Python Dictionaries

Chapter 9

Python for Everybody
www.py4e.com

What is a Collection?

- A collection is nice because we can put more than one value in it and carry them all around in one convenient package
- We have a bunch of values in a single “variable”
- We do this by having more than one place “in” the variable
- We have ways of finding the different places in the variable

What is Not a “Collection”?

Most of our variables have one value in them - when we put a new value in the variable - the old value is overwritten

```
$ python
>>> x = 2
>>> x = 4
>>> print(x)
4
```

A Story of Two Collections..

- List

  A linear collection of values
  Lookup by position 0 .. length-1

- Dictionary

  A linear collection of key-value pairs
  Lookup by "tag" or "key"

https://en.wikipedia.org/wiki/Index_card#/media/File:LA2-katalogkort.jpg
https://commons.wikimedia.org/wiki/File:Shelves-of-file-folders.jpg

Dictionaries

- Dictionaries are Python’s most powerful data collection
- Dictionaries allow us to do fast database-like operations in Python
- Similar concepts in different programming languages
  - Associative Arrays - Perl / PHP
  - Properties or Map or HashMap - Java
  - Property Bag - C# / .Net

Dictionaries over time in Python

- Prior to Python 3.7 dictionaries did not keep entries in the order of insertion
- Python 3.7 (2018) and later dictionaries keep entries in the order they were inserted
- "insertion order" is not "always sorted order"

Below the Abstraction

- Python lists, dictionaries, and tuples are "abstract objects" designed to be easy to use
- For now we will just understand them and use them and thank the creators of Python for making them easy for us
- Using Python collections is easy. Creating the code to support them is tricky and uses Computer Science concepts like dynamic memory, arrays, linked lists, hash maps and trees.
- But that implementation detail is for a later course…

Lists (Review)

- We append values to the end of a List and look them up by position
- We insert values into a Dictionary using a key and retrieve them using a key

```
>>> cards = list()
>>> cards.append(12)
>>> cards.append(3)
>>> cards.append(75)
>>> print(cards)
[12, 3, 75]
>>> print(cards[1])
3
>>> cards[1] = cards[1] + 2
>>> print(cards)
[12, 5, 75]
```

Dictionaries

- We append values to the end of a List and look them up by position
- We insert values into a Dictionary using a key and retrieve them using a key

```
>>> cabinet = dict()
>>> cabinet['summer'] = 12
>>> cabinet['fall'] = 3
>>> cabinet['spring'] = 75
>>> print(cabinet)
{'summer': 12, fall': 3, spring': 75}
>>> print(cabinet['fall'])
3
>>> cabinet['fall'] = cabinet['fall'] + 2
>>> print(cabinet)
{'summer': 12, 'fall': 5, 'spring': 75}
```

Comparing Lists and Dictionaries

Dictionaries are like lists except that they use keys instead of positions to look up values

```
>>> lst = list()
>>> lst.append(21)
>>> lst.append(183)
>>> print(lst)
[21, 183]
>>> lst[0] = 23
>>> print(lst)
[23, 183]
```

```
>>> ddd = dict()
>>> ddd['age'] = 21
>>> ddd['course'] = 182
>>> print(ddd)
{'age': 21, 'course': 182}
>>> ddd['age'] = 23
>>> print(ddd)
{'age': 23, 'course': 182}
```

Dictionary Literals (Constants)

- Dictionary literals use curly braces and have key : value pairs
- You can make an empty dictionary using empty curly braces

```
>>> jjj = { 'chuck' : 1 , 'fred' : 42, 'jan': 100}
>>> print(jjj)
{'chuck': 1, 'fred': 42, 'jan': 100}
>>> ooo = { }
>>> print(ooo)
{}
>>>
```

Most Common Name?

Most Common Name?

marquard

zhen

csev

zhen

cwen

marquard

zhen

csev

cwen

zhen

csev

marquard

zhen

Most Common Name?

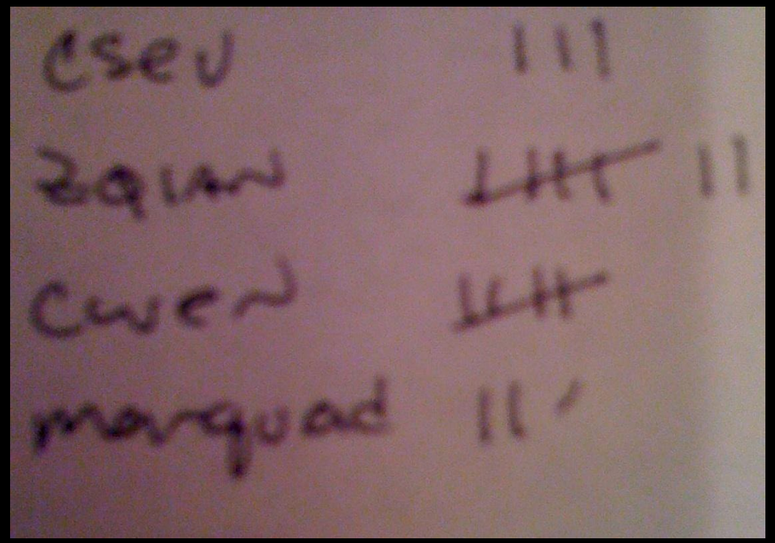
marquard

zhen

csev

zhen

cwen



csev

cwen

zhen

csev

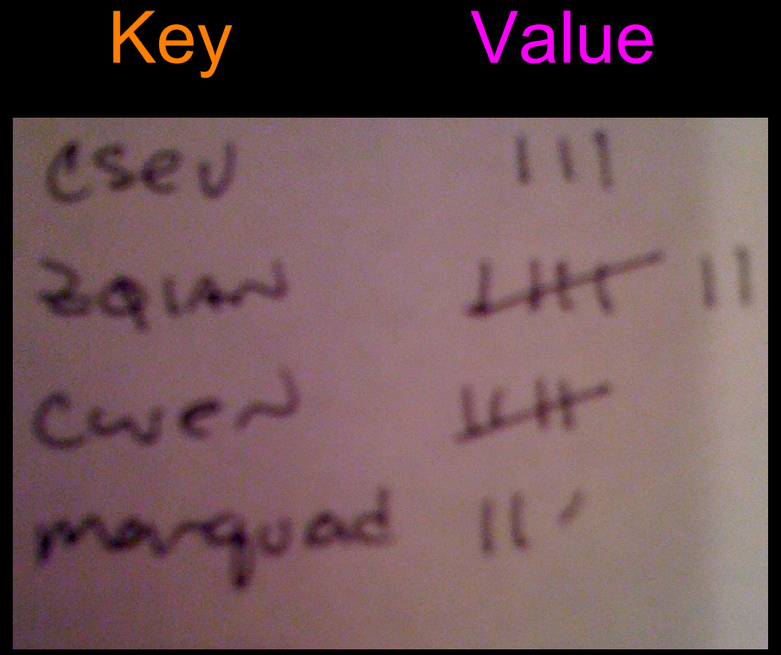
marquard

zhen

Many Counters with a Dictionary

One common use of dictionaries is counting how often we “see” something

```
>>> ccc = dict()
>>> ccc['csev'] = 1
>>> ccc['cwen'] = 1
>>> print(ccc)
{'csev': 1, 'cwen': 1}
>>> ccc['cwen'] = ccc['cwen'] + 1
>>> print(ccc)
{'csev': 1, 'cwen': 2}
```



Dictionary Tracebacks

- It is an error to reference a key which is not in the dictionary
- We can use the in operator to see if a key is in the dictionary

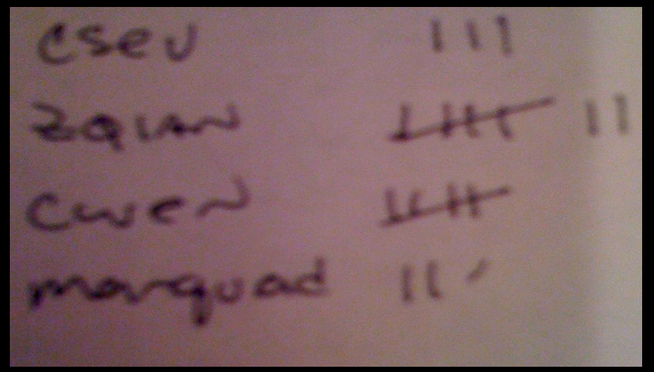
```
>>> ccc = dict()
>>> print(ccc['csev'])
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
KeyError: 'csev'
>>> 'csev' in ccc
False
```

When We See a New Name

When we encounter a new name, we need to add a new entry in the dictionary and if this the second or later time we have seen the name, we simply add one to the count in the dictionary under that name

```
counts = dict()
names = ['csev', 'cwen', 'csev', 'zqian', 'cwen']
for name in names :
    if name not in counts:
       counts[name] = 1
    else :
        counts[name] = counts[name] + 1
print(counts)
```

{'csev': 2, 'cwen': 2 , 'zqian': 1}



The get Method for Dictionaries

The pattern of checking to see if a key is already in a dictionary and assuming a default value if the key is not there is so common that there is a method called get() that does this for us

```
if name in counts:
    x = counts[name]
else :
    x = 0
```

```
x = counts.get(name, 0)
```

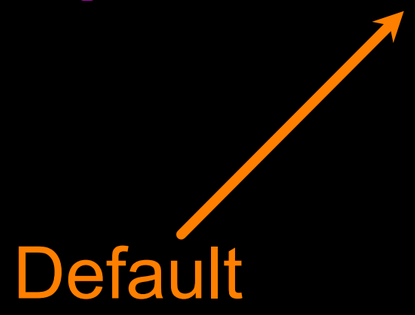
Default value if key does not exist (and no Traceback).

{'csev': 2, 'cwen': 2 , 'zqian': 1}

Simplified Counting with get()

We can use get() and provide a default value of zero when the key is not yet in the dictionary - and then just add one

```
counts = dict()
names = ['csev', 'cwen', 'csev', 'zqian', 'cwen']
for name in names :
    counts[name] = counts.get(name, 0) + 1
print(counts)
```



{'csev': 2, 'cwen': 2 , 'zqian': 1}

Counting Words in Text

Writing programs (or programming) is a very creative and rewarding activity. You can write programs for many reasons ranging from making your living to solving a difficult data analysis problem to having fun to helping someone else solve a problem. This book assumes that everyone needs to know how to program and that once you know how to program, you will figure out what you want to do with your newfound skills.

We are surrounded in our daily lives with computers ranging from laptops to cell phones. We can think of these computers as our "personal assistants" who can take care of many things on our behalf. The hardware in our current-day computers is essentially built to continuously ask us the question, "What would you like me to do next?"

Our computers are fast and have vast amounts of memory and could be very helpful to us if we only knew the language to speak to explain to the computer what we would like it to do next. If we knew this language we could tell the computer to do tasks on our behalf that were repetitive. Interestingly, the kinds of things computers can do best are often the kinds of things that we humans find boring and mind-numbing.

Counting Pattern

```
counts = dict()
print('Enter a line of text:')
line = input('')

words = line.split()

print('Words:', words)

print('Counting...')
for word in words:
    counts[word] = counts.get(word,0) + 1
print('Counts', counts)
```

The general pattern to count the words in a line of text is to split the line into words, then loop through the words and use a dictionary to track the count of each word independently.

```
python wordcount.py
Enter a line of text:
the clown ran after the car and the car ran into the tent
and the tent fell down on the clown and the car

Words: ['the', 'clown', 'ran', 'after', 'the', 'car',
'and', 'the', 'car', 'ran', 'into', 'the', 'tent', 'and',
'the', 'tent', 'fell', 'down', 'on', 'the', 'clown',
'and', 'the', 'car']
Counting…

Counts {'the': 7, 'clown': 2, 'ran': 2, 'after': 1, 'car':
3, 'and': 3, 'into': 1, 'tent': 2, 'fell': 1, 'down': 1,
'on': 1}
```

```
counts = dict()
line = input('Enter a line of text:')
words = line.split()

print('Words:', words)
print('Counting...’)

for word in words:
    counts[word] = counts.get(word,0) + 1
print('Counts', counts)
```

```
python wordcount.py
Enter a line of text:
the clown ran after the car and the car ran into the tent and the tent fell down on the clown and the car

Words: ['the', 'clown', 'ran', 'after', 'the', 'car', 'and', 'the', 'car', 'ran', 'into', 'the', 'tent', 'and', 'the', 'tent', 'fell', 'down', 'on', 'the', 'clown', 'and', 'the', 'car']
Counting...

Counts {'the': 7, 'clown': 2, 'ran': 2, 'after': 1, 'car': 3, 'and': 3, 'into': 1, 'tent': 2, 'fell': 1, 'down': 1, 'on': 1}
```

Definite Loops and Dictionaries

We can write a for loop that goes through all the entries in a dictionary - actually it goes through all of the keys in the dictionary and looks up the values

```
>>> counts = { 'chuck' : 1 , 'fred' : 42, 'jan': 100}
>>> for key in counts:
...     print(key, counts[key])
...
chuck 1
fred 42
jan 100
>>>
```

Retrieving Lists of Keys and Values

You can get a list of keys, values, or items (both) from a dictionary

```
>>> jjj = { 'chuck' : 1 , 'fred' : 42, 'jan': 100}
>>> print(list(jjj))
['chuck', 'fred', 'jan']
>>> print(list(jjj.keys()))
['chuck', 'fred', 'jan']
>>> print(list(jjj.values()))
[1, 42, 100]
>>> print(list(jjj.items()))
[('chuck', 1), ('fred', 42), ('jan', 100)]
>>>
```

What is a “tuple”? - coming soon...

Bonus: Two Iteration Variables!

- We loop through the key-value pairs in a dictionary using *two* iteration variables
- Each iteration, the first variable is the key and the second variable is the corresponding value for the key

```
jjj = { 'chuck' : 1 , 'fred' : 42, 'jan': 100}
for aaa,bbb in jjj.items() :
    print(aaa, bbb)
```

```
chuck 1
fred 42
jan 100
```

aaa	bbb
[chuck]	1
[fred]	42
[jan]	100

```
name = input('Enter file:')
handle = open(name)

counts = dict()
for line in handle:
    words = line.split()
    for word in words:
        counts[word] = counts.get(word,0) + 1

bigcount = None
bigword = None
for word,count in counts.items():
    if bigcount is None or count > bigcount:
        bigword = word
        bigcount = count

print(bigword, bigcount)
```

```
python words.py
Enter file: words.txt
to 16
```

```
python words.py
Enter file: clown.txt
the 7
```

Using two nested loops

Summary

- What is a collection
- Lists versus dictionaries
- Dictionary Constants
- The most common word
- Using the get() method
- Writing dictionary loops
- Sneak peek: Tuples

Acknowledgements / Contributions

Initial Development: Charles Severance, University of Michigan School of Information

… Insert new Contributors or translation credits here

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