More about Lists & Dictionaries
Multi Dimensional Lists

- All of the lists we have been creating so far have been one dimensional (i.e. linear) in nature
- High level programming languages also have the ability to construct lists that can store multiple values within the same element
Multi Dimensional Lists

- A one dimensional list can be thought of as a line
- A two dimensional list can be thought of as a plane
- A three dimensional list can be thought of as a cube
- … etc!
You can create a two dimensional list in Python by simply nesting a list inside of another list. Example:

```python
mylist = [ [ 'a', 'b', 'c' ],
           [ 'd', 'e', 'f' ] ]

print (mylist[0])
print (mylist[0][0])
print (mylist[1][1])

>> [ 'a', 'b', 'c' ]
>> a
>> e
```
Dictionaries

- A Dictionary in Python is a sequence object like a list
- Unlike a list, a Dictionary doesn’t use integer based index values.
- Instead, Dictionaries use immutable objects (like Strings) to index their content
- In other languages Dictionaries are often referred to as “Associative Arrays” or “Hashmaps”
Lists vs. Dictionaries

- Sequence Structure
- Mutable (can be changed if you know which index you are modifying)
- Items are stored in a particular order based on index values
- Items can be indexed using an integer
Lists vs. Dictionaries

- Sequence Structure
- Mutable (can be changed if you know which index you are modifying)
- Items are not stored in any particular order
- Items can be indexed using anything that is immutable (String, etc)
Creating a Dictionary

❖ You can create a Dictionary using the curly braces – “{“ and “}”, like this:

```python
my_dictionary = { }
```

❖ This will create an empty Dictionary
In order to add an item to a Dictionary you need to specify a “key” – this is usually in the form of a String.

You can then associate some data with that key. For example I could associate the number 3.2 with the key “python” by doing this:

```
my_dictionary[“python”] = 3.2
```

This will place the number 3.2 into the Dictionary at the position marked by the String “python”
Accessing Dictionary items

- You can access all items in a Dictionary by printing it out, like this:

  ```python
  print (my_dictionary)
  ```

- However, you often just want to access one item – this works the same as with an array, but you will use a key instead of an integer index:

  ```python
  print ( my_dictionary[“python”] )
  ```
Creating a Dictionary with Values

- Dictionaries store key / value pairs. You can initialize a Dictionary with a known set of key / value pairs by using the following syntax:

```python
my_dictionary = { "python":3.2, "java":1.8 }
```

- This will create a Dictionary with the keys "python" and "java"
Note that you cannot access elements in a Dictionary that have not been defined. This would raise an exception if “java” was not a key in the Dictionary:

```python
print ( my_dictionary["java"] )
```

You can use the “in” operator to test to see if a key is in a dictionary like this:

```python
if ( "java" in my_dictionary" ):
```

Note that this will check for the presence of a key in a dictionary, not for the data that the key is storing!
Deleting a key in a Dictionary

❖ You can use the del command to delete a key in a Dictionary, like this:

del my_dictionary[“java”]

❖ Make sure that you know that the key in question has been defined in the Dictionary before you run this command!
Clearing a Dictionary

❖ You can clear all keys in a Dictionary by doing the following:

my_dictionary.clear()
Behind the Scenes: How Dictionaries work
Working with Dictionary Keys and Values
In a list we can easily visit all "slots" in the list by visiting every index value in the list, like this:

```python
mylist = [ 'a', 'b', 'c', 'd' ]
for i in range(0, len(mylist)):
    print (mylist[i])
```

However, we can't do this with a Dictionary since the index values for a dictionary are not necessarily going to be integers

We can use the "keys()" method to ask a Dictionary object to expose all of the keys that are defined within that Dictionary like this:

```python
my_dictionary.keys()
```
Iterating over every item in a Dictionary

❖ To iterate over every time in a Dictionary you need to be able to visit every key value (as opposed to simply knowing the size of a list and iterating over the integer range of the list)

❖ You can extract all the keys from a Dictionary by doing the following:

```python
for key in my_dictionary.keys():
```

❖ The target variable “key” will assume each key value in your Dictionary as the loop progresses.

❖ You can print out all items with their keys by doing the following:

```python
for key in my_dictionary.keys():
    print (key, " == ", my_dictionary[key])
```
Iterating over every item in a Dictionary

- There is no guarantee that the keys() method will return the keys of a dictionary in any particular order.

- However, you can ask Python to sort the keys before you iterate over them, like this:

```python
for key in sorted( my_dictionary.keys() ):
```

- This will sort the keys in ascending order, which then lets you access the elements in the dictionary in ascending order.
Finding all the values in a Dictionary

- You can also iterate over just the values in a dictionary (not just the keys) using this syntax:

  ```python
  for v in my_dictionary.values():
    print (v)
  ```

- Note that doing this will only expose the values in a dictionary and not the key – this means that you cannot change the values in the dictionary using this method. This is analogous to iterating over a list like this:

  ```python
  for item in my_list:
    print (item)
  ```
Iterating over every item in a Dictionary

- You can also iterate over a Dictionary by using the following technique to extract both the key and the value at the same time:

  ```python
  for key, value in my_dictionary.items():
      print (key, value)
  ```
Programming Challenges
Programming Challenge
Programming Challenge

- Write a program that asks the user to enter in a series of student names and test scores
- Use a Dictionary to store a new record in the dictionary based on the student name (i.e. the name becomes the key) – store the student score at that position.
- When you are finished print out the names and scores of all students
- Extension: print them out in alphabetical order!
Programming Challenge
Extension: Allow the user to enter in multiple scores for each student. If the student already has a score simply add it to the total score for the student.

- You will also need to keep track of the number of tests somehow
  - You could create a separate dictionary for # of tests
  - You could store a list in a single dictionary that has two fields – one for points and one for number of tests
Programming Challenge

- Count the frequency of all words in the Declaration of Independence