Programming **201**

Introduction to Python Data Structures

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By the end of this session

- You will know **What a data structure is!**
- You will have an understanding of **Primitive** vs **Non-Primitive data structures**
- Will have done a lot of **hands-on** coding and using **Non-Primitive data structures**

List, tuple, set, dictionary

Data Structure

Data structure is a **data** organization, management, and storage format that enables efficient access and modification

```
1.  isEarth='True'
2.  name='Earth'
3.  rank=3
4.  radius=6371.0088
5.  aliensFound=False
6.
7.  print(f'''
8.  {isEarth}:{type(isEarth)}
9.  {name}:{type(name)}
10. {rank}:{type(rank)}
11. {radius}:{type(radius)}
12. {aliensFound}:{type(aliensFound)}
13. ''')
```

This data is small and simple but in real world it might get complicated

```
127.0.0.1 - - [31/Oct/2017:11:11:37 +0530] "GET / HTTP/1.1" 200 729 "-" "Mozilla/5.0
127.0.0.1 - - [31/Oct/2017:11:11:37 +0530] "GET /icons/blank.gif HTTP/1.1" 200 431 "h
fox/56.0"
127.0.0.1 - - [31/Oct/2017:11:11:37 +0530] "GET /icons/folder.gif HTTP/1.1" 200 509 "
efox/56.0"
127.0.0.1 - - [31/Oct/2017:11:11:37 +0530] "GET /icons/text.gif HTTP/1.1" 200 513 "ht
ox/56.0"
127.0.0.1 - - [31/Oct/2017:11:11:38 +0530] "GET /favicon.ico HTTP/1.1" 404 500 "-" "M
127.0.0.1 - - [31/Oct/2017:11:12:05 +0530] "GET /tecmint/ HTTP/1.1" 200 787 "http://l
0"
127.0.0.1 - - [31/Oct/2017:11:12:05 +0530] "GET /icons/back.gif HTTP/1.1" 200 499 "ht
01 Firefox/56.0"
127.0.0.1 - - [31/Oct/2017:11:13:58 +0530] "GET /tecmint/Videos/ HTTP/1.1" 200 817 "h
101 Firefox/56.0"
127.0.0.1 - - [31/Oct/2017:11:13:58 +0530] "GET /icons/compressed.gif HTTP/1.1" 200 1
) Gecko/20100101 Firefox/56.0"
127.0.0.1 - - [31/Oct/2017:11:13:58 +0530] "GET /icons/movie.gif HTTP/1.1" 200 527 "h
o/20100101 Firefox/56.0"
::1 - - [31/Oct/2017:11:26:57 +0530] "GET /ravi HTTP/1.1" 404 494 "-" "Mozilla/5.0 (X
.36"
::1 - - [31/Oct/2017:11:26:57 +0530] "GET /favicon.ico HTTP/1.1" 404 500 "http://loca
ome/60.0.3112.90 Safari/537.36"
::1 - - [31/Oct/2017:11:27:20 +0530] "GET /anusha HTTP/1.1" 404 496 "-" "Mozilla/5.0
37.36"
Waiting for data... (interrupt to abort)
```

- add - seach - update - del

- 1 by 1

Data Structures

Data structures allow us to efficiently

store and **manage**

data

Manage data: Add, Read, search, update, delete, iterate, etc *(data processing)*

Types of data structures

single/scalar

Collection

Primitive	Non- Primitive
int	list
float	tuple
str	set
bool	dict
	any other user defined...

Primitive types store scalar/single values, while non-primitive store multiple values.
Non primitive can be a collection of primitive and non primitive data types.

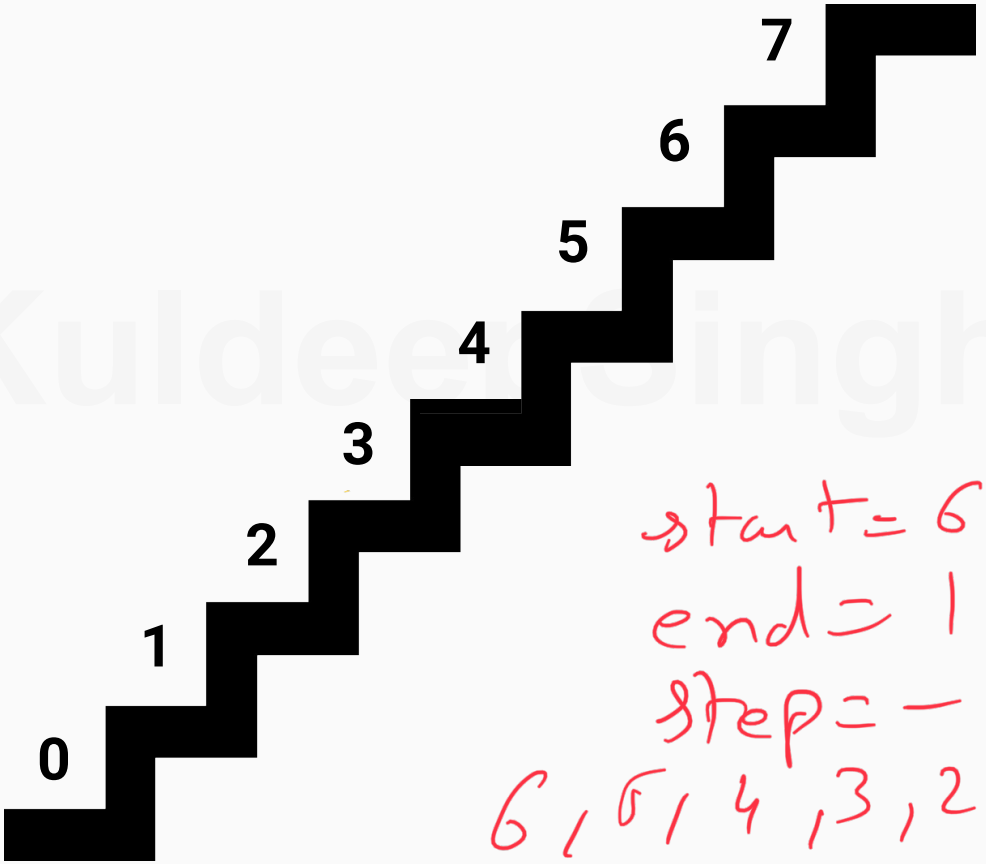
list

```
1.  # a list is represented by []
2.
3.  ## empty list
4.  products = []
5.
6.  ## non-empty list
7.  player = ['ronaldo', 7, 1.87, True]
8.
9.  ## another list
10. grocery = [3,'chairs', 3, 'tables', 1.5, 'apples', True, ['ronaldo', 7, 1.87, True]]
11.
12. print(player, '\n', grocery)
13. print(type(player), '\n', type(grocery))
14.
15. ### NOTES ###
16. # 1: A list can contain any data type (including a list)
17. # 2: A list can contain duplicates
```

list

```
1.  # indexing in a list
2.  # list is 0-indexed
3.  #[0 1 2 3..... -3 -2 -1]
4.
5.  avengers = ['thor', 'iron-man', 'hulk', 'cap']
6.  ############  0           1         2         3
7.  ############ -4          -3        -2        -1
8.
9.  print(avengers[0], avengers[-4])
10. print(avengers[1], avengers[-3])
```

list



start = 6
end = 1
step = -1
6, 5, 4, 3, 2, 1

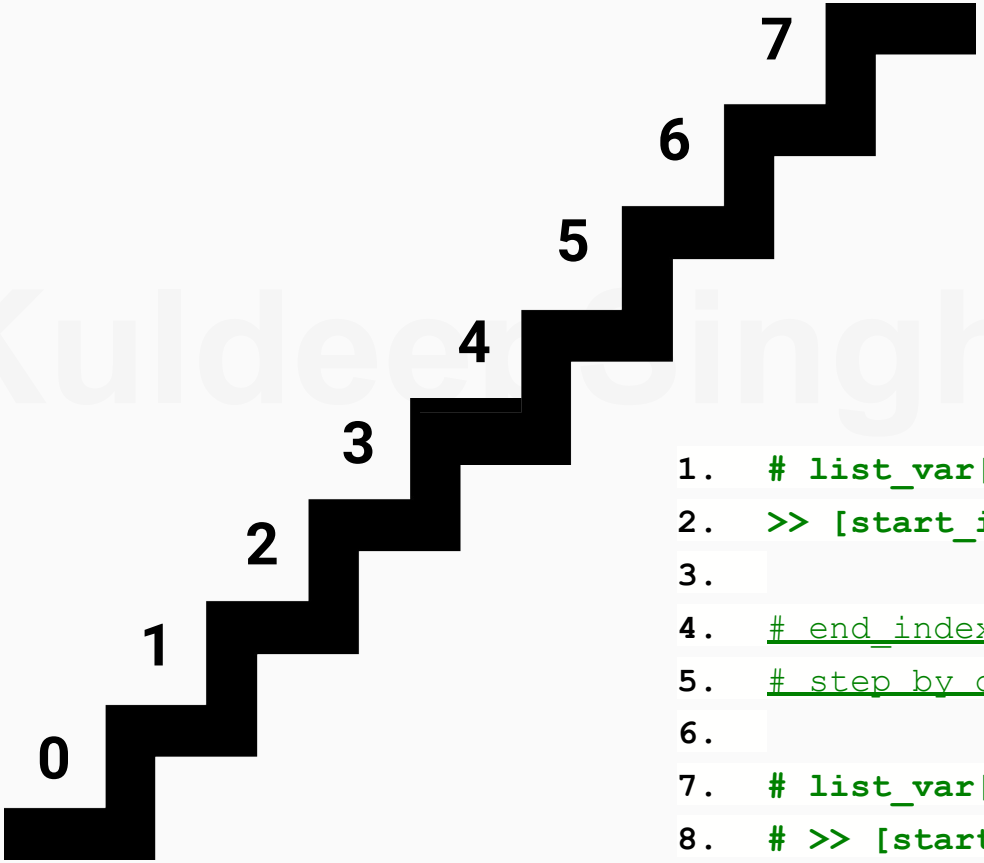
start = 0
end = 5
0, 1, 2, 3, 4, 5
by default step is +1

start = 1
end = absolute end
step = 2
1, 3, 5, 7

list

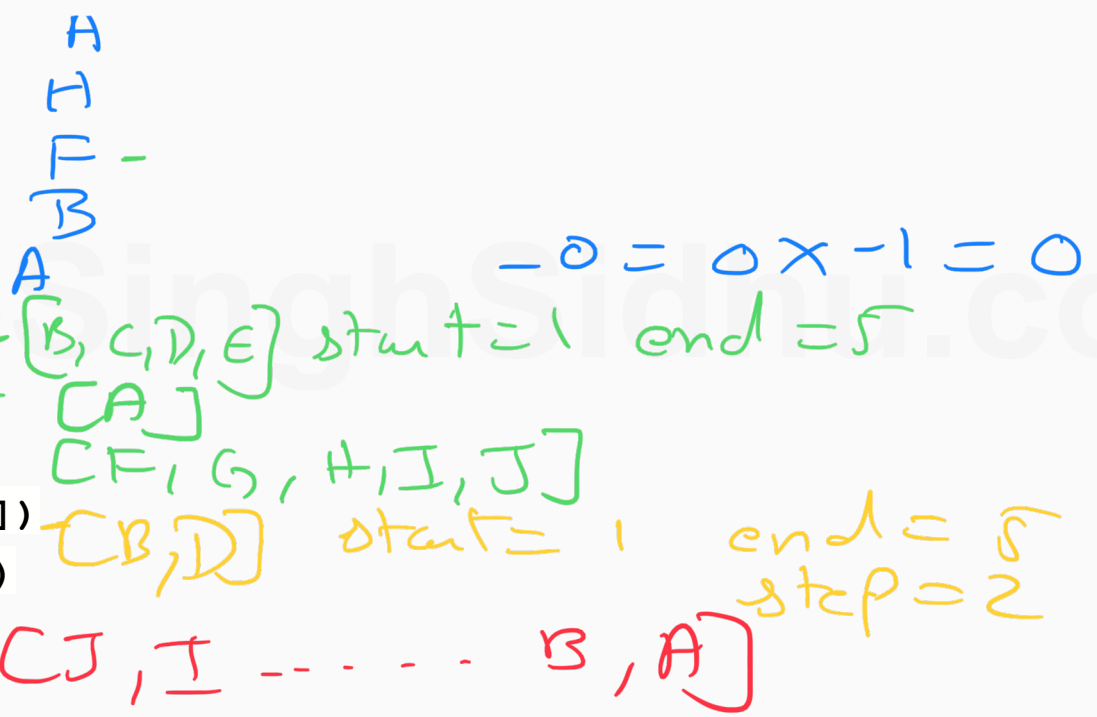
```
1.  # slicing a list >>> my_list[from:till:step]
2.
3.  avengers = ['thor', 'iron-man', 'hulk', 'cap']
4.
5.  print(avengers[1:3]) # slicing
6.  print(avengers[:3]) # slicing one side
7.  print(avengers[1:]) # slicing one side
8.  print(avengers[0:3:2]) # steps
9.  print(avengers[::-1]) # reverse steps
10.
11.  ### NOTES ###
12.  # 1: my_list[from:till:step] by default from=0, till=list length, step=1
13.  # 2: from is included, till is not
```

list




```
1.  # list_var[start_index:end_index]
2.  >> [start_index, start_index+1...end_index-1]
3.
4.  # end_index is NOT included
5.  # step by default is 1
6.
7.  # list_var[start_index:end_index: step]
8.  # >> [start_index, start_index+step...end_index-1]
```

```
1.  # first 10 english alphabets
2.  alphabets = ['A','B','C','D','E','F','G','H','I','J']
3.  print(alphabets[0])
4.  print(alphabets[-3])
5.  print(alphabets[5])
6.  print(alphabets[1])
7.  print(alphabets[-0])
8.  print(alphabets[1:5])
9.  print(alphabets[:1])
10. print(alphabets[5:])
11. print(alphabets[1:5:2])
12. print(alphabets[::-1])
```



list

```
1.  ## step by step understanding
2.
3.  # how to access each element 1 by 1 (traversing)
4.  # using a loop
5.
6.  avengers = ['thor', 'iron-man', 'hulk', 'cap']
7.
8.  for hero in avengers:
9.      print(hero)
10.
11. ### NOTES ###
12. # 1: here hero is a temp variable whose value changes iteratively
13. # 2: it starts and ends automatically
```

list

```
1.  # manipulating/updating the list elements
2.
3.  avengers = ['thor', 'iron-man', 'hulk', 'cap']
4.
5.  print(avengers, avengers[0])
6.  avengers[0] = 'god of thunder'
7.  print(avengers, avengers[0])
8.
9.  print(avengers, avengers[1], type(avengers[1]))
10. avengers[1] = False
11. print(avengers, avengers[1], type(avengers[1]))
12.
13. ### NOTES ###
14. # 1: list is a mutable data structure, that is it is editable
15. # 2: you can change an element of the list from one data type to another
```

list

```
1.  # adding elements to the list using append(element) and insert(pos, element)
2.
3.  avengers = ['thor', 'iron-man', 'hulk', 'cap']
4.
5.  print(avengers)
6.  avengers.append('gamora')
7.  print(avengers)
8.  avengers.append('nebula')
9.  print(avengers)
10.
11.  avengers.insert(1,'loki')
12.  print(avengers)
13.
14.
15.  ### NOTES ###
16.  # 1: append() is used to add elements to a list (at the end)
17.  # 2: insert() is used to insert element at a specific location in a list
```

list

```
1.  # merging list into a list using extend()
2.  avengers = ['thor', 'iron-man', 'hulk', 'cap']
3.  DC = ['batman', 'superman', 'aquaman']
4.
5.  print(avengers)
6.  avengers.extend(DC)
7.
8.  print(avengers)
9.
10. # here DC is untouched
11. print(DC)
12.
13. ### NOTES ###
14. # 1: extend() is used to merge one list to another
15. # 2: the list is added at the end
```

list

```
1.  ## What is the difference between append vs insert vs extend?
2.
3.  #  append() adds element at the end of the list
4.  #  insert() adds element at desired index
5.  #  extend() merges a list into an existing list
```

list

```
1.  # removing elements from a list
2.  avengers = ['thor', 'iron-man', 'hulk', 'cap']
3.  avengers.insert(1,'loki')
4.  avengers.append('thanos')
5.  print(avengers)
6.  # now avengers is ['thor', 'loki', 'iron-man', 'hulk', 'cap', 'thanos']
7.  # remove()
8.  avengers.remove('thanos')
9.  print(avengers)
10. # del
11. del avengers[1]
12. print(avengers)
13. del avengers[::2]
14. print(avengers)
15.
16. ### NOTES ###
17. # 1: we can use remove() to remove an element using the value(first occurence)
18. # 2: we can use del to remove an element using the index, del here is a keyword
19. # 3: we can use del to remove list slices
```

list

```
1.  # removing element from the list using pop() >>> returns the deleted
    element
2.  avengers = ['thor', 'iron-man', 'hulk', 'cap']
3.  lastHero = avengers.pop()
4.  print(lastHero, '\n',avengers)
5.  secondHero = avengers.pop(1)
6.  print(secondHero, '\n',avengers)
7.
8.  ### NOTES ###
9.  >>> Differences
10. # 1: remove(): removes based on value
11. # 2: del: deletes element or slices using index
12. # 3: pop(): removes an element and returns it
```

list

```
1.  # sorting the list
2.  avengers = ['thor', 'iron-man', 'hulk', 'cap']
3.
4.  avengers.sort()
5.
6.  print(avengers)
```

list

```
1.  # searching the list (Quick Search)
2.  ## using in keyword to quickly check if any element is present in the list
    or not
3.  avengers = ['thor', 'iron-man', 'hulk', 'cap']
4.  print('groot' in avengers)
5.  print('iron-man' in avengers)
```

list

```
1.  ## doing element by element comparison
2.  avengers = ['thor', 'iron-man', 'hulk', 'cap']
3.
4.  for myHero in avengers:
5.      if myHero=='hulk':
6.          print('found hulk')
7.          break
```

```
# count the number of 5 rs coins in the list
# when does first 5 rs coin appear

coins = [1,2,5,6,5,7,8,5,10]
count=0
locFound=False
loc=0
for coin in coins:
    if coin==5:
        count+=1
        locFound=True
    if locFound==False:
        loc+=1

print(f'Number of 5 rupees coin found are  {count}')
print(f'First 5 rs coin appears at  {loc}')

## directly use count to count an element
print(f'Number of 5 rupees coin found are  {coins.count(5)}')
## directly use index to find index of an element
print(f'First 5 rs coin appears at  {coins.index(5)}')
```

list

Manage list data:

- Add
- Delete
- update
- Search
- sort
- Go 1 by 1

tuple

```
1.  # Tuples are created using ()
2.
3.  ## Tuples are popular for their read only nature
4.  ## that is tuples are immutable >> no add/update/delete/sort
5.
6.  ### Empty tuple
7.  empty = ()
8.
9.  ### filled tuple
10. days = ('sun','mon','tue','wed','thu','fri','sat')
11. print(days, type(days))
12. #### reading
13. print(days[0])
14. #### searching
15. print('mon' in days)
16.
17. # days[0]='funday' # ERROR: cannot update tuple
```

tuple

When do we use tuples:
When we don’t want data to be modified by anyone for system stability

Eg:

For a ecommerce website,
Model numbers, product id will be stored in a tuple
While things like sale price, discount, qty available will be stored in a list

Packing and Unpacking of elements

```
1.  # unpacking elements
2.
3.  #tuple
4.  flavours= ('sweet','sour') #packed
5.  f1,f2 = flavours
6.  print(f1,f2)
7.
8.  # list
9.  flavours= ['sweet','sour'] #packed
10. f1,f2 = flavours
11. print(f1,f2)
12.
13. ## we generally do it for upto 3 to 5 elements
14. ## the number of elements packed to unpacked should be equal
15. ### errors
16. #### f1,f2,f3 = ['sweet','sour']
17. #### f1,f2 = ['sweet','sour','salty']
```

sets

```
1.  # sets in python are represented by {}
2.
3.  # sets allow us to store distinct/unique elements
4.  colors = {'red','cyan','cyan','orange','green','red','Red'}
5.  print(colors)
6.  # traversing
7.  for c in colors:
8.      print(c)
9.  # sets are unordered so no indexing is supported or sorting
10. # print(colors[1])
```

sets

```
1.  # sets is same as sets in math class
2.
3.  setA ={1,2,3,4,5}
4.  setB ={4,5,6,7,8}
5.
6.  # union
7.  print(setA.union(setB))
8.  # intersection
9.  print(setA.intersection(setB))
10. # difference
11. print(setA.difference(setB)) # elements of a that are not in b
```

sets

```
1.  # empty set
2.  emptySet = set()
3.  print(emptySet, type(emptySet))
4.
5.  # add things to set
6.  emptySet.add(1)
7.  emptySet.add(2)
8.  emptySet.add(3)
9.  print(emptySet)
10.
11. # can add duplicates as many times we want but will only be stored once
12. emptySet.add(1)
13. emptySet.add(1)
14. print(emptySet)
15.
16. # remove
17. emptySet.remove(2)
18. # emptySet.remove(2) # ERROR: Cannot remove something that is not present
19. print(emptySet)
```

len()

```
1.  # len
2.
3.  # str
4.  name = 'ronaldo'
5.
6.  # list
7.  player = ['ronaldo', 7, 1.87, True]
8.  ## another list
9.  grocery = [3,'chairs', 3, 'tables', 1.5, 'apples', True, ['ronaldo', 7, 1.87, True]]
10.
11.  # tuple
12.  days = ('sun','mon','tue','wed','thu','fri','sat')
13.
14.  # sets
15.  colors = {'red','cyan','cyan','orange','green','red','Red'}
16.
17.  print(len(name), len(player), len(grocery), len(days), len(colors))
```

dict

```
1.  # python dictionaries are a special data structure
2.  # key:value pair (data)
3.
4.  # example an oxford dictionary word: meaning
5.  # you search the word which is the key
6.  # to get the meaning which is the value
7.
8.  oxford = {'apple':'good fruit', 'trump':'president', 'google':'company'}
9.  print(oxford['google'])
```

To be discussed in detail...

https://www.hackerrank.com/domains/python

Practice

This is just the beginning