

## Objectives

- Dictionaries

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## How Does `in` Work for Lists?

- Example: `guess in prevGuesses`, where `prevGuesses` is a list object
  - For each element in list, checks if element equals (`==`) `guess`
- In the worst case, how many elements does `in` have to check?
  - How could we improve the search?

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## Faster Lookups

- If I wanted to know the Registrar's phone number, ...
  - Would I search through an alphabetized list of phone numbers?
  - No, I would look up the Registrar and find the phone number **associated** with the Registrar
- This type of data structure is known as a **dictionary** in Python
  - Maps a **key** to a **value**
  - Phone book's key: "Registrar", value: phone number

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## Examples of Dictionaries

Dictionary	Keys	Values
Dictionary		
Textbook's index		
Cookbook		
URL (Uniform Resource Locator)		

- Any other things we've done/used in class?

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## Examples of Dictionaries

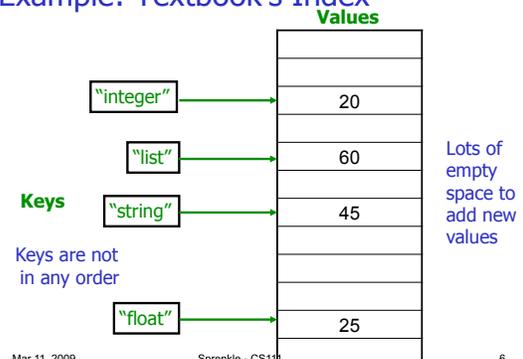
- Real-world:
  - Dictionary
  - Textbook's index
  - Cookbook
  - URL (Uniform Resource Locator)
- Examples from class
  - Function name --> function definition
  - Variable name --> value
  - ASCII value --> character

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## Example: Textbook's Index



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## Dictionaries in Python

- Map **keys** to **values**
  - Keys are probably not alphabetized
  - Mappings are from *one* key to one *or more* values
    - Keys are **unique**, Values are not necessarily unique
      - Example: student id --> last name
    - Keys must be **immutable** (numbers, strings)
- Similar to Hashtables/Hashmaps in other languages

How would we handle if there is more than one value for a key?

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## Why Dictionaries?

- Another way to store data
- Allow fast lookup of data
  - Requires keys, unique keys
    - Data may not have a natural mapping

Pros	Cons
Fast lookup ( <i>much</i> faster than lists if a lot of elements)	Requires a lot of space, unique keys

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## Creating Dictionaries in Python

Syntax:

```
{<key>:<value>, ..., <key>:<value>}
```

```
empty = {}
```

```
ascii = { 'a':97, 'b':98, 'c':99, ..., 'z':122 }
```

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## Dictionary Operations

Indexing	<dict>[<key>]
Length (# of keys)	len(<dict>)
Iteration	for <key> in <dict>:
Membership	<key> in <dict>
Deletion	del <dict>[<key>]

Unlike strings and lists, doesn't make sense to do slicing, concatenation, repetition for dictionaries

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## Dictionary Methods

Method Name	Functionality
<dict>.clear()	Remove all items from dictionary
<dict>.keys()	Returns a copy of dictionary's <i>list</i> of keys
<dict>.values()	Returns a copy of dictionary's <i>list</i> of values
<dict>.get(x[, default])	Returns <dict>[x] if x is a key; Otherwise, returns None (or default value)

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## Accessing Values using Keys

- Syntax:  
<dictionary>[<key>]
- Examples:  

```
ascii['z']
```

```
directory['registrar']
```
- **KeyError** if key is not in dictionary
  - Runtime error; exits program

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## Alternatively, Using `get` method

- `<dict>.get(x[, default])`
    - Returns `<dict>[x]` if `x` is a key; Otherwise, returns `None` (or default value)
- ```
ascii.get('z')  
directory.get('registrar')
```
- If no mapping, get **None** back instead of **KeyError**

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## Accessing Values Using Keys

- Typically, you will check if dictionary has a key before trying to access the key

```
if 'z' in ascii:  
    value = ascii['z']
```

Know mapping exists before trying to access

- Or handle if get default back

```
val = ascii.get('z')  
if val is None:  
    # do something ...
```

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## Special Value: `None`

- Special value we can use
  - E.g., Return value from function when there is an error
- Similar to **null** in Java
- If you execute

```
list = list.sort()  
print list
```

  - Prints `None` because `list.sort()` does **not return** anything

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## Example Using `None`

```
# returns the lowercase letter translated by the key.  
# If letter is not a lowercase letter, returns None  
def translateLetter( letter, key ):  
    if letter < 'a' or letter > 'z':  
        return None  
    #As usual ...
```

```
# example use  
encLetter = translateLetter(char, key)  
if encLetter is None:  
    print "Error in message: ", char
```

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## Inserting Key-Value Pairs

- Syntax:

```
<dictionary>[<key>] = <value>
```
- `ascii['a'] = 97`
  - Creates new mapping of 'a' --> 97

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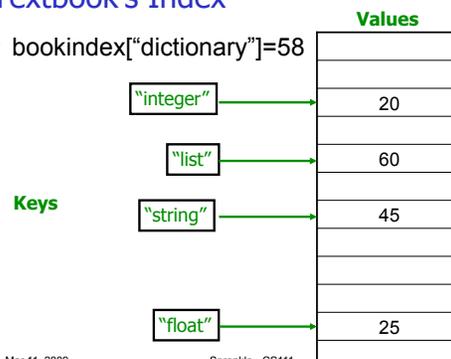
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ascii\_dictionary.py

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## Textbook's Index

- `bookindex["dictionary"] = 58`



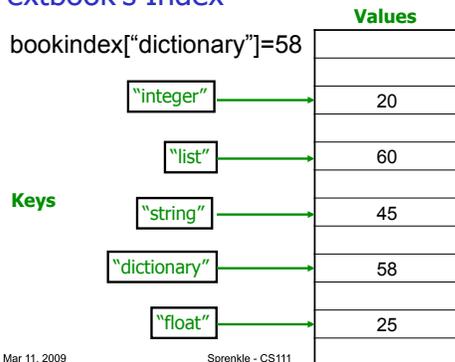
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## Textbook's Index

- `bookindex["dictionary"]=58`



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## Adding/Modifying Key-Value Pairs

- Syntax:

`<dictionary>[<key>] = <value>`

- `directory['registrar'] = 8455`
  - Modifies old entry (if it existed) and changes mapping for 'registrar' to 8455

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## Problem

- Given a file of the form
  - `<lastname> <year>`
- Create a mapping between the last names and years
  - How do we want to model the data?
  - What is the key? What is the value?

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`years_dictionary.py`

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## Why Data File Problems Ad Nauseam?

- "Parsing" data files for different purposes is very common

### Simplified web application access log:

```
128.4.131.54 [09/Aug/2005:14:01:35] GET /dspace/simple-search
128.4.133.79 [09/Aug/2005:14:13:13] GET /dspace/simple-search
128.4.133.139 [09/Aug/2005:14:28:20] GET /dspace/simple-search
128.4.133.139 [09/Aug/2005:14:32:45] GET /dspace/adv-search
...
```

I write scripts to

- create user sessions (use as test cases)
- analyze user sessions (avg. length, patterns)
- emulate user sessions

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## Problem

- Given a file of the form
  - `<lastname> <year>`
- Create and display a mapping between the last names and years
  - How to display the mapping in a pretty way?
  - What order is the data printed in?

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`years_dictionary.py`

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## Problem

- Modify the previous program to keep track of the number of students of each year
  - How do we want to model the data?
  - What is the key? What is the value?
  
- Could we solve this using a list?

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`years_dictionary2.py`

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## Analyzing years\_dictionary2.py

- Anything useful/general that we could put in a function?

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## This Week

- Lab 8 due Friday
- Broader Issue: Digital Humanities

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