range.

Example

```
my_list = [10, 20, 'Jessa', 12.50, 'Emma', 25, 50]
# Extracting a portion of the list from 2nd till 5th element
print(my_list[2:5])
# Output ['Jessa', 12.5, 'Emma']
```

Let us see few more examples of slicing a list such as

- Extract a portion of the list
- Reverse a list
- Slicing with a step
- Slice without specifying start or end position

Example

```
my_list = [5, 8, 'Tom', 7.50, 'Emma']

# slice first four items
print(my_list[:4])
# Output [5, 8, 'Tom', 7.5]

# print every second element
# with a skip count 2
print(my_list[::2])
# Output [5, 'Tom', 'Emma']

# reversing the list
print(my_list[::-1])
# Output ['Emma', 7.5, 'Tom', 8, 5]

# Without end_value
# Stating from 3nd item to last item
print(my_list[3:])
# Output [7.5, 'Emma']
```


Iterating a List

The objects in the list can be iterated over one by one, by using a for a loop.

```
my_list = [5, 8, 'Tom', 7.50, 'Emma']

# iterate a list
for item in my_list:
```

```
    print(item)
```

Output

```
5

8

Tom

7.5

Emma
```

Iterate along with an index number

The index value starts from 0 to (length of the list-1). Hence using the function range () is ideal for this scenario.

The range function returns a sequence of numbers. By default, it returns starting from 0 to the specified number (increments by 1). The starting and ending values can be passed according to our needs.

Example

```
my_list = [5, 8, 'Tom', 7.50, 'Emma']

# iterate a list
for i in range(0, len(my_list)):
    # print each item using index number
    print(my_list[i])
```

Output

```
5

8

Tom
```

```
7.5

Emma
```

Adding elements to the list

We can add a new element/list of elements to the list using the list methods such as `append ()`, `insert()`, and `extend()`.

Append item at the end of the list

The append () method will accept only one parameter and add it at the end of the list.

Let's see the example to add the element 'Emma' at the end of the list.


```
my_list = list([5, 8, 'Tom', 7.50])

# Using append()
my_list.append('Emma')
print(my_list)
# Output [5, 8, 'Tom', 7.5, 'Emma']

# append the nested list at the end
my_list.append([25, 50, 75])
print(my_list)
# Output [5, 8, 'Tom', 7.5, 'Emma', [25, 50, 75]]
```

Add item at the specified position in the list

Use the `insert ()` method to add the object/item at the specified position in the list. The insert method accepts two parameters position and object.

```
insert(index, object)
```

It will insert the `object` in the specified `index`. Let us see this with an example.

```
my_list = list([5, 8, 'Tom', 7.50])

# Using insert()
# insert 25 at position 2
my_list.insert(2, 25)
print(my_list)
# Output [5, 8, 25, 'Tom', 7.5]

# insert nested list at at position 3
my_list.insert(3, [25, 50, 75])
print(my_list)
# Output [5, 8, 25, [25, 50, 75], 'Tom', 7.5]
```


As seen in the above example item 25 is added at the index position 2.

Using extend ()

The extend method will accept the list of elements and add them at the end of the list. We can even add another list by using this method.

Let's add three items at the end of the list.

```
my_list = list([5, 8, 'Tom', 7.50])

# Using extend()
my_list.extend([25, 75, 100])
print(my_list)
# Output [5, 8, 'Tom', 7.5, 25, 75, 100]
```

As seen in the above example we have three integer values at once. All the values get added in the order they were passed and it gets appended at the end of the list.

Modify the items of a List

The list is a mutable sequence of iterable objects. It means we can modify the items of a list. Use the index number and assignment operator (`=`) to assign a new value to an item.

Let's see how to perform the following two modification scenarios

- Modify the individual item.
- Modify the range of items

```
my_list = list([2, 4, 6, 8, 10, 12])

# modify single item
my_list[0] = 20
print(my_list)
# Output [20, 4, 6, 8, 10, 12]

# modify range of items
# modify from 1st index to 4th
my_list[1:4] = [40, 60, 80]
print(my_list)
# Output [20, 40, 60, 80, 10, 12]

# modify from 3rd index to end
my_list[3:] = [80, 100, 120]
print(my_list)
# Output [20, 40, 60, 80, 100, 120]
```

Modify all items

Use for loop to iterate and modify all items at once. Let's see how to modify each item of a list.

```
my_list = list([2, 4, 6, 8])

# change value of all items
for i in range(len(my_list)):
    # calculate square of each number
    square = my_list[i] * my_list[i]
    my_list[i] = square

print(my_list)
# Output [4, 16, 36, 64]
```

Removing elements from a List

The elements from the list can be removed using the following list methods.

method	Description
`remove(item)`	To remove the first occurrence of the item from the list.
`pop(index)`	Removes and returns the item at the given index from the list.
`clear()`	To remove all items from the list. The output will be an empty list.
`del list_name`	Delete the entire list.

Python List methods to remove item

Remove specific item

Use the `remove()` method to remove the first occurrence of the item from the list.

Note: It Throws a `keyerror` if an item not present in the original list.

Example

```
my_list = list([2, 4, 6, 8, 10, 12])

# remove item 6
my_list.remove(6)
# remove item 8
my_list.remove(8)

print(my_list)
# Output [2, 4, 10, 12]
```

Remove all occurrence of a specific item

Use a loop to remove all occurrence of a specific item

```
my_list = list([6, 4, 6, 6, 8, 12])

for item in my_list:
    my_list.remove(6)

print(my_list)
# Output [4, 8, 12]
```

Remove item present at given index

Use the `pop()` method to remove the item at the given index. The `pop()` method removes and returns the item present at the given index.

Note: It will remove the last time from the list if the index number is not passed.

Example

```
my_list = list([2, 4, 6, 8, 10, 12])

# remove item present at index 2
my_list.pop(2)
print(my_list)
# Output [2, 4, 8, 10, 12]

# remove item without passing index number
my_list.pop()
print(my_list)
# Output [2, 4, 8, 10]
```


Remove the range of items

Use del keyword along with list slicing to remove the range of items

```
my_list = list([2, 4, 6, 8, 10, 12])

# remove range of items
# remove item from index 2 to 5
del my_list[2:5]
print(my_list)
# Output [2, 4, 12]

# remove all items starting from index 3
my_list = list([2, 4, 6, 8, 10, 12])
del my_list[3:]
print(my_list)
# Output [2, 4, 6]
```

Remove all items

Use the list' `clear()` method to remove all items from the list.
The `clear()` method truncates the list.

```
my_list = list([2, 4, 6, 8, 10, 12])

# clear list
my_list.clear()
print(my_list)
# Output []

# Delete entire list
del my_list
```


Finding an element in the list

Use the `index()` function to find an item in a list.

The `index()` function will accept the value of the element as a parameter and returns the first occurrence of the element or returns `ValueError` if the element does not exist.

```
my_list = list([2, 4, 6, 8, 10, 12])

print(my_list.index(8))
```

```
# Output 3

# returns error since the element does not exist in the list.
# my_list.index(100)
```

Concatenation of two lists

The concatenation of two lists means merging of two lists. There are two ways to do that.

- Using the `+` operator.
- Using the `extend()` method. The `extend()` method appends the new list's items at the end of the calling list.

Example

```
my_list1 = [1, 2, 3]
my_list2 = [4, 5, 6]

# Using + operator
my_list3 = my_list1 + my_list2
print(my_list3)
# Output [1, 2, 3, 4, 5, 6]

# Using extend() method
my_list1.extend(my_list2)
print(my_list1)
# Output [1, 2, 3, 4, 5, 6]
```


Copying a list

There are two ways by which a copy of a list can be created. Let us see each one with an example.

Using assignment operator (=)

This is a straightforward way of creating a copy. In this method, the new list will be a deep copy. The changes that we make in the original list will be reflected in the new list.

This is called **deep copying.**

```
my_list1 = [1, 2, 3]

# Using = operator
new_list = my_list1
# printing the new list
print(new_list)
# Output [1, 2, 3]

# making changes in the original list
my_list1.append(4)

# print both copies
print(my_list1)
# result [1, 2, 3, 4]
print(new_list)
# result [1, 2, 3, 4]
```


As seen in the above example a copy of the list has been created. The changes made to the original list are reflected in the copied list as well.

Note: When you set `list1 = list2`, you are making them refer to the same `list` object, so when you modify one of them, all references associated with that object reflect the current state of the object. So don't use the assignment operator to copy the dictionary instead use the `copy()` method.

Using the copy() method

The copy method can be used to create a copy of a list. This will create a new list and any changes made in the original list will not reflect in the new list. This is **shallow copying**.

```
my_list1 = [1, 2, 3]

# Using copy() method
```

```
new_list = my_list1.copy()
# printing the new list
print(new_list)
# Output [1, 2, 3]

# making changes in the original list
my_list1.append(4)

# print both copies
print(my_list1)
# result [1, 2, 3, 4]
print(new_list)
# result [1, 2, 3]
```

As seen in the above example a copy of the list has been created. The changes made to the original list are not reflected in the copy.

List operations

We can perform some operations over the list by using certain functions like `sort()`, `reverse()`, `clear()` etc.

Sort List using sort()

The sort function sorts the elements in the list in ascending order.

```
mylist = [3,2,1]
mylist.sort()
print(mylist)
```

Output

```
[1, 2, 3]
```

As seen in the above example the items are sorted in the ascending order.

Reverse a List using reverse()

The reverse function is used to reverse the elements in the list.

```
mylist = [3, 4, 5, 6, 1]
mylist.reverse()
print(mylist)
```


Output

```
[1, 6, 5, 4, 3]
```

As seen in the above example the items in the list are printed in the reverse order here.

Python Built-in functions with List

In addition to the built-in methods available in the list, we can use the built-in functions as well on the list. Let us see a few of them for example.

Using max() & min()

The max function returns the maximum value in the list while the min function returns the minimum value in the list.

```
mylist = [3, 4, 5, 6, 1]
print(max(mylist)) #returns the maximum number in the list.
print(min(mylist)) #returns the minimum number in the list.
```

Output

```
6

1
```

As seen in the above example the `max` function returns 6 and `min` function returns 1.

Using sum()

The sum function returns the sum of all the elements in the list.

```
mylist = [3, 4, 5, 6, 1]
print(sum(mylist))
```

Output

```
19
```

As seen in the above example the sum function returns the sum of all the elements in the list.

all()

In the case of all() function, the return value will be true only when all the values inside the list are true. Let us see the different item values and the return values.

Item Values in List	Return Value
All Values are True	True
One or more False Values	False
All False Values	False
Empty List	True

```
#with all true values
samplelist1 = [1,1,True]
print("all() All True values::",all(samplelist1))

#with one false
```

```
samplelist2 = [0,1,True,1]
print("all() with One false value ::",all(samplelist2))

#with all false
samplelist3 = [0,0,False]
print("all() with all false values ::",all(samplelist3))

#empty list
samplelist4 = []
```

Output

```
all() All True values:: True

all() with One false value :: False

all() with all false values :: False

all() Empty list :: True
```


any()

The any() method will return true if there is at least one true value. In the case of Empty List, it will return false.
Let us see the same possible combination of values for any() function in a list and its return values.

Item Values in List	Return Value
All Values are True	True
One or more False Values	True
All False Values	False
Empty List	False

Similarly, let's see each one of the above scenarios with a small example.

```
#with all true values
samplelist1 = [1,1,True]
print("any() True values::",any(samplelist1))

#with one false
samplelist2 = [0,1,True,1]
print("any() One false value ::",any(samplelist2))


#with all false
samplelist3 = [0,0,False]
print("any() all false values ::",any(samplelist3))

#empty list
samplelist4 = []
print("any() Empty list ::",any(samplelist4))
```

Output

```
any() True values:: True

any() One false value :: True

any() all false values :: False

any() Empty list :: False
```

Nested List

The list can contain another list (sub-list), which in turn contains another list and so on. This is termed a nested list.


```
mylist = [3, 4, 5, 6, 3, [1, 2, 3], 4]
```

In order to retrieve the elements of the inner list we need a nested `For-Loop`.

```
nestedlist = [[2,4,6,8,10],[1,3,5,7,9]]

print("Accessing the third element of the second list",nestedlist[1][2])
```

```
for i in nestedlist:
  print("list",i,"elements")
  for j in i:
    print(j)
```

Output

```
Accessing the third element of the second list 5

list [2, 4, 6, 8, 10] elements

2

4

6

8

10

list [1, 3, 5, 7, 9] elements

1

3

5

7

9
```

As we can see in the above output the indexing of the nested lists with the index value of the outer loop first followed by the inner list. We can print values of the inner lists through a nested `for-loop`.

List Comprehension

List comprehension is a simpler method to create a list from an existing list. It is generally a list of iterables generated with an option to include only the items which satisfy a condition.

```
outputList = {expression(variable) for variable in inputList [if variable
condition1][if variable condition2]
```

- `expression`: Optional. expression to compute the members of the output List which satisfies the optional conditions
- `variable`: Required. a variable that represents the members of the input List.
- `inputList`: Required. Represents the input set.
- `condition1`, `condition2` etc; : Optional. Filter conditions for the members of the output List.

```
inputList = [4,7,11,13,18,20]
#creating a list with square values of only the even numbers
squareList = [var**2 for var in inputList if var%2==0]
print(squareList)
```

Output

```
[16, 324, 400]
```

As seen in the above example we have created a new list from an existing input list in a single statement. The new list now contains only the squares of the even numbers present in the input list.

We can even create a list when the input is a continuous range of numbers.


```
#creating even square list for a range of numbers
squarelist1 = [s**2 for s in range(10)if s%2 == 0]
print(squarelist1)
```

Output

```
[0, 4, 16, 36, 64]
```

As seen in the above example we have created a list of squares of only even numbers in a range. The output is again a list so the items will be ordered.

Summary of List operations

For the following examples, we assume that `l1` and `l2` are lists, `x`, `i`, `j`, `k`, `n` are integers.

`l1 = [10, 20, 30, 40, 50]` and `l2 = [60, 70, 80, 60]`

Operation	Description
`x in l1`	Check if the list `l1` contains item `x`.
`x not in l2`	Check if list `l1` does not contain item `x`.
`l1 + l2`	Concatenate the lists `l1` and `l2`. Creates a new list containing the items from `l1` and `l2`.
`l1 * 5`	Repeat the list `l1` 5 times.
`l1[i]`	Get the item at index `i`. Example `l1[2]` is 30.
`l1[i:j]`	List slicing. Get the items from index `i` up to index `j` (excluding `j`) as a List. An example `l1[0:2]` is `[10, 20]`
`l1[i:j:k]`	List slicing with step. Returns a List with the items from index `i` up to index j taking every k- example `l1[0:4:2]` is [10, 30].
`len(l1)`	Returns a count of total items in a list.
`l2.count(60)`	Returns the number of times a particular item (60) appears in a list. The answer is 2.

Operation	Description
`l1.index(30)`	Returns the index number of a particular item (30) in a list. The answer is 2.
`l1.index(30, 2, 5)`	Returns the index number of a particular item (30) in a list. But search Returns the item wit maximum value from a list. The answer is 60 only from index number 2 to 5.
`min(l1)`	Returns the item with a minimum value from a list. The answer is 10.
`max(l1)`	Returns the item with maximum value from a list. The answer is 60.
`l1.append(100)`	Add item at the end of the list
`l1.append([2, 5, 7])`	Append the nested list at the end
`l1[2] = 40`	Modify the item present at index 2
`l1.remove(40)`	Removes the first occurrence of item 40 from the list.
`pop(2)`	Removes and returns the item at index 2 from the list.
`l1.clear()`	Make list empty
`l3= l1.copy()`	Copy `l1` into `l2`

Summary of Python List Operations