COSC 1306 - Prog for Non-Majors

Dictionaries and Sets

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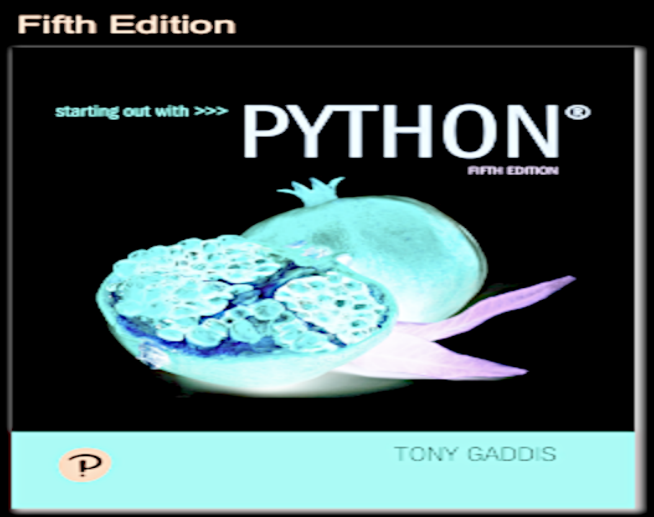
Lesson Topics Overview

- Dictionaries
- Sets
- Serializing Objects



Chapter 8
More About Strings

Dictionaries

- Dictionary: object that stores a collection of data
  - Each element consists of a key and a value
    - Often referred to as mapping of key to value
    - Key must be an immutable object
  - To retrieve a specific value, use the key associated with it
  - Format for creating a dictionary
    dictionary = {key1:val1, key2:val2}

Retrieving a Value from a Dictionary

- Elements in dictionary are unsorted.
- General format for retrieving value from dictionary: dictionary[key]
  - If key in the dictionary, associated value is returned, otherwise, KeyError exception is raised.
- Test whether a key is in a dictionary using the in and not in operators.
  - Helps prevent KeyError exceptions.

Adding Elements to an Existing Dictionary

- Dictionaries are mutable objects
- To add a new key-value pair:

  dictionary[key] = value

  - If key exists in the dictionary, the value associated with it will be changed.

Deleting Elements From an Existing Dictionary

- To delete a key-value pair:

  del dictionary[key]

  - If key is not in the dictionary, KeyError exception is raised.

Getting the Number of Elements and Mixing Data Types

- len function: used to obtain number of elements in a dictionary.
- Keys must be immutable objects, but associated values can be any type of object.
  - One dictionary can include keys of several different immutable types.
- Values stored in a single dictionary can be of different types.

Creating an Empty Dictionary and Using for Loop to Iterate Over a Dictionary

- To create an empty dictionary:
  - Use {}
  - Use built-in function dict()
  - Elements can be added to the dictionary as program executes.
- Use a for loop to iterate over a dictionary.
  - General format: for key in dictionary:

Some Dictionary Methods (1 of 5)

- clear method: deletes all the elements in a dictionary, leaving it empty.
  - Format: dictionary.clear()
- get method: gets a value associated with specified key from the dictionary.
  - Format: dictionary.get(key, default)
    default is returned if key is not found.
  - Alternative to [] operator.
    Cannot raise KeyError exception.

Some Dictionary Methods (2 of 5)

- items method: returns all the dictionaries keys and associated values
  - Format: dictionary.items()
  - Returned as a dictionary view
    - Each element in dictionary view is a tuple which contains a key and its associated value.
    - Use a for loop to iterate over the tuples in the sequence.
    - Can use a variable which receives a tuple, or can use two variables which receive key and value.

Some Dictionary Methods (3 of 5)

- keys method: returns all the dictionaries keys as a sequence
  - Format: dictionary.keys()
- pop method: returns value associated with specified key and removes that key-value pair from the dictionary.
  - Format: dictionary.pop(key, default)
  - default is returned if key is not found.

Some Dictionary Methods (4 of 5)

- popitem method: Returns, as a tuple, the key-value pair that was last added to the dictionary. The method also removes the key-value pair from the dictionary.
  - Format: dictionary.popitem()
  - Key-value pair returned as a tuple.
- values method: returns all the dictionaries values as a sequence.
  - Format: dictionary.values()
  - Use a for loop to iterate over the values.

Some Dictionary Methods (5 of 5)

Figure 1: Some of the dictionary methods

Method	Description
`clear`	Clears the contents of a dictionary.
`get`	Gets the value associated with a specified key. If the key is not found, the method does not raise an exception. Instead, it returns a default value.
`items`	Returns all the keys in a dictionary and their associated values as a sequence of tuples.
`keys`	Returns all the keys in a dictionary as a sequence of tuples.
`pop`	Returns the value associated with a specified key and removes that key-value pair from the dictionary. If the key is not found, the method returns a default value.
`popitem`	Returns, as a tuple, the key-value pair that was last added to the dictionary. The method also removes the key-value pair from the dictionary.
`values`	Returns all the values in the dictionary as a sequence of tuples.

Dictionary Comprehensions (1 of 6)

- Dictionary comprehension: an expression that reads a sequence of input elements and uses those input elements to produce a dictionary.

Dictionary Comprehensions (2 of 6)

Example: create a dictionary in which the keys are the integers 1 through 4 and the values are the squares of the keys.

Using a for loop

```
>>> numbers = [1, 2, 3, 4]
>>> squares = {}
>>> for item in numbers:
...     squares[item] = item**2
...
>>> squares
{1: 1, 2: 4, 3: 9, 4: 16}
>>>
```

Using a dictionary comprehension

```
>>> squares = {item:item**2 for
     item in numbers}
>>> squares
{1: 1, 2: 4, 3: 9, 4: 16}
>>>
```

Dictionary Comprehensions (3 of 6)

```
squares = item : item**2 for item in numbers
```

- The iteration expression iterates over the elements of numbers.
- Each time it iterates, the target variable item is assigned the value of an element.
- At the end of each iteration, an element containing item as the key and item**2 as the value is added to the new dictionary.

Dictionary Comprehensions (4 of 6)

Example: You have an existing list of strings. Create a dictionary in which the keys are the stings in the list, and the values are the lengths of the strings.

```
>>> names = ['Jeremy', 'Kate', 'Peg']
>>> str_lengths = {item:len(item) for item in
    names}
>>> str_lengths
{'Jeremy': 6, 'Kate': 4, 'Peg': 3}
>>>
```

Dictionary Comprehensions (5 of 6)

Example: making a copy of a dictionary

```
>>> dict1 = {'A':1, 'B':2, 'C':3}
>>> dict2 = {k:v for k,v in dict1.items()}
>>> dict2
{'A': 1, 'B': 2, 'C': 3}
>>>
```

Dictionary Comprehensions (6 of 6)

- You can use an if clause in a dictionary comprehension to select only certain elements of the input sequence.
- Example: A dictionary contains cities and their populations as key-value pairs. Select only the cities with a population greater than 2 million.

```
>>> populations = {'New York': 8398748, 'Los Angeles':
    3990456,
...                 'Chicago': 2705994, 'Houston':
    2325502,
...                 'Phoenix': 1660272, 'Philadelphia':
    1584138}
>>> largest = {k:v for k,v in populations.items() if v
    > 2000000}
>>> largest
{'New York': 8398748, 'Los Angeles': 3990456, 'Chicago'
    : 2705994, 'Houston': 2325502}
>>>
```

Sets

- Set: object that stores a collection of data in same way as mathematical set
  - All items must be unique.
  - Set is unordered.
  - Elements can be of different data types.

Creating a Set

- set function: used to create a set.
  - For empty set, call set()
  - For non-empty set, call set(argument) where argument is an object that contains iterable elements.
    - e.g., argument can be a list, string, or tuple.
    - If argument is a string, each character becomes a set element.
    - For set of strings, pass them to the function as a list.
    - If argument contains duplicates, only one of the duplicates will appear in the set.

Getting the Number of and Adding Elements

- len function: returns the number of elements in the set.
- Sets are mutable objects.
- add method: adds an element to a set.
- update method: adds a group of elements to a set.
  - Argument must be a sequence containing iterable elements, and each of the elements is added to the set.

Deleting Elements From a Set

- remove and discard methods: remove the specified item from the set.
  - The item that should be removed is passed to both methods as an argument.
  - Behave differently when the specified item is not found in the set.
    - remove method raises a KeyError exception.
    - discard method does not raise an exception.
- clear method: clears all the elements of the set.

Using the for Loop, in, and not in Operators With a Set

- A for loop can be used to iterate over elements in a set.
  - General format: for item in set:
  - The loop iterates once for each element in the set.
- The in operator can be used to test whether a value exists in a set.
  - Similarly, the not in operator can be used to test whether a value does not exist in a set.

Finding the Union of Sets

- Union of two sets: a set that contains all the elements of both sets.
- To find the union of two sets:
  - Use the union method
    - Format: set1.union(set2)
  - Use the | operator
    - Format: set1 | set2
  - Both techniques return a new set which contains the union of both sets.

Finding the Intersection of Sets

- Intersection of two sets: a set that contains only the elements found in both sets.
- To find the intersection of two sets:
  - Use the intersection method
    - Format: set1.intersection(set2)
  - Use the & operator
    - Format: set1 & set2
  - Both techniques return a new set which contains the intersection of both sets.

Finding the Difference of Sets

- Difference of two sets: a set that contains the elements that appear in the first set but do not appear in the second set.

- To find the difference of two sets:
  - Use the difference method
    - Format: set1.difference(set2)
  - Use the - operator
    - Format: set1 - set2

Finding the Symmetric Difference of Sets

- Symmetric difference of two sets: a set that contains the elements that are not shared by the two sets.
- To find the symmetric difference of two sets:
  - Use the symmetric_difference method
    - Format: set1.symmetric_difference(set2)
  - Use the ^ operator
    - Format: set1 ^ set2

Finding Subsets and Supersets (1 of 2)

- Set A is subset of set B if all the elements in set A are included in set B.
- To determine whether set A is subset of set B
  - Use the issubset method
    - Format: setA.issubset(setB)
  - Use the <= operator
    - Format: setA <= setB

Finding Subsets and Supersets (2 of 2)

- Set A is superset of set B if it contains all the elements of set B.
- To determine whether set A is superset of set B.
  - Use the issuperset method
    - Format: setA.issuperset(setB)
  - Use the >= operator
    - Format: setA >= setB

Set Comprehensions (1 of 4)

- Set comprehension: a concise expression that creates a new set by iterating over the elements of a sequence.
- Set comprehensions are written just like list comprehensions, except that a set comprehension is enclosed in curly braces ({}) instead of brackets ([])

Set Comprehensions (2 of 4)

Example: making a copy of a set.

```
>>> set1 = set([1, 2, 3, 4, 5])
>>> set2 = {item for item in set1}
>>> set2
{1, 2, 3, 4, 5}
>>>
```

Set Comprehensions (3 of 4)

Example: creating a set that contains the squares of the numbers stored in another set.

```
>>> set1 = set([1, 2, 3, 4, 5])
>>> set2 = {item**2 for item in set1}
>>> set2
{1, 4, 9, 16, 25}
>>>
```

Set Comprehensions (4 of 4)

Example: copying the numbers in a set that are less than 10

```
>>> set1 = set([1, 20, 2, 40, 3, 50])
>>> set2 = {item for item in set1 if item < 10}
>>> set2
{1, 2, 3}
>>>
```

Serializing Objects (1 of 3)

- Serialize an object: convert the object to a stream of bytes that can easily be stored in a file.
- Pickling: serializing an object.

Serializing Objects (2 of 3)

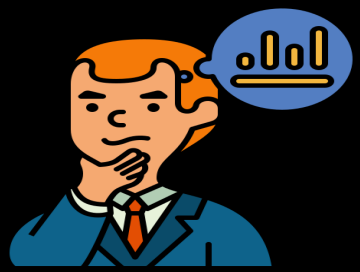
- To pickle an object:
  - Import the pickle module.
  - Open a file for binary writing.
  - Call the pickle.dump function.
    - Format: pickle.dump(object, file)
  - Close the file.
- You can pickle multiple objects to one file prior to closing the file.

Serializing Objects (3 of 3)

- Unpickling: retrieving pickled object
- To unpickle an object:
  - Import the pickle module.
  - Open a file for binary writing.
  - Call the pickle.load function.
    - Format: pickle.load(file)
  - Close the file.
- You can unpickle multiple objects from the file.

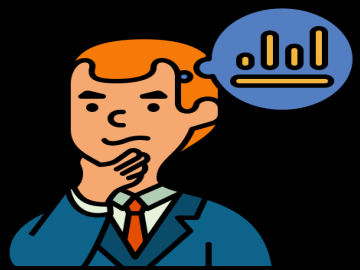
Summary (1 of 2)

- This chapter covered:
  - Dictionaries, including:
    - Creating dictionaries.
    - Inserting, retrieving, adding, and deleting key-value pairs.
    - for loops and in and not in operators.
    - Dictionary methods.



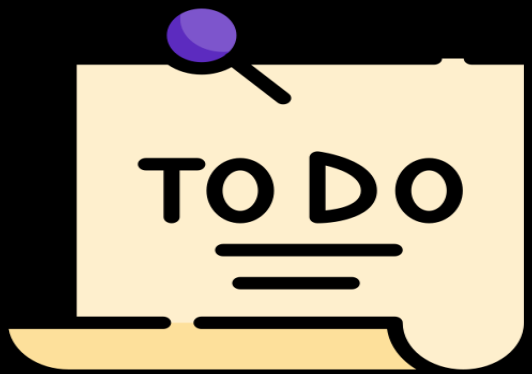
Summary (2 of 2)

- This chapter covered (cont'd):
  - Sets:
    - Creating sets.
    - Adding elements to and removing elements from sets.
    - Finding set union, intersection, difference and symmetric difference.
    - Finding subsets and supersets.
  - Serializing objects.
    - Pickling and unpickling objects.



Things to do

- Start and Complete Assignment-4!
- Read Textbook Chapter-9.
- Practice the exercise problems at the end of the Chapter.



Questions?

Please ask your Questions to clarify!