ISYS90088
Introduction to Application Development

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Week 8 – Contd. from week 6: tuples & Dictionaries

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Objectives

After completing this lecture, you will be able to:

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- Work with Tuples
- Work with Dictionaries

Lists, tuples and Dictionaries

- A **list** allows the programmer to manipulate a sequence of data values of any types
  - Indicate by enclosing its elements in []

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Lists, tuples and Dictionaries

- A **list** allows the programmer to manipulate a sequence of data values of any types
  - Indicate by enclosing its elements in []
- A **tuple** resembles a list, but is immutable
  - Indicate by enclosing its elements in ()

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Tuples

- A **tuple** resembles a list, but is immutable
  - Indicate by enclosing its elements in ()
- The differences between tuples and lists are:
  - the tuples cannot be changed unlike lists
  - tuples use parentheses, whereas lists use square brackets

- Creating a tuple is as simple as putting different comma-separated values.

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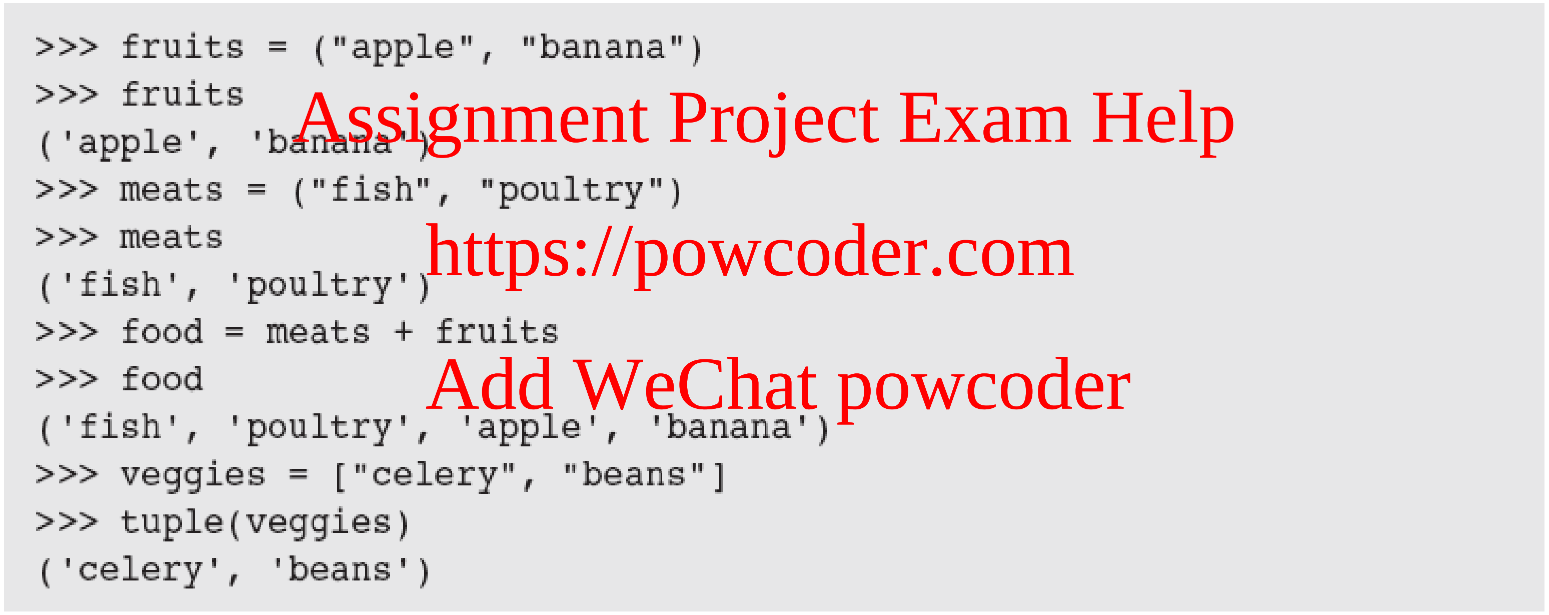
Tuples

- Lists can be converted to tuples; two sets of tuples can be concatenated
- 

```
>>> fruits = ("apple", "banana")
>>> fruits
('apple', 'banana')
>>> meats = ("fish", "poultry")
>>> meats
('fish', 'poultry')
>>> food = meats + fruits
>>> food
('fish', 'poultry', 'apple', 'banana')
>>> veggies = ["celery", "beans"]
>>> tuple(veggies)
('celery', 'beans')
```

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- Most of the operators and functions used with lists can be used in a similar fashion with tuples

Tuples

- Most of the operators and functions used with lists can be used in a similar fashion with tuples:

  - The empty tuple is written as two parentheses containing nothing

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```
tup1 = ();
```

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  - To write a tuple containing a single value you have to include a comma, even though there is only one value —

```
tup1 = (50,);
```

Tuples

- Most of the operators and functions used with lists can be used in a similar fashion with tuples:

  - The empty tuple is written as two parentheses containing nothing

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```
      tup1 = ();
```

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  for lists: `list1 = []`

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  - To write a tuple containing a single value you have to include a comma, even though there is only one value —

```
      tup1 = (50,);
   For lists: list1 = [50]
```

Tuples

- Like string indices, tuple indices start at 0. The operations performed are: concatenation, iteration, in, slicing and indexing

- Accessing Values in Tuples: use the square brackets for slicing along with the index or indices to obtain value available at that index.

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- Updating Tuples - Tuples are immutable which means you cannot update or change the values of tuple elements.

- Delete Tuple Elements - Removing individual tuple elements is not possible.

Tuples

➢ To explicitly remove an entire tuple, just use the **del** statement. For example:

```
tuple1 = ('physics', 'chemistry', 1997, 2000)
print (tuple1)
del tuple1
print ("After deleting tuple : ")
print (tuple1)
```

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- This produces the following result (check example). Note an exception raised, this is because after **del tup** tuple does not exist any more.

Example:

```
>>>tuple3 = (1,2,3)
>>>list(tuple3)
[1,2,3]
```

Tuples

Built-in Tuple Functions can be used:

```
## length, max and min in a tuple
   tuple1, tuple2 = ('zar', 'xyz', 'zara'), (100, 500, 20)
   print ("Max value element : ", max(tuple1))
   print ("Max value element : ", max(tuple2))
   print ("Min value element : ", min(tuple1))
   print ("Min value element : ", min(tuple2))
   print ("First tuple length : ", len(tuple1))
   print ("Second tuple length : ", len(tuple2))

#convert a list of items into tuples
   Listofitems = [23, 'years', 'dogs', 'cats'];
   toaTuple = tuple(Listofitems)
   print ("Tuple elements : ", toaTuple)
```

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Difference between lists and tuples

- Lists are mutable. Lists however have this method called append. In order for most of your appends to be fast, python will actually create a larger array in memory *just in case* you append.
- This way, when you do append, it does not have to recreate a list every time. You can add items to the list .How would it know that you don't want to maybe add a 4th 5th 6th element? To play safe, we assume you might want more in the memory
- On the other hand, by using tuples, it tells python that you want an immutable structure. Give me space for 3 things, fill those slots up, and move on.
- Since tuples are immutable, this means that tuples are fixed. We can't do anything to them in memory.
- Performance: processing of tuples is said to be faster than list processing
- Using tuples is safe: Since they are immutable, we cant change content of the tuple. This can be useful when you don't want any data modified by your code

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Lists, tuples and Dictionaries

- A **list** allows the programmer to manipulate a sequence of data values of any types
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- A **dictionary** organizes data values by association with other data values rather than by '**sequential position**'

- Lists and dictionaries provide powerful ways to organize data in useful and interesting applications

Dictionaries

- A dictionary organizes information by **association**, not position
  - Example: When you use a dictionary to look up the definition of "Mammal," you don't start at page 1; instead, you turn to the words beginning with "M"
- Data structures organized by association are also called **tables** or **association lists**
- In Python, a **dictionary** associates a set of **keys** with data values

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Dictionary Literals

- A Python dictionary is written as a sequence of key/value pairs separated by commas
  - Pairs are sometimes called **entries**
  - Enclosed in curly braces ({ and })
  - A colon (:) separates a key and its value
- Examples:

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```
{'Sarah':'476-3321', 'Nathan':'351-7743'}  #A Phone book
{'Name':'Molly', 'Age':18}     # Personal information
{}                            #An empty dictionary
```

Mixing data types in a dictionary

- Keys in a dictionary are immutable but their associated values can be of any type. For example, the values can be lists.

d1 = {‘matt’: [23, 2000, 2010], ‘anne’: [25, 2545, 2012], ‘jack’: [34, 2500, 2011]}

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- The values stored in a single dictionary can be of different types. For example one element in the dictionary can be a string, another an integer, another a float etc..

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Example:

```
>>> employee_record = {'name':'kevin', 'Age': 43,
'ID':23145, 'payrate':24.99}
>>>employee_record
{'Age': 43, 'name': 'kevin', 'ID': 23145,
'payrate': 24.99}
```

Properties of Dictionary Keys

Dictionary values have no restrictions. However, same is not true for the keys. There exists a mapping between keys and the values. There are two important points to remember about dictionary keys –

(a) More than one entry per key not allowed. Which means no duplicate key is allowed. When duplicate keys encountered during assignment, the last assignment wins. For example –

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```
>>>dict = {'Name': 'Amie', 'Age': 10, 'Name': 'Jack'}
>>> print ("dict['Name']: ", dict['Name'])
```

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When the above code is executed, it produces the following result –

```
dict['Name']: ‘jack’  => Why?
```

Dictionaries: as hash tables to explain immutability

(b) Keys are immutable. For example, when you insert a key into a hash table, the hash table asks the key for its hash code, and remembers it along with the key itself and the associated value. When you later perform a lookup, the hash table asks the key you're looking for its hash code, and can very quickly find all the keys in the table that have the same hash code.

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- If a key is mutable, then finding the value associated with the unique key is not possible – the hash table would be messed up as you wont know accurately the associated value to the specific key.

Adding Keys and Replacing Values

- Add a new key/value pair to a dictionary using **[]**:

```
<a dictionary>[<a key>] = <a value>
```

- Example:

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```
>>> info = {}
>>> info["name"] = "Sandy"
>>> info["occupation"] = "hacker"
>>> info
{'name': 'Sandy', 'occupation': 'hacker'}
>>>
```

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- Use **[]** to replace a value at an existing key:

```
>>> info["occupation"] = "manager"
>>> info
{'name': 'Sandy', 'occupation': 'manager'}
>>>
```

Accessing Values

- Use **[]** to obtain the value associated with a key
  - If key is not present in dictionary, an error is raised

```
>>> info["name"]
'Sandy'
>>> info["job"]
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
KeyError: 'job'
>>>
```

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- If the existence of a key is uncertain, test for it using the dictionary method **get**

```
>>> print(info.get("job", None))
None
>>>
```

Deleting elements

- To delete an existing key-value pair from a dictionary, use the **`del`** statement. After the statement is executed, the key and its associated value will be deleted from the dictionary. Assignment Project Exam Help
- If the key does not exist, a KeyError exception is raised.

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Syntax:

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```
del dictionary_name[key]
```

Note: To prevent the KeyError from being raised, use the in opeartor to determine whether the key exists before you try to delete it and its associated value.

Dict: Del and Clear

>>>dict = {'Name': ’Anne', 'Age': 10, 'Class': ’Third’}

>>>del dict['Name']; # remove entry with key 'Name’

What is the output?

>>>dict.clear();   # remove all entries in dict

What is the output?

>>>del dict ;   # delete entire dictionary

What is the output?

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Using `in` and `not in` operators to test for a value in a Dictionary

```
#illustrate in operator to find a value in dict
phonebook = {'jack':'0423123', 'jill':'2345433',
'jane':'3334444'}

if 'jack' in phonebook:
        print(phonebook['jack'])
else:
        print('not found')


# to illustrate not in operator to find a value in
dictionary
if 'jacky' not in phonebook:
        print('not found')
```

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Using the `for` loop to iterate over a Dictionary – traverse thru' a dictionary

```
for var in <dictionary_name>:
   statement
   statement
   ...
   ...
```

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Example:

```
employee_record = {'name':'Kevin', 'Age': 43,
'ID':23145, 'payrate':24.99}
for key in employee_record:
   print(key)
```

Note: when the dict is printed, the order is different from the initial order in the dict. This means accessing elements using an index is not possible in dictionaries.

Traversing a Dictionary

- To print all of the keys and their values:

  info = {'apple': 'jack', 'banana':'jill', 'pears': 'brad'}

```
for key in info:
   print(key, info[key])
```

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- Alternative: Use the dictionary method **items()**

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```
>>> grades = {90:"A", 80:"B", 70:"C"}
>>> grades.items()
[(80, 'B'), (90, 'A'), (70, 'C')]
```

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  – Entries are represented as tuples within the list

```
for (key, value) in grades.items():
   print(key, value)
```

- You can sort the list first:

```
theKeys = list(info.keys())
theKeys.sort()
for key in theKeys:
   print(key, info[key])
```

Assessing information: check this!

```
>>> d1 = {'matt': [23, 2000, 2010],
'anne': [25, 2545, 2012], 'jack’:
[34, 2500, 2011]}
```

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```
>>> if 'jack' in d1:
  print(d1['jack'])
```

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```
[34, 2500, 2011]
>>> d1['jack'][2]
2011
```

Example code : check this out!

```
info = {'apple': ['jack', 'jane'], 'banana':
['jill'], 'pears': ['brad', 'sally']}
keylist = list(info.keys())
keylist.sort() #sorted this list
for key in keylist:
    print(key, info[key])
    print(key, info[key][0])
```

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What does this output?

Try this - dictionary with a list of values for a key

```
list1 = []
d1 = {'matt': [23, 2000, 2010], 'anne':
[25, 2545, 2012], 'jack':
                [34, 2500, 2011]}
for list1 in d1['matt']:
   print(list1)
```

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What is the output?

Getting the number of elements in a dictionary using **`len`**

- Use the built in method called **`len`**

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Example:

```
>>> employee_record = {'name':'kevin',
'Age': 43, 'ID':23145, 'payrate':24.99}
>>>len(employee_record)
4
```

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Other Dictionary methods: **`clear`**

- Use the built in method called **`clear`**

`Syntax:`

```
dictionary_name.clear()
```

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Example:

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```
>>> employee_record = {'name':'kevin',
'Age': 43, 'ID':23145, 'payrate':24.99}
>>> employee_record.clear()
>>> employee_record
{}
```

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Other Dictionary methods: **`get`**

- Use the built in method called **`get`**
- When executed, this methods outputs the value associated with the key that is searched. If not present, will output the default value as shown in the example.

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Syntax:

```
dictionary_name.get(key, default)
```

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Example:

```
>>> employee_record = {'name':'kevin', 'Age':
43, 'ID':23145, 'payrate':24.99}
>>> employee_record.get(‘name’, ‘not found’}
'kevin’
>>> employee_record.get('dob', 'not found')
'not found'
```

Other Dictionary methods: **`items`**

- Use the built in method called **`items`**
- When executed, it outputs all the key-value pairs in a ***dictionary view.***

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Syntax:

```
dictionary_name.items()
```

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Example:

```
>>> employee_record = {'name':'kevin',
'Age': 43, 'ID':23145, 'payrate':24.99}
>>> employee_record.items()
dict_items([('payrate', 24.99), ('name',
'kevin'), ('ID', 23145), ('Age', 43)])
```

Other Dictionary methods: **`keys`**

- Use the built in method called **`keys`**
- When executed, it outputs all the keys

Syntax:

```
dictionary_name.keys()
```

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Example:

```
>>> employee_record = {'name':'kevin',
'Age': 43, 'ID':23145, 'payrate':24.99}
>>> employee_record.keys()
ID
payrate
name
Age
```

Other Dictionary methods: **`values`**

- Use the built in method called **`values`**
- When executed, it outputs all the values in the dict

Syntax:

```
dictionary_name.values()
```

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Example:

```
>>> employee_record = {'name':'kevin',
'Age': 43, 'ID':23145, 'payrate':24.99}
>>> employee_record.values()
24.99
kevin
23145
43
```

Other Dictionary methods: **pop and popitem**

- Use the built in method called **pop**
- When executed, it outputs the value associated with the specific key and removes it from the dict.

Syntax:

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```
   dictionary_name.pop(key, default)
```

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Example:

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```
>>> employee_record = {'name':'kevin', 'Age': 43,
'ID':23145, 'payrate':24.99}
>>> employee_record.pop('name')
'kevin'
>>> employee_record
{'payrate': 24.99, 'ID': 23145, 'Age': 43}
>>>
```

Other Dictionary methods: **pop and popitem**

- Use the built in method called **popitem**
- When executed, it outputs a key-value pair, and it removes that key-value pair from the dict. (front of the list/dict – last in first out)

Syntax:

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```
   dictionary_name.popitem()
```

Example:

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```
>>> employee_record
{'payrate': 24.99, 'name': 'kevin', 'ID': 23145, 'Age':
45}
>>> employee_record.popitem()
('payrate', 24.99)
>>> employee_record.popitem()
('name', 'kevin')
>>> employee_record.popitem()
('ID', 23145)
>>>
```

Traversing: using list and dict methods

```
>>> employee_record = {'name':'kevin',
'Age': 43, 'ID':23145, 'payrate':24.99}
>>> list(employee_record.keys())
['payrate', 'name', 'ID', 'Age']
>>> list(employee_record.values())
[24.99, 'kevin', 23145, 43]
>>> >>> list(employee_record.items())
[('payrate', 24.99), ('name', 'kevin'),
('ID', 23145), ('Age', 43)]
>>>
```

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Example: creating a dict from a list

```
from collections import defaultdict
employee_list = [('yosh',23,2001),
('farah', 22, 2010), ('matt', 34, 2000)]

#you can take a list of tuples and make it
#into a dict with key-value pairs
#start with an empty dict, start a for
loop #and append values to a key

d1 = defaultdict(list)
for key, age, start_date in employee_list:
   d1[key].append(age)
   d1[key].append(start_date)
print(d1, d1.items(), d1.values())
```

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