COMPSCI 101

Principles of Programming

Lecture 22 – Python dictionaries 1

Learning outcomes

At the end of this lecture, students should be able to:

- understand what a dictionary is
- create a dictionary object
- add items to a dictionary
- retrieve items from a dictionary
- traverse the pairs in a dictionary

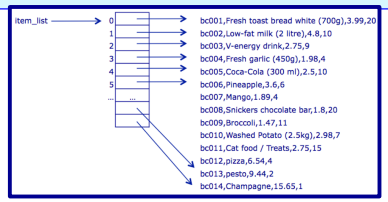
Recap

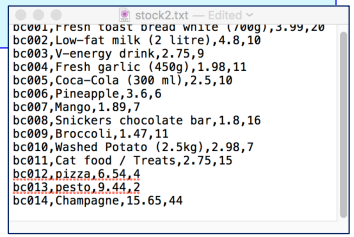
Exercise from lecture 21 on file input and output:

```
def save_stock(filename, list_of_items):
    outfile = open(filename, "w")
    for item in list_of_items:
        outfile.write(item + "\n")
    outfile.close()

def main():
   …
   save_stock("stock2.txt", items_list)

main()
```





Python dictionaries

A dictionary is a mapping from a key to its associated data value.

- Each key maps to a value.
- The key has to be unique and an **immutable** object.

A phone book is an example of a mapping: the key is the person's name (plus address) and the associated value is their phone number.

You can think of a dictionary as a group of pairs, where the first element of the pair, the **key**, is used to retrieve the second element, the **corresponding value**.

The key and its associated value is called a **key-value pair** or they can be called an **item**.

Creating an object of type dict

Curly braces are used for dictionaries and empty curly braces {} define an empty dictionary, i.e., containing no key-value pairs:

```
def main():
  english_italian = {}
  print(english_italian)
  print(type(english_italian))

main()
```

```
{}
<class 'dict'>
```

Another way to create an empty dictionary object is (does exactly the same thing as the code above) is:

```
def main():
  english_italian = dict()
  print(english_italian)
  print(type(english_italian))

main()
```

```
{}
<class 'dict'>
```


dict is a Python type

Note that the name, **dict,** is a Python type

(**<class 'dict'>**)

and should not be used as a variable name.

```
def main():
  english_italian = dict()

main()
```


Creating a dictionary which contains pairs

A dictionary object can be initialised with key-value pairs:

Each associated pair is separated by '**:**' and the pairs are separated by commas.

```
def main():
  english_italian = {"yes":"si", "bye":"ciao", "no":"no",
                     "maybe":"forse", "thank you":"grazie"}
  print(english_italian)

  contacts = {"Jill": 3456, "James": 3456, "Yi": 7654,
                                           "Syed": 6754}
  print(contacts)

main()
```

```
{'maybe': 'forse', 'bye': 'ciao', 'yes': 'si', 'no': 'no',
'thank you': 'grazie'}
{'Yi': 7654, 'Jill': 3456, 'Syed': 6754, 'James': 3456}
```

Note: the keys MUST be unique but the associated values need not.

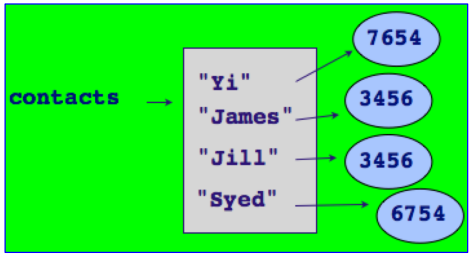
Visualising the dictionary

```
def main():
  contacts = {"Jill": 3456, "James": 3456, "Yi": 7654,
                                           "Syed": 6754}

  print(contacts)

main()
```

```
{'Jill': 3456, 'Syed': 6754, 'James': 3456, 'Yi': 7654}
```



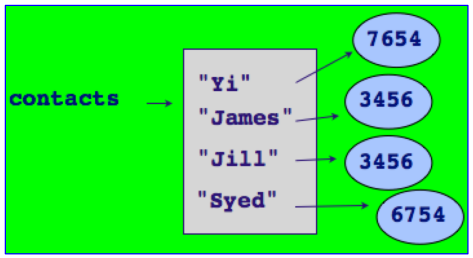
Note: when the key-value pairs are printed, the order is not predictable.

The keys of the dictionary must be immutable

The **keys** of a dictionary must be of a type which is **immutable** such as: string, int, tuple.

The **keys** of a dictionary must be **unique**.

The values can be of any type and they do not need to be unique.

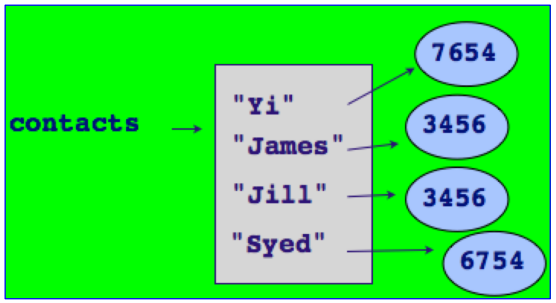


Remember: lists are mutable. Dictionary keys cannot be of type list.

Dictionaries are not ordered structures

Dictionary elements **cannot** be accessed using the index value. A dictionary is a collection of key:value pairs.

There is no predictable order to the key:value pairs in a dictionary (the order may change as new pairs are added and removed).



Adding a pair to the dictionary

Key-value pairs can be added to the dictionary using assignment statements. For example,

```
def main():
  contacts = {"Jill": 3456, "James": 3456, "Yi": 7654,
                                                "Syed": 6754}
  contacts["Mark"] = 7654
  contacts["Jerry"] = 7004

  print(contacts)

main()
```

```
{'Jerry': 7004, 'Syed': 6754, 'Yi': 7654, 'Mark': 7654,
'Jill': 3456, 'James': 3456}
```

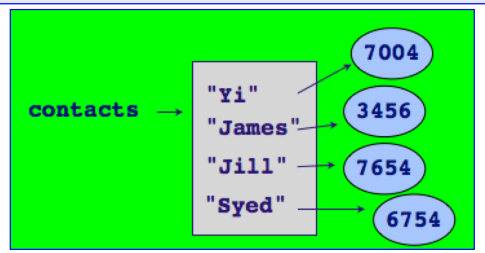
Note: when the key-value pairs are printed, the order is not predictable.

Changing the associated value in a dictionary

The associated value of a pair can be changed by assigning a different value to the dictionary key. This replaces the old value.

```
def main():
  contacts = {"Jill": 3456, "James": 3456, "Yi": 7654,
                                                "Syed": 6754}
  contacts["Jill"] = 7654
  contacts["Yi"] = 7004
  print(contacts)
main()
```

```
{'Syed': 6754, 'Yi': 7004, 'James': 3456, 'Jill': 7654}
```



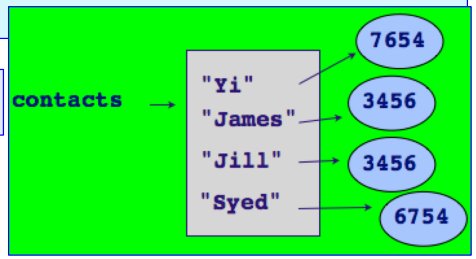
Access the value associated with a key

The value associated with a certain key can be accessed using square brackets (enclosing the key):

```
def main():
  contacts = {"Jill": 3456, "James": 3456, "Yi": 7654,
                                                "Syed": 6754}
  name1 = "Jill"
  name2 = "James"
  print(name1, "is at extension:", contacts[name1])
  if contacts[name1] == contacts[name2]:
      print(name2, "has the same extension")

main()
```

```
Jill is at extension: 3456
James has the same extension
```



The number of key-value pairs in a dictionary

The **len()** function can be used with a dictionary object to find out how many key-value pairs are currently in the dictionary:

```
def main():
  contacts = {"Jill": 3456, "James": 3456, "Yi": 7654,
                                                "Syed": 6754}
  print(len(contacts), "in dictionary")
  contacts["Yi"] = 7654
  contacts["Jerry"] = 7004
  print(len(contacts), "in dictionary")

main()
```

```
4 in dictionary
5 in dictionary
```


Check if a key is in the dictionary

The '**in**' operator can be used to check if a **key** is in the dictionary:

```
def main():
  contacts = {"Jill": 3456, "James": 3456, "Yi": 7654,
                                                "Syed": 6754}
  name = "Jack"
  if name in contacts:
     print(name, "is at extension:", contacts[name])
  else:
     contacts[name] = 0

  if name in contacts:
     print(name, "is at extension:", contacts[name])

  print(contacts)

main()
```

```
Jack is at extension: 0
{'Jill': 3456, 'James': 3456, 'Yi': 7654, 'Syed': 6754, 'Jack': 0}
```


Traversing the pairs in the dictionaries

Use a **for … in** loop to traverse (visit) each **key** in the dictionary:

```
def main():
  contacts = {"Jill": 3456, "James": 3456, "Yi": 7654,
                                                "Syed": 6754}
  for name in contacts:
     print(name , "-", contacts[name])

main()
```

```
Yi - 7654
Jill - 3456
Syed - 6754
James - 3456
```

Same code

```
def main():
  contacts = {"Jill": 3456, "James": 3456, "Yi": 7654,
                                                "Syed": 6754}
  for key in contacts:
     print(key, "-", contacts[key])

main()
```

The in operator with dictionaries

An error is raised when accessing a key which is not in the dictionary. Test before accessing a key-value pair.

```
1 def main():
2     contacts = {"Jill": 3456, "James": 3456, "Yi": 7654,
                                                "Syed": 6754}
3     if "Jill" in contacts:              #Test first
4         print("Jill", "-", contacts["Jill"])

5     print(contacts["Izzy"])

6 main()
```

```
Jill - 3456
Traceback (most recent call last):
  File "LectureCode.py", line 5, in <module>
    print(contacts["Izzy"])
KeyError: 'Izzy'
```


Exercise

"Story.txt" is a text file. The following program reads the text from the file, converts it to lower case, and creates a dictionary of all the **unique** words which start with a vowel ("a", "e", "i","o", "u"). Note: the key is the vowel and each word is added to the corresponding associated list (the associated list grows as the text is processed).

```
def main():
    vowel_words_dict = get_dictionary_from_file_words("Story.txt")
    display_results(vowel_words_dict)

def get_dictionary_from_file_words(filename): #complete the code

def display_results(vowel_words): #complete the code

main()
```

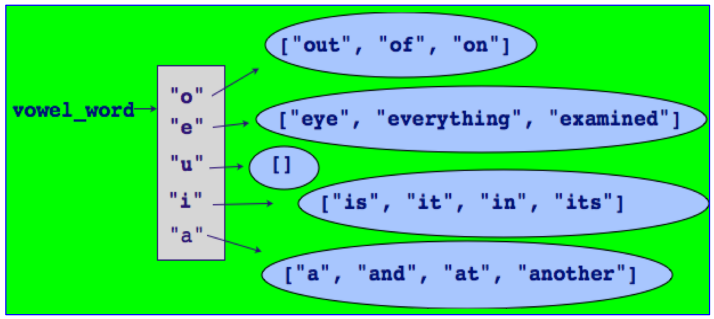
```
e - ['eye,', 'everything', 'examined']
u - []
i - ['is', 'it', 'in', 'its']
o - ['out', 'of', 'on']
a - ['a', 'and', 'at', 'another']
```

Note: For this program, the punctuation has been left in the text. This means that the word 'eye' is a different word to the word 'eye,'.

Exercise

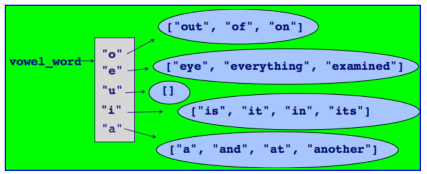
Story.txt

A small trouble is like a pebble Hold it too close to your eye and it fills the whole world and puts everything out of focus Hold it at the proper distance and it can be examined and properly classified Throw it at your feet and it can be seen in its true setting just another tiny bump on the pathway of life



Exercise

```
def get_dictionary_from_file_words(filename):
```




```
A small trouble is like a pebble  Hold it too close to your
eye  and it fills the whole world and puts everything out of
focus  Hold it at the proper distance  and it can be examined
and properly classified  Throw it at your feet and it can be
seen in its true setting  just another tiny bump on the
pathway of life
```

Exercise

```
def display_results(vowel_words_dict):
```

```
e - ['eye,', 'everything', 'examined']
u - []
i - ['is', 'it', 'in', 'its']
o - ['out', 'of', 'on']
a - ['a', 'and', 'at', 'ad', 'another']
```


Summary

In Python:

- dictionaries are used to store key:value pairs (also called items)
- an empty dictionary object can be created in two ways
- items can be added to a dictionary
- Items can be retrieved from the dictionary
- the keys of a dictionary can be traversed using for … in

Python features used in this lecture

```
english_italian = {"yes":"si", "bye":"ciao", "no":"no", "maybe":"forse",
                                                    "thank you":"grazie"}
english_italian["never"] = "mai"
print(english_italian["bye"] )

for word in english_italian:
    print(english_italian[word])

print(len(english_italian))
```