[220 / 319] Dictionaries

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Learning Objectives Today

Data structures
- definition
- motivation

Dictionaries in Python
- creation, lookup
- updates, deletes

When to use dictionaries over lists
- holes in the labels
- non-integer labels

Chapter 11 of Think Python

Today's Outline

Data Structures

Mappings

Dictionaries

Mutations: Updates, Deletes, and Inserts

Coding examples

Vocabulary: a list is an example of a **data structure**

Data Structures

Definition (from Wikipedia):

a **data structure** is a **collection of data values**,
the **relationships** among them,
and the functions or **operations**
that can be applied to the data

every value has an index, representing an order within the list

a list can contain a bunch of values of varying types

L.sort(), len(L), L.pop(0), L.append(x), update, iterate (for loop), etc

Data Structures

Definition (from Wikipedia):

a **data structure** is a **collection of data values**,
the **relationships** among them,
and the functions or **operations**
that can be applied to the data

suggested note-taking

	values	**relationships**	**operations**
`list`	anything	ordered (0,1,...)	indexing, pop, len, index, slicing, in, iteration (for), ...
`set`	????	no ordering	`in`, `==`
`dict`			
...			

Motivation: lots of data

For loops:

- copy/paste is a pain
- don't know how many times to copy/paste before program runs

For data structures:

- creating many variables is a pain
  (imagine your program analyzes ten thousand values)
- don't know how many values you will have before program runs

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Mappings

Common data structure approach:

- **store many values**
- give each value a label
- use labels to lookup values

List example:

```
nums = [300, 200, 400, 100]
```

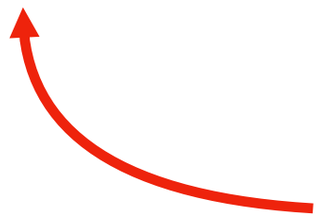
Mappings

Common data structure approach:

- store many values
- **give each value a label**
- use labels to lookup values

List example:

```
nums = [300, 200, 400, 100]
        0    1    2    3
```



the “labels” are indexes, which are implicitly attached to values

Mappings

Common data structure approach:

- store many values
- give each value a label
- **use labels to lookup values**

List example:

```
nums = [300, 200, 400, 100]

x = nums[2]    # x = 400
```

we use the "label" (i.e., the index)
to lookup the value (here 400)

Mappings

Common data structure approach:

- store many values
- give each value a label
- use labels to lookup values

lists are an **inflexible** mapping structure, because we don't have control over **labels**

List example:

what if we don't want consecutive integers as labels? E.g., 0, 10, and 20 (but not between)?

```
nums = [300, 200, 400, 100]
```

what if we want to use strings as labels?

```
x = nums[2]    # x=400
```

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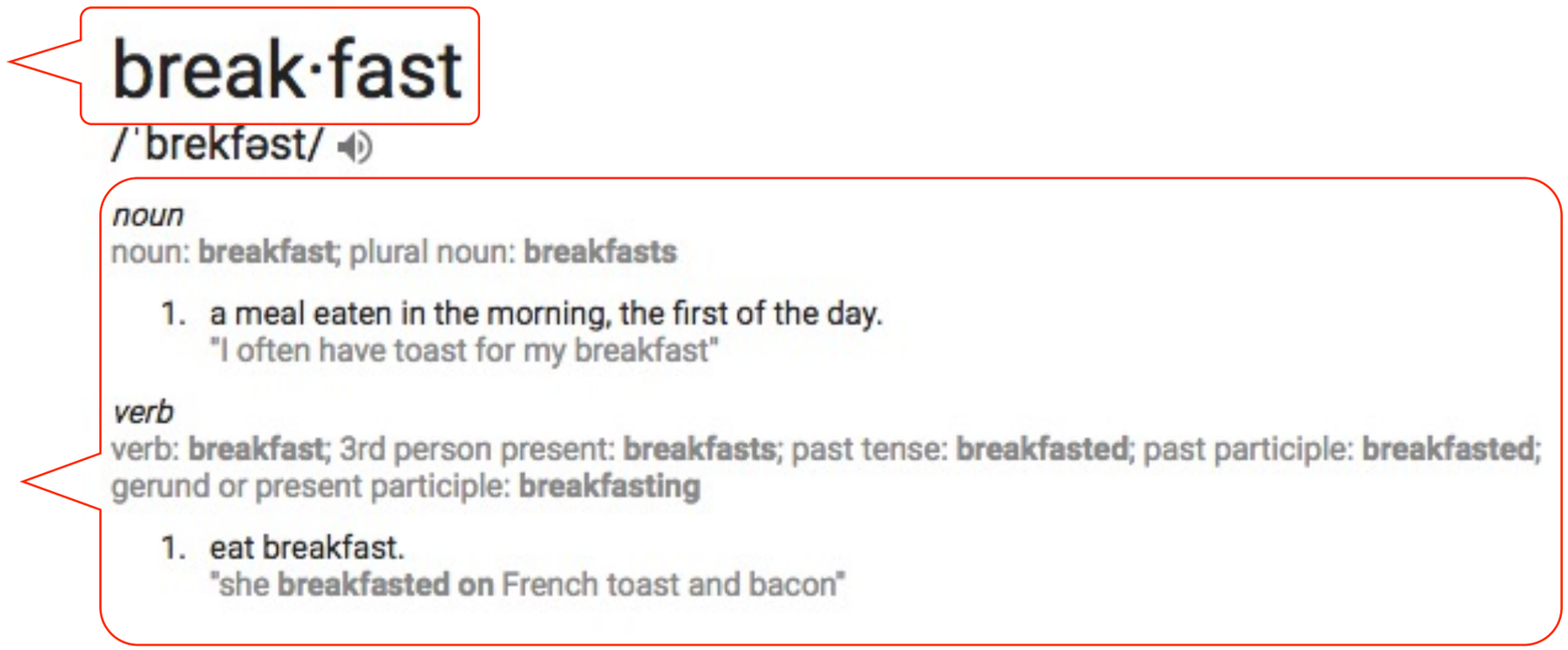
Why call it a dictionary?

this key
(the word)

maps to…

this value
(the definition)



Python dicts have insertion-based order (Python version > 3.6)

Dictionary

Dictionaries map labels (called keys, rather than indexes) to values

- values can be anything we choose (as with lists)
- keys can be nearly anything we choose (must be immutable)

```
nums_list = [900, 700, 800]
```

nums_list[1] → 700

a dictionary would let us give 700 a label other than it's position

Dictionary

Dictionaries map labels (called keys, rather than indexes) to values

- values can be anything we choose (as with lists)
- keys can be nearly anything we choose (must be immutable)

```
nums_list = [900, 700, 800]
```

nums_list[1] ➡ 700

```
nums_dict = {“first”:900, “third”:700, “second”:800}
```

we have the same values

Dictionary

Dictionaries map labels (called keys, rather than indexes) to values

- values can be anything we choose (as with lists)
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```
nums_list = [900, 700, 800]
```

nums_list[1] → 700

```
nums_dict = {"first":900, "third":700, "second":800}
```

we use **curly braces** instead of **square brackets**

careful! curly braces are for both `sets` and `dicts`

Dictionary

Dictionaries map labels (called keys, rather than indexes) to values

- values can be anything we choose (as with lists)
- keys can be nearly anything we choose (must be immutable)

```
                  0     1     2
nums_list = [900, 700, 800]
```

nums_list[1] ➡ 700

```
nums_dict = {"first":900, "third":700, "second":800}
```

we choose the label (called a key) for each value.
Here the keys are the strings "first", "third", and "second"

we put a colon between each key and value

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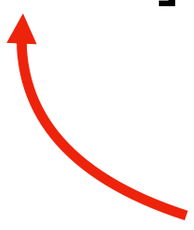
```
nums_list = [900, 700, 800]
```

nums_list[1] → 700

```
nums_dict = {"first":900, "third":700, "second":800}
```

nums_dict["second"] → 800



lookup for a dict is like indexing for a list (label in brackets).
Just use a key (that we chose) instead of an index.

Dictionary

Dictionaries map labels (called keys, rather than indexes) to values

- values can be anything we choose (as with lists)
- keys can be nearly anything we choose (must be immutable)

```
nums_list = [900, 700, 800]
```

nums_list[1] → 700

```
nums_dict = {"first":900, "third":700, "second":800}
```

nums_dict["first"] → 900

lookup for a dict is like indexing for a list (label in brackets).
Just use a key (that we chose) instead of an index.

Dictionary

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- values can be anything we choose (as with lists)
- keys can be nearly anything we choose (must be immutable)

```
nums_list = [900, 700, 800]
```

nums_list[1] → 700

```
nums_dict = {"first":900, "third":700, "second":800}
```

nums_dict["third"] → 700

lookup for a dict is like indexing for a list (label in brackets). Just use a key (that we chose) instead of an index.

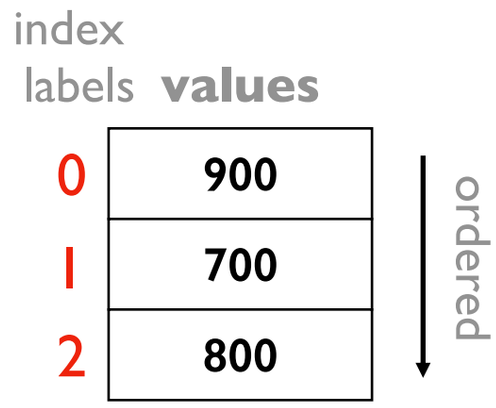
Dictionary

Dictionaries map labels (called keys, rather than indexes) to values

- values can be anything we choose (as with lists)
- keys can be nearly anything we choose (must be immutable)

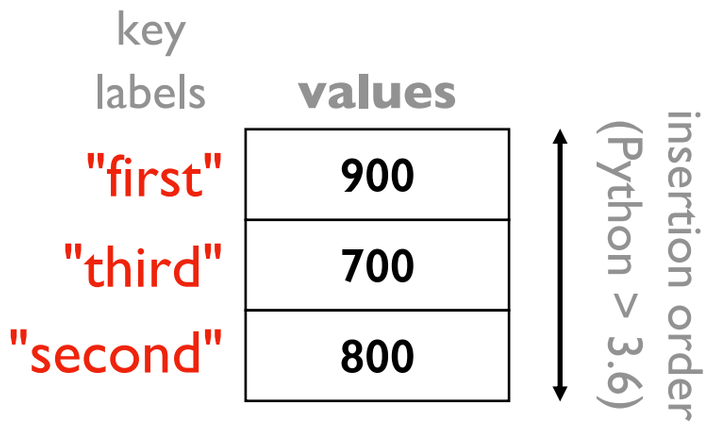
```
nums_list = [900, 700, 800]
```

nums_list[1] → 700

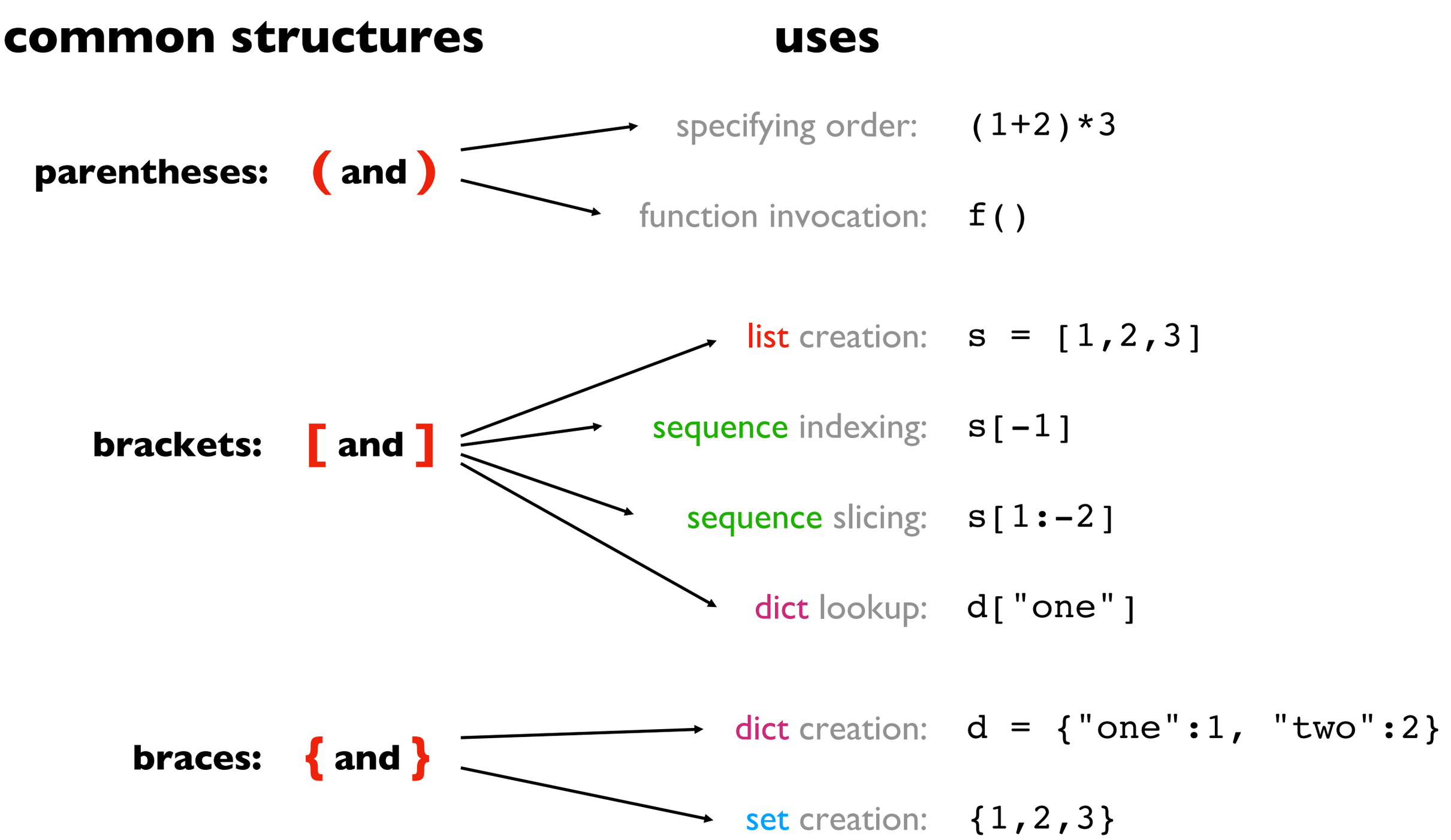



```
nums_dict = {“first”:900, “third”:700, “second”:800}
```

nums_dict[“third”] → 700



A note on parenthetical characters



Empty set, list, and dict

braces: **{ and }**

dict creation:

```
d = {}
```

or

```
d = dict()
```

set creation:

```
s = set()
```

brackets: **[and]**

list creation:

```
l = list()
```

or

```
l = []
```

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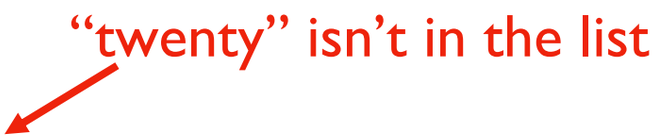
Dictionary Updates

```
>>> lst = ["zero", "ten", "not set"]
>>> lst[2] = "twenty"
>>> lst
['zero', 'ten', 'twenty']


>>> d = {0: "zero", 10: "ten", 20: "not set"}
>>> d[20] = "twenty"
>>> d
{0: 'zero', 10: 'ten', 20: 'twenty'}
```

dictionary updates look like list updates

Dictionary Deletes

```
>>> lst = ["zero", "ten", "twenty"]
>>> lst.pop(-1)
'twenty'
>>> lst
['zero', 'ten']

>>> d = {0: "zero", 10: "ten", 20: "twenty"}
>>> d.pop(20)
'twenty'
>>> d
{0: 'zero', 10: 'ten'}
```



dictionary deletes look like list deletes

Dictionary Inserts

```
>>> lst = ["zero", "ten"]
>>> lst.append("twenty")  # doesn't work: lst[2] = ...
>>> lst
['zero', 'ten', 'twenty']

>>> d = {0: "zero", 10: "ten"}
>>> d[20] = "twenty"
>>> d
{0: 'zero', 10: 'ten', 20: 'twenty'}
```

with a dict, if you try to set a value at a key,
it automatically creates it (doesn't work w/ lists)

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Example: Print Tornados per Year

Goal: given a CSV of CS220 survey data,
print each major's frequency

Input:

- A CSV

Output:

- count per major

Example output (not actual count):

Computer Science: 40
Engineering: 50
Business: 20

https://guide.wisc.edu/

Example: Score Keeping App

Goal: let users enter scores for various players

Input:

- Commands: set score, lookup score, get highest

Output:

- The champion and their score

https://www.google.com/url?sa=i&source=images&cd=&cad=rja&uact=8&ved=0ahUKEwi37NjD--bgAhUI5IMKHUXvAnUQMwhrKAEwAQ&url=https%3A%2F%2Fwww.amazon.com%2FTachikara-Porta-Score-Flip-Scoreboard%2Fdp%2FB006VP8M26&psig=AOvVaw2vUf2T1DoEbyB-Qj9Bi7Ws&ust=1551736624958766&ictx=3&uact=3

Example:

prompt> **python scores.py**
enter a cmd (type "help" for descriptions): **set alice 10**
enter a cmd (type "help" for descriptions): **high**
Alice: 10
enter a cmd (type "help" for descriptions): **q**
exiting

Challenge: Wizard of Oz

Goal: count how often each word appears in the Wizard of Oz

Input:

- Plaintext of book (from Project Gutenberg)

Output:

- The count of each word

https://en.wikipedia.org/wiki/The_Wizard_of_Oz_(1939_film)