Python List

Python offers a range of compound datatypes often referred to as sequences. List is one of the most frequently used and very versatile datatype used in Python.

Creating a List

In Python programming, a list is created by placing all the items (elements) inside a square bracket [ ], separated by commas. It can have any number of items and they may be of different types (integer, float, string etc.). A list can even have another list as an item. These are called nested list.

```
# empty list
my_list = []

# list of integers
my_list = [1, 2, 3]

# list with mixed datatypes
my_list = [1, "Hello", 3.4]

# nested list
my_list = ["mouse", [8, 4, 6]]
```

Accessing Elements in a List

There are various ways in which we can access the elements of a list.

Indexing

We can use the index operator [] to access an item in a list. Index starts from 0. So, a list having 5 elements will have index from 0 to 4. Trying to access an element other that this will raise an `IndexError`. The index must be an integer. We can't use float or other types, this will result into `TypeError`. Nested list are accessed using nested indexing.

```
>>> my_list = ['p','r','o','b','e']
>>> my_list[0]
'p'
>>> my_list[2]
'o'
```

```
>>> my_list[4]
'e'
>>> my_list[4.0]
...
TypeError: list indices must be integers, not float
>>> my_list[5]
...
IndexError: list index out of range

>>> n_list = ["Happy", [2,0,1,5]]
>>> n_list[0][1]    # nested indexing
'a'
>>> n_list[1][3]    # nested indexing
5
```

Negative indexing

Python allows negative indexing for its sequences. The index of -1 refers to the last item, -2 to the second last item and so on.

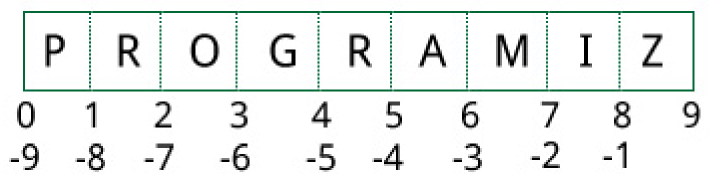
```
>>> my_list = ['p','r','o','b','e']
>>> my_list[-1]
'e'
>>> my_list[-5]
'p'
```

Slicing

We can access a range of items in a list by using the slicing operator (colon).

```
>>> my_list = ['p','r','o','g','r','a','m','i','z']
>>> my_list[2:5]    # elements 3rd to 5th
['o', 'g', 'r']
>>> my_list[:-5]    # elements beginning to 4th
['p', 'r', 'o', 'g']
>>> my_list[5:]     # elements 6th to end
['a', 'm', 'i', 'z']
>>> my_list[:]      # elements beginning to end
['p', 'r', 'o', 'g', 'r', 'a', 'm', 'i', 'z']
```

Slicing can be best visualized by considering the index to be between the elements as shown below. So if we want to access a range, we need two index that will slice that portion from the list.



Changing or Adding Elements to a List

List are mutable, meaning, their elements can be changed unlike string or tuple. We can use assignment operator (=) to change an item or a range of items.

```
>>> odd = [2, 4, 6, 8]    # mistake values
>>> odd[0] = 1            # change the 1st item
>>> odd
[1, 4, 6, 8]
>>> odd[1:4] = [3, 5, 7]  # change 2nd to 4th items
>>> odd                   # changed values
[1, 3, 5, 7]
```

We can add one item to a list using `append()` method or add several items using `extend()` method.

```
>>> odd
[1, 3, 5]
>>> odd.append(7)
>>> odd
[1, 3, 5, 7]
>>> odd.extend([9, 11, 13])
>>> odd
[1, 3, 5, 7, 9, 11, 13]
```

We can also use + operator to combine two lists. This is also called concatenation. The * operator repeats a list for the given number of times.

```
>>> odd
[1, 3, 5]
>>> odd + [9, 7, 5]
[1, 3, 5, 9, 7, 5]
>>> ["re"] * 3
['re', 're', 're']
```

Furthermore, we can insert one item at a desired location by using the method `insert()` or insert multiple items by squeezing it into an empty slice of a list.

```
>>> odd
[1, 9]
>>> odd.insert(1,3)
>>> odd
[1, 3, 9]
>>> odd[2:2] = [5, 7]
>>> odd
[1, 3, 5, 7, 9]
```

Deleting or Removing Elements from a List

We can delete one or more items from a list using the keyword `del`. It can even delete the list entirely.

```
>>> my_list = ['p','r','o','b','l','e','m']
>>> del my_list[2]    # delete one item
>>> my_list
['p', 'r', 'b', 'l', 'e', 'm']
>>> del my_list[1:5]  # delete multiplt items
>>> my_list
['p', 'm']
>>> del my_list       # delete entire list
>>> my_list
...
NameError: name 'my_list' is not defined
```

We can use `remove()` method to remove the given item or `pop()` method to remove an item at the given index. The `pop()` method removes and returns the last item if index is not provided. This helps us implement lists as stacks (first in, last out data structure). We can also use the `clear()` method to empty a list.

```
>>> my_list = ['p','r','o','b','l','e','m']
>>> my_list.remove('p')
>>> my_list
['r', 'o', 'b', 'l', 'e', 'm']
>>> my_list.pop(1)
'o'
>>> my_list
['r', 'b', 'l', 'e', 'm']
```

```
>>> my_list.pop()
'm'
>>> my_list
['r', 'b', 'l', 'e']
>>> my_list.clear()
>>> my_list
[]
```

Finally, we can also delete items in a list by assigning an empty list to a slice of elements.

```
>>> my_list = ['p','r','o','b','l','e','m']
>>> my_list[2:3] = []
>>> my_list
['p', 'r', 'b', 'l', 'e', 'm']
>>> my_list[2:5] = []
>>> my_list
['p', 'r', 'm']
```

Python List Methods

Methods that are available with list object in Python programming are tabulated below. They are accessed as `list.method()`. Some of the methods have already been used above.

Python List Methods

Method	Description
append(*x*)	Add item *x* at the end of the list
extend(*L*)	Add all items in given list *L* to the end
insert(*i*, *x*)	Insert item *x* at position *i*
remove(*x*)	Remove first item that is equal to *x*, from the list
pop([*i*])	Remove and return item at position *i* (last item if *i* is not provided)
clear()	Remove all items and empty the list
index(*x*)	Return index of first item that is equal to *x*
count(*x*)	Return the number of items that is equal to *x*
sort()	Sort items in a list in ascending order

reverse()	Reverse the order of items in a list
copy()	Return a shallow copy of the list

```
>>> my_list = [3, 8, 1, 6, 0, 8, 4]
>>> my_list.index(8)
1
>>> my_list.count(8)
2
>>> my_list.sort()
>>> my_list
[0, 1, 3, 4, 6, 8, 8]
>>> my_list.reverse()
>>> my_list
[8, 8, 6, 4, 3, 1, 0]
```

Python List Comprehension

List comprehension is an elegant and concise way to create new list from an existing list in Python. List comprehension consists of an expression followed by `for` statement inside square brackets. Here is an example to make a list with each item being increasing power of 2.

```
>>> pow2 = [2 ** x for x in range(10)]
>>> pow2
[1, 2, 4, 8, 16, 32, 64, 128, 256, 512]
```

This code is equivalent to

```
pow2 = []
for x in range(10):
   pow2.append(2 ** x)
```

A list comprehension can optionally contain more `for` or `if` statements. An optional `if` statement can filter out items for the new list. Here are some examples.

```
>>> pow2 = [2 ** x for x in range(10) if x > 5]
>>> pow2
[64, 128, 256, 512]
```

```
>>> odd = [x for x in range(20) if x % 2 == 1]
>>> odd
[1, 3, 5, 7, 9, 11, 13, 15, 17, 19]
>>> [x+y for x in ['Python ','C '] for y in ['Language','Programming']]
['Python Language', 'Python Programming', 'C Language', 'C Programming']
```

Other List Operations

List Membership Test

We can test if an item exists in a list or not, using the keyword `in`.

```
>>> my_list = ['p','r','o','b','l','e','m']
>>> 'p' in my_list
True
>>> 'a' in my_list
False
>>> 'c' not in my_list
True
```

Iterating Through a List

Using a `for` loop we can iterate though each item in a list.

```
>>> for fruit in ['apple','banana','mango']:
...     print("I like",fruit)
...
I like apple
I like banana
I like mango
```

Built-in Functions with List

Built-in functions like `all()`, `any()`, `enumerate()`, `len()`, `max()`, `min()`, `list()`, `sorted()` etc. are commonly used with list to perform different tasks.

Built-in Functions with List

Function	Description
all()	Return `True` if all elements of the list are true (or if the list is empty).

any()	Return `True` if any element of the list is true. If the list is empty, return `False.`
enumerate()	Return an enumerate object. It contains the index and value of all the items of list as a tuple.
len()	Return the length (the number of items) in the list.
list()	Convert an iterable (tuple, string, set, dictionary) to a list.
max()	Return the largest item in the list.
min()	Return the smallest item in the list
sorted()	Return a new sorted list (does not sort the list itself).
sum()	Retrun the sum of all elements in the list.