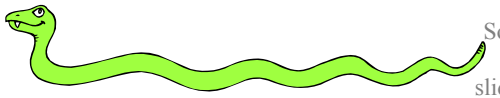
Python dicts and sets



Some material adapted from Upenn cis391 slides and other sources

Overview

- Python doesn't have traditional vectors and arrays!
- Instead, Python makes heavy use of the **dict** datatype (a hashtable) which can serve as a *sparse array*
  - Efficient traditional arrays are available as modules that interface to C
- A Python **set** is derived from a dict

Dictionaries: A *Mapping* type

- Dictionaries store a *mapping* between a set of keys and a set of values
  - Keys can be any *immutable* type.
  - Values can be any type
  - A single dictionary can store values of different types
- You can define, modify, view, lookup or delete the key-value pairs in the dictionary
- Python's dictionaries are also known as *hash tables* and *associative arrays*

Creating & accessing dictionaries

```
>>> d = {'user':'bozo', 'pswd':1234}
>>> d['user']
'bozo'
>>> d['pswd']
1234
>>> d['bozo']
Traceback (innermost last):
  File '<interactive input>' line 1,
 in ?
KeyError: bozo
```

Updating Dictionaries

```
>>> d = {'user':'bozo', 'pswd':1234}
>>> d['user'] = 'clown'
>>> d
{'user':'clown', 'pswd':1234}
```

- Keys must be unique
- Assigning to an existing key replaces its value

```
>>> d['id'] = 45
>>> d
{'user':'clown', 'id':45, 'pswd':1234}
```

- Dictionaries are unordered
  - New entries can appear anywhere in output
- Dictionaries work by *hashing*

Removing dictionary entries

```
>>> d = {'user':'bozo', 'p':1234, 'i':34}
>>> del d['user']  # Remove one.
>>> d
{'p':1234, 'i':34}
>>> d.clear()      # Remove all.
>>> d
{}
>>> a=[1,2]
>>> del a[1]       # del works on lists, too
>>> a
[1]
```

Useful Accessor Methods

```
>>> d = {'user':'bozo', 'p':1234, 'i':34}

>>> d.keys()  # List of keys, VERY useful
['user', 'p', 'i']

>>> d.values() # List of values
['bozo', 1234, 34]

>>> d.items()  # List of item tuples
[('user','bozo'), ('p',1234), ('i',34)]
```

A Dictionary Example

Problem: count the frequency of each word in text read from the standard input, print results

Six versions of increasing complexity

- **wf1.py** is a simple start
- **wf2.py** uses a common idiom for default values
- **wf3.py** sorts the output alphabetically
- **wf4.py** downcase and strip punctuation from words and ignore stop words
- **wf5.py** sort output by frequency
- **wf6.py** add command line options: -n, -t, -h

Dictionary example: wf1.py

```
#!/usr/bin/python
import sys
freq = {}   # frequency of words in text
for line in sys.stdin:
    for word in line.split():
        if word in freq:
            freq[word] = 1 + freq[word]
        else:
            freq[word] = 1
print freq
```

Dictionary example wf1.py

```
#!/usr/bin/python
import sys
freq = {}   # frequency of words in text
for line in sys.stdin:
    for word in line.split():
        if word in freq:
            freq[word] = 1 + freq[word]
        else:
            freq[word] = 1
print freq
```

This is a common pattern

Dictionary example wf2.py

```
#!/usr/bin/python
import sys
freq = {}   # frequency of words in text
for line in sys.stdin:
    for word in line.split():
        freq[word] = 1 + freq.get(word, 0)
print freq
```

key

Default value if not found

Dictionary example wf3.py

```
#!/usr/bin/python
import sys
freq = {}   # frequency of words in text
for line in sys.stdin:
    for word in line.split():
        freq[word] = freq.get(word,0)

for w in sorted(freq.keys()):
    print w, freq[w]
```

Dictionary example wf4.py

```
#!/usr/bin/python
import sys

punctuation = """'!"#$%&\'()*+,-./:;<=>?
 @[\\]^_`{|}~'"""

freq = {}     # frequency of words in text

stop_words = set()
for line in open("stop_words.txt"):
    stop_words.add(line.strip())
```

Dictionary example wf4.py

```
for line in sys.stdin:
    for word in line.split():
        word = word.strip(punct).lower()
        if word not in stop_words:
            freq[word] = freq.get(word,0)+1

# print sorted words and their frequencies
for w in sorted(freq.keys()):
    print w, freq[w]
```

Dictionary example wf5.py

```
#!/usr/bin/python
import sys
from operator import itemgetter

…
words = sorted(freq.items(),
 key=itemgetter(1), reverse=True)

for (w,f) in words:
    print w, f
```

Dictionary example wf6.py

```
from optparse import OptionParser
# read command line arguments and process
parser = OptionParser()
parser.add_option('-n', '--number', type="int",
  default=-1, help='number of words to report')
parser.add_option("-t", "--threshold", type="int",
  default=0, help="print if frequency > threshold")
(options, args) = parser.parse_args()
...
# print the top option.number words but only those
# with freq>option.threshold
for (word, freq) in words[:options.number]:
    if freq > options.threshold:
        print freq, word
```

Why must keys be immutable?

- The keys used in a dictionary must be immutable objects?

```
>>> name1, name2 = 'john', ['bob', 'marley']
>>> fav = name2
>>> d = {name1: 'alive', name2: 'dead'}
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
TypeError: list objects are unhashable
```

- Why is this?
- Suppose we could index a value for name2
- and then did `fav[0] = "Bobby"`
- Could we find d[name2] or d[fav] or …?

defaultdict

```
>>> from collections import defaultdict
>>> kids = defaultdict(list, {'alice': ['mary',
'nick'], 'bob': ['oscar', 'peggy']})
>>> kids['bob']
['oscar', 'peggy']
>>> kids['carol']
[]
>>> age = defaultdict(int)
>>> age['alice'] = 30
>>> age['bob']
0
>>> age['bob'] += 1
>>> age
defaultdict(<type 'int'>, {'bob': 1, 'alice': 30})
```