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# Objectives

After performing this lab, students shall be able to understand Python data structures which includes:

* Python lists
* Python tuples
* Python dictionaries

# Task Distribution

| **Total Time** | **170 Minutes** |
| --- | --- |
| Python Lists | 20 Minutes |
| Python Tuples | 10 Minutes |
| Python Dictionaries | 20 Minutes |
| Exercise | 110 Minutes |
| Online Submission | 10 Minutes |

# Python Lists

Everything is Python is treated as an object. Lists in Python represent ordered sequences of values. Lists are "mutable", meaning they can be modified "in place". You can access individual list elements with square brackets. Python uses *zero-based* indexing, so the first element has index 0.

Here are a few examples of how to create lists:

# List of integers

primes = [2, 3, 5, 7]

# We can put other types of things in lists

planets = ['Mercury', 'Venus', 'Earth', 'Mars', 'Jupiter', 'Saturn', 'Uranus', 'Neptune']

# We can even make a list of lists

hands = [

['J', 'Q', 'K'],

['2', '2', '2'],

['6', 'A', 'K'], # (Comma after the last element is optional)

]

# A list can contain a mix of different types of variables:

my\_favourite\_things = [32, 'AI Lab, 100.25]

## Indexing & Slicing Examples

Consider our list of planets created above:

planets[0] # 'Mercury'

planets[1] # 'Venus'

planets[-1] # 'Neptune'

planets[-2] # 'Uranus'

# List Slicing

# first three planets

planets[0:3] # ['Mercury', 'Venus', 'Earth']

planets[:3] # ['Mercury', 'Venus', 'Earth']

# All the planets from index 3 onward

planets[3:] # ['Mars', 'Jupiter', 'Saturn', 'Uranus', 'Neptune']

# All the planets except the first and last

planets[1:-1] # ['Venus', 'Earth', 'Mars', 'Jupiter', 'Saturn', 'Uranus']

# The last 3 planets

planets[-3:] # ['Saturn', 'Uranus', 'Neptune']

## List Modification Examples

Working with the same planets list:

# Rename Mars

planets[3] = 'Malacandra'

# ['Mercury', 'Venus', 'Earth', 'Malacandra', 'Jupiter', 'Saturn', 'Uranus', 'Neptune']

# Rename multiple list indexes

planets[:3] = ['Mur', 'Vee', 'Ur']

['Mur', 'Vee', 'Ur', 'Malacandra', 'Jupiter', 'Saturn', 'Uranus', 'Neptune']

## List functions

Python has several useful functions for working with lists.

len(planets) # 8

# The planets sorted in alphabetical order

sorted(planets)

# ['Earth', 'Jupiter', 'Mars', 'Mercury', 'Neptune', 'Saturn', 'Uranus', 'Venus']

primes = [2, 3, 5, 7]

sum(primes) # 17

max(primes) # 7

# Let’s add Pluto to the planets list

planets.append('Pluto')

# Pop removes and returns the last element of the list

planets.pop() # ‘Pluto’

# Remove an item from a list given its index instead of its value

a = [-1, 1, 66.25, 333, 333, 1234.5]

del a[0] # [1, 66.25, 333, 333, 1234.5]

# Remove slices from the list

del a[2:4] # [1, 66.25, 1234.5]

planets.index('Earth') # 2

# Is Earth a planet?

"Earth" in planets # True

# Is Pluto a planet?

"Pluto" in planets # False (We removed it remember)

# Finally to find all the methods associated with Python list object

help(planets)

# Python Dictionaries

Dictionaries and lists share the following characteristics:

* Both are mutable.
* Both are dynamic. They can grow and shrink as needed.
* Both can be nested. A list can contain another list. A dictionary can contain another dictionary. A dictionary can also contain a list, and vice versa.

Dictionaries differ from lists primarily in how elements are accessed:

* List elements are accessed by their position in the list, via indexing.
* Dictionary elements are accessed via keys not by numerical index.

Duplicate keys are not allowed. A dictionary key must be of a type that is immutable. E.g. a key cannot be a list or a dict.

Here are a few examples to create dictionaries:

MLB\_team = {

'Colorado' : 'Rockies',

'Boston' : 'Red Sox',

'Minnesota': 'Twins',

'Milwaukee': 'Brewers',

'Seattle' : 'Mariners'

}

# Can also be defined as:

MLB\_team = dict([

('Colorado', 'Rockies'),

('Boston', 'Red Sox'),

('Minnesota', 'Twins'),

('Milwaukee', 'Brewers'),

('Seattle', 'Mariners')

])

# Another way

tel = dict(sape=4139, guido=4127, jack=4098)

# dict comprehensions can be used to create dictionaries from arbitrary key and value expression

{x: x\*\*2 for x in (2, 4, 6)} # {2: 4, 4: 16, 6: 36}

# Building a dictionary incrementally – if you don’t know all the key-value pairs in advance

person = {}

person['fname'] = 'Joe'

person['lname'] = 'Fonebone'

person['age'] = 51

person['spouse'] = 'Edna'

person['children'] = ['Ralph', 'Betty', 'Joey']

person['pets'] = {'dog': 'Fido', 'cat': 'Sox'}

# {'fname': 'Joe', 'lname': 'Fonebone', 'age': 51, 'spouse': 'Edna',

'children': ['Ralph', 'Betty', 'Joey'], 'pets': {'dog': 'Fido', 'cat': 'Sox'}}

## Dictionary Modification Examples

A few examples to access the dictionary elements, add new key value pairs, or update previous value:

# Retrieve a value

MLB\_team['Minnesota'] # 'Twins'

# Add a new entry

MLB\_team['Kansas City'] = 'Royals'

# Update an entry

MLB\_team['Seattle'] = 'Seahawks'

## Dictionary Formatting Example

The % operator works conveniently to substitute values from a dict into a string by name:

hash = {}

hash['word'] = 'garfield'

hash['count'] = 42

s = 'I want %(count)d copies of %(word)s' % hash # %d for int, %s for string

# 'I want 42 copies of garfield'

## Dictionary Functions

The following is an overview of methods that apply to dictionaries:

# Let’s use this dict for to demonstrate dictionary functions

d = {'a': 10, 'b': 20, 'c': 30}

# Clears a dictionary.

d.clear() # {}

# Returns the value for a key if it exists in the dictionary.

print(d.get('b')) # 20

# Removes a key from a dictionary, if it is present, and returns its value.

d.pop('b') # 20

# Returns a list of key-value pairs in a dictionary.

list(d.items()) # [('a', 10), ('b', 20), ('c', 30)]

list(d.items())[1][0] # 'b'

list(d.items())[1][1] # 20

# Returns a list of keys in a dictionary.

list(d.keys()) # ['a', 'b', 'c']

# Returns a list of values in a dictionary.

list(d.values()) # [10, 20, 30]

# Removes the last key-value pair from a dictionary.

d.popitem() # ('c', 30)

# Merges a dictionary with another dictionary or with an iterable of key-value pairs.

d2 = {'b': 200, 'd': 400}

d.update(d2) # {'a': 10, 'b': 200, 'c': 30, 'd': 400}