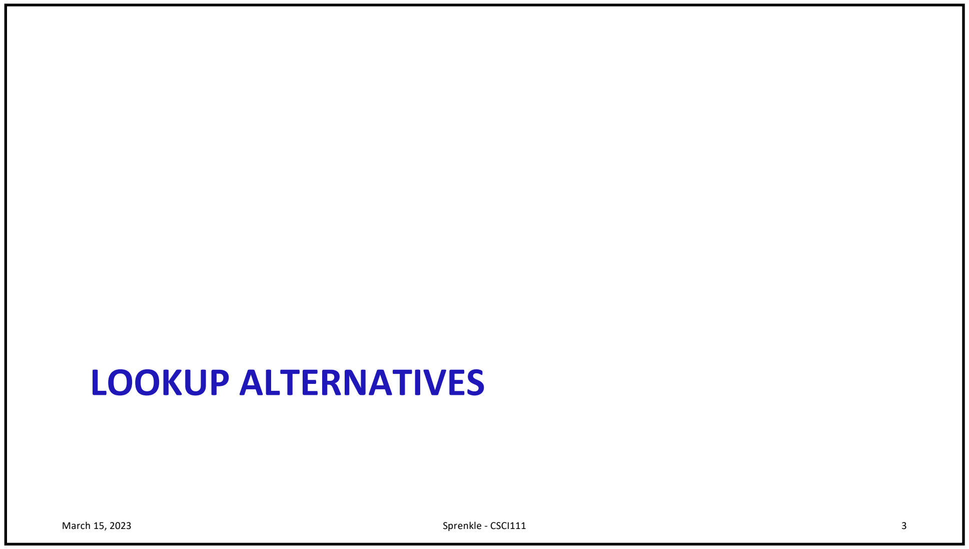
Objectives

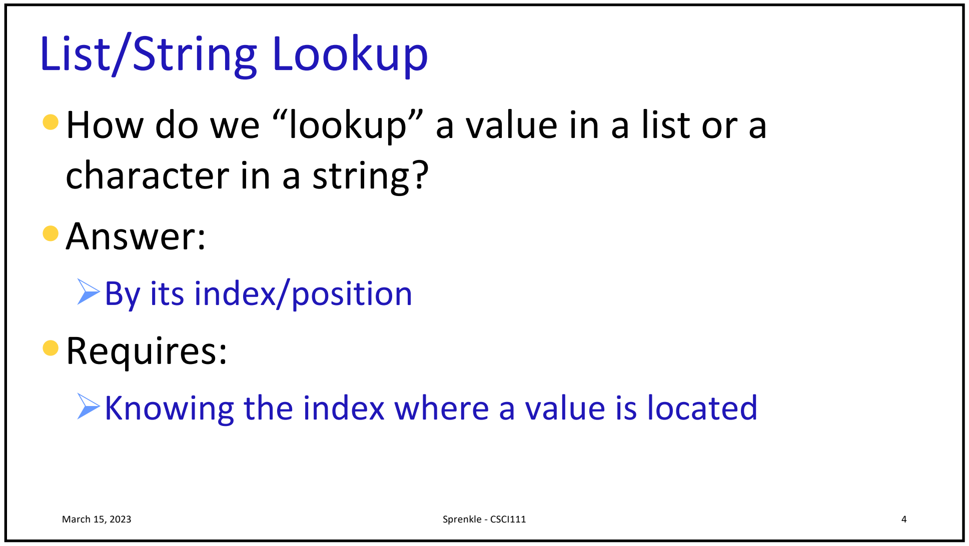
- Dictionaries

Lab Preparation Suggestions

- Review frequently
  - Learning a new language
  - Better to have some practice every day (rather than every week)
- Review example programs
  - Do you [still] understand them after class?
- Active work in interactive text book
  - Don’t just click the boxes
- Focus is on the current week, but we are using tools we learned in the last ~8 weeks.



LOOKUP ALTERNATIVES



List/String Lookup

- How do we “lookup” a value in a list or a character in a string?
- Answer:
  - By its index/position
- Requires:
  - Knowing the index where a value is located

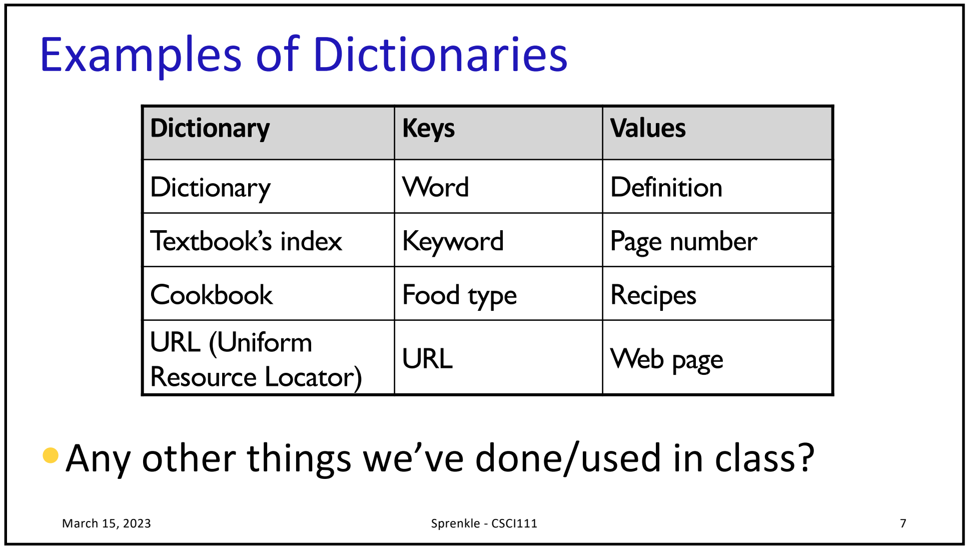
Alternative Lookup

- Alternative: look up something by its key
  - Example: When I lookup my friend’s phone number in my contacts, I don’t know that the number is at position X in my contacts. I look up my friend’s number by her *name*.
  - Need a fast way to figure out “given this *key*, what is the *value* associated with it?”
- This type of data structure is known as a ***dictionary*** in Python
  - Maps a **key** to a **value**
  - Contacts’ key: name; value: phone number

Examples of Dictionaries

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

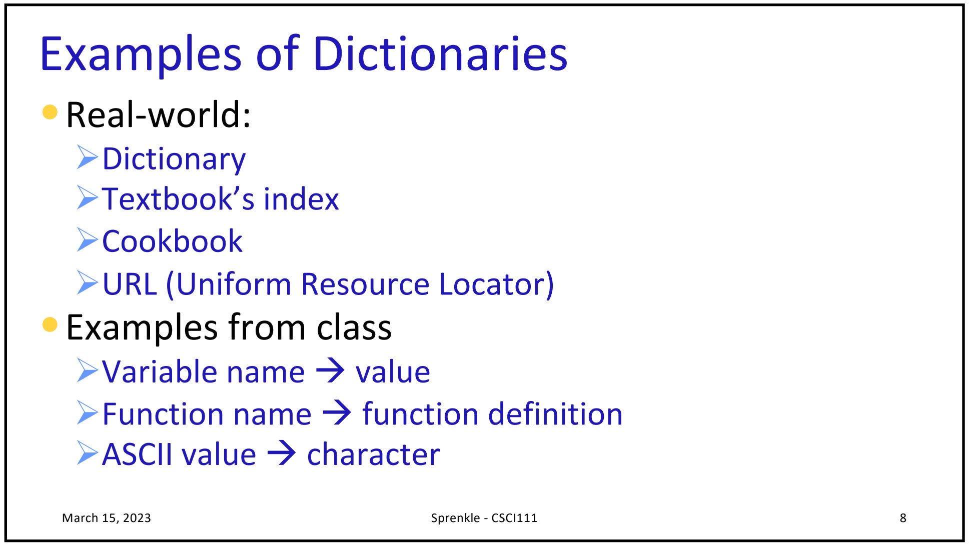
- Any other things we’ve done/used in class?



Examples of Dictionaries

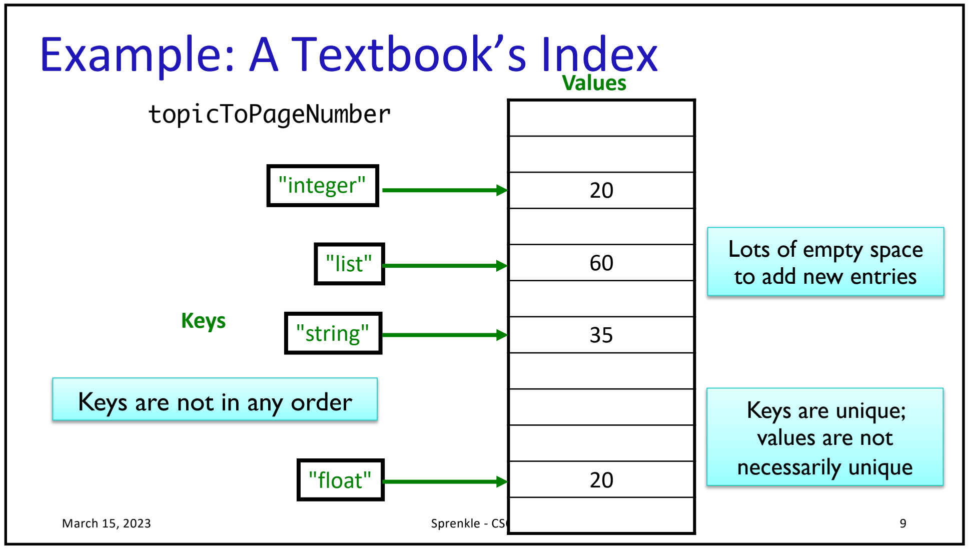
Dictionary	Keys	Values
Dictionary	Word	Definition
Textbook's index	Keyword	Page number
Cookbook	Food type	Recipes
URL (Uniform Resource Locator)	URL	Web page

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



Examples of Dictionaries

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



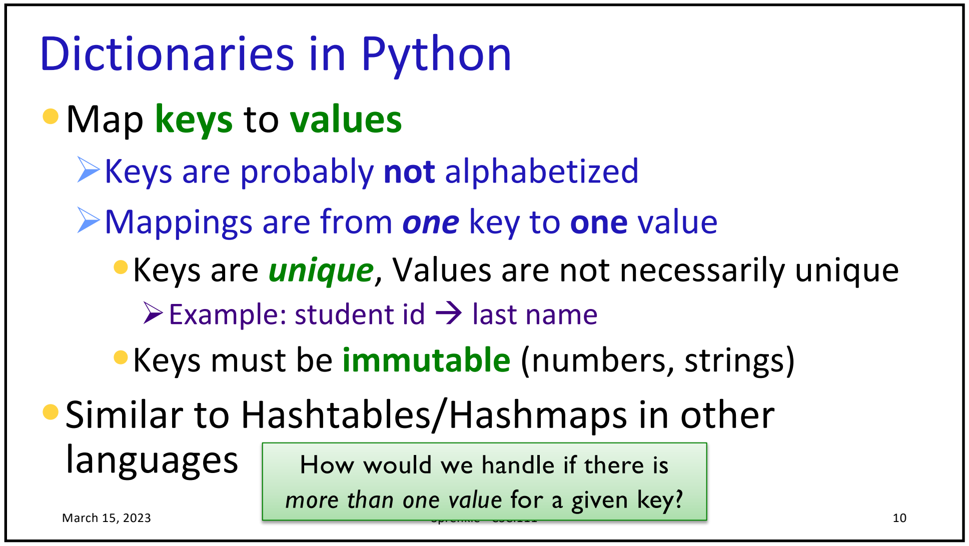
Example: A Textbook's Index

`topicToPageNumber`

Lots of empty space to add new entries

Keys are not in any order

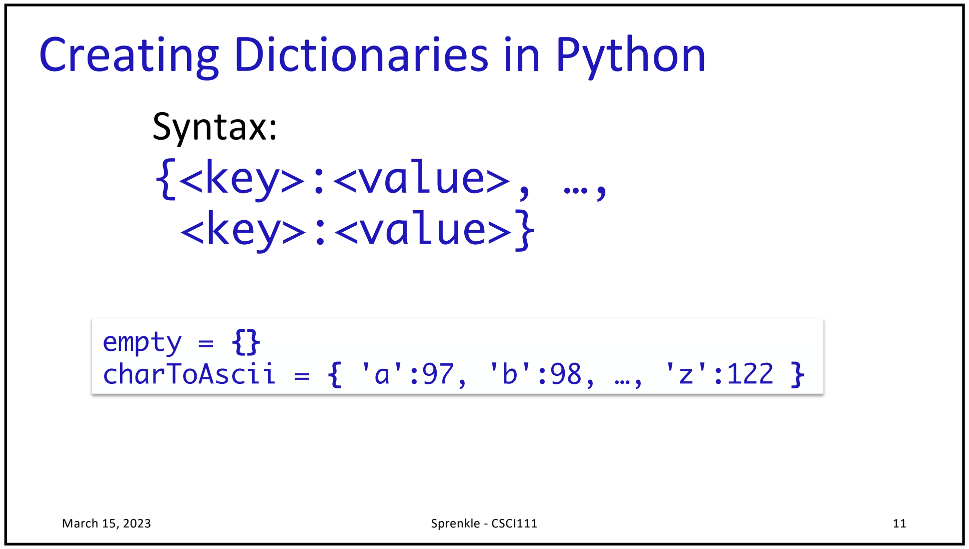
Keys are unique; values are not necessarily unique



Dictionaries in Python

- Map **keys** to **values**
  - Keys are probably **not** alphabetized
  - Mappings are from ***one*** key to **one** value
    - 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 given key?

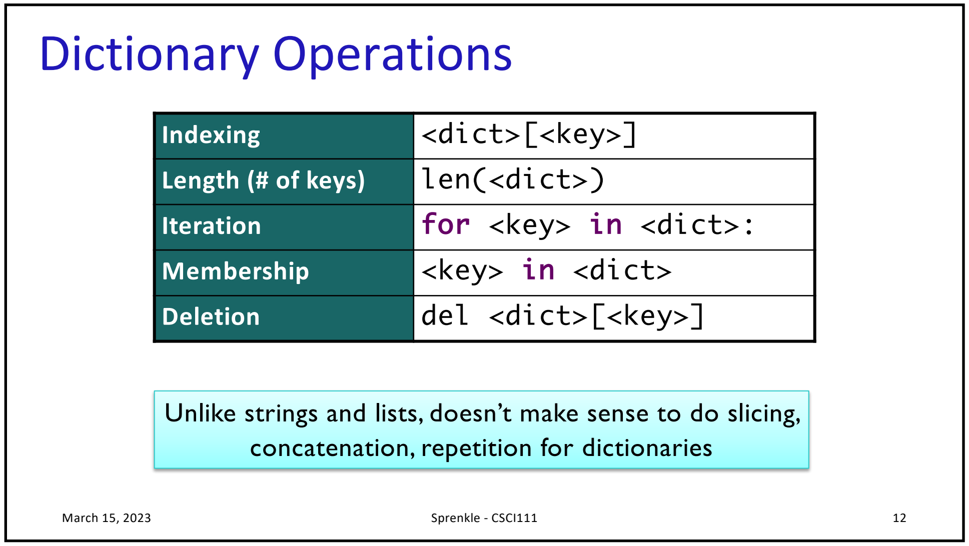


Creating Dictionaries in Python

Syntax:

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

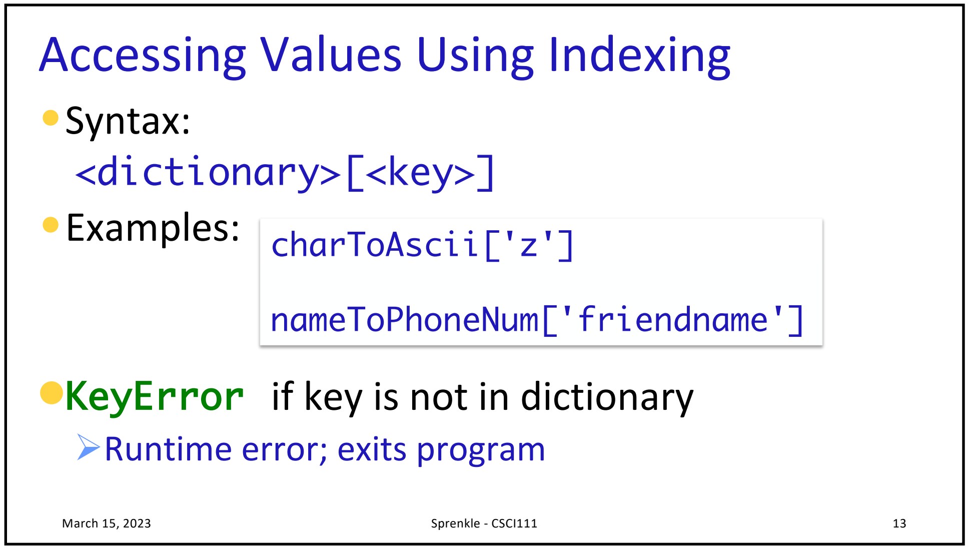
```
empty = {}
charToAscii = { 'a':97, 'b':98, …, 'z':122 }
```



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



Accessing Values Using Indexing

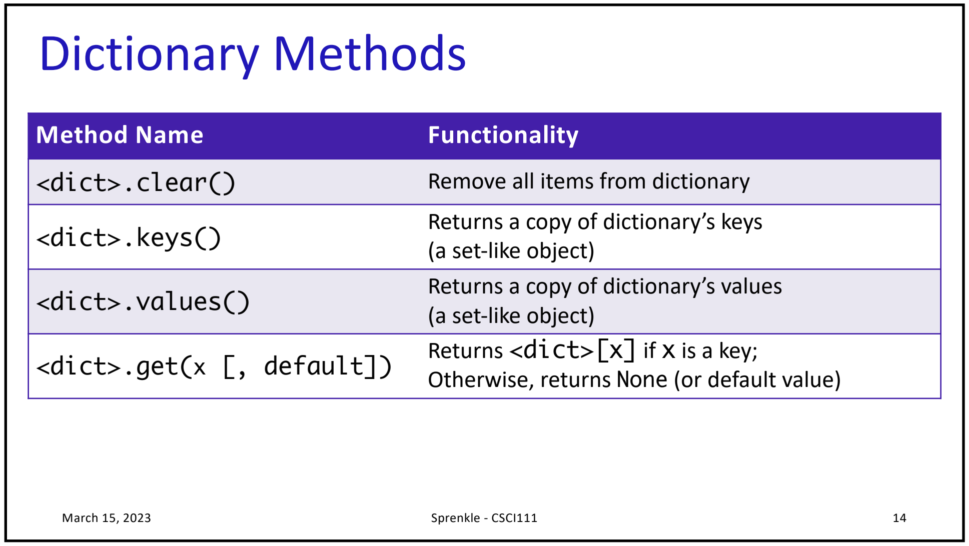
- Syntax:

```
<dictionary>[<key>]
```

- Examples:

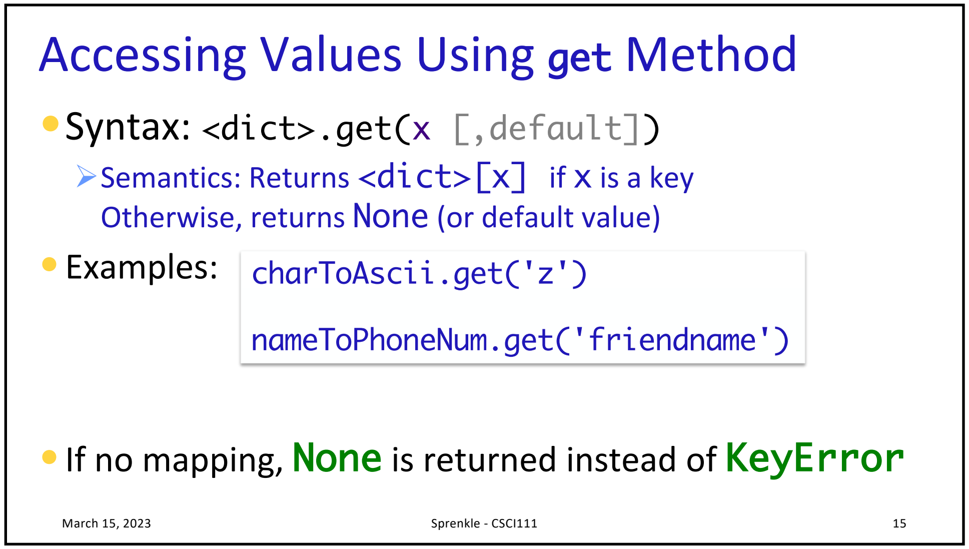
```
charToAscii['z']

nameToPhoneNum['friendname']
```

- KeyError if key is not in dictionary
  - Runtime error; exits program



Dictionary Methods

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

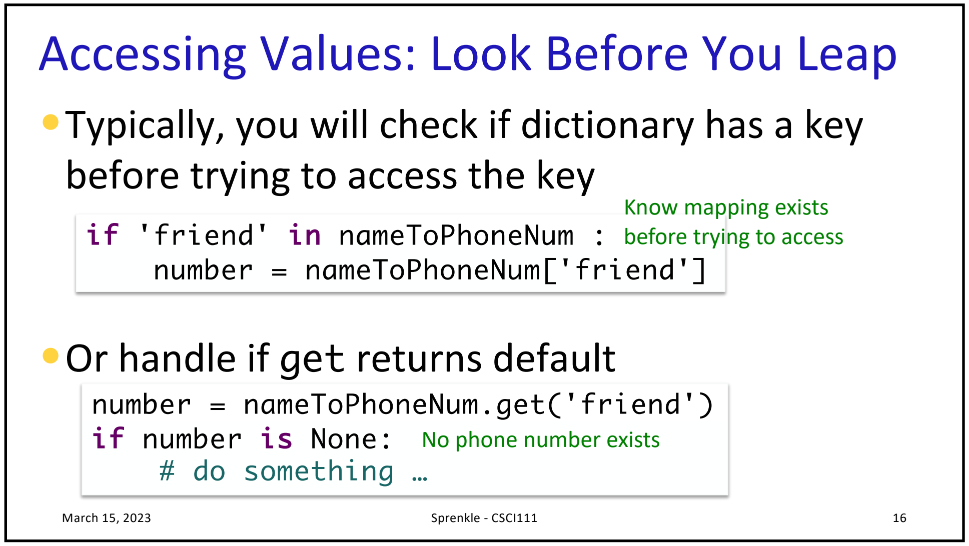


Accessing Values Using **get** Method

- Syntax: `<dict>.get(x [,default])`
  - Semantics: Returns `<dict>[x]` if `x` is a key
    Otherwise, returns `None` (or default value)
- Examples:

```
charToAscii.get('z')

nameToPhoneNum.get('friendname')
```

- If no mapping, **None** is returned instead of **KeyError**



Accessing Values: Look Before You Leap

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

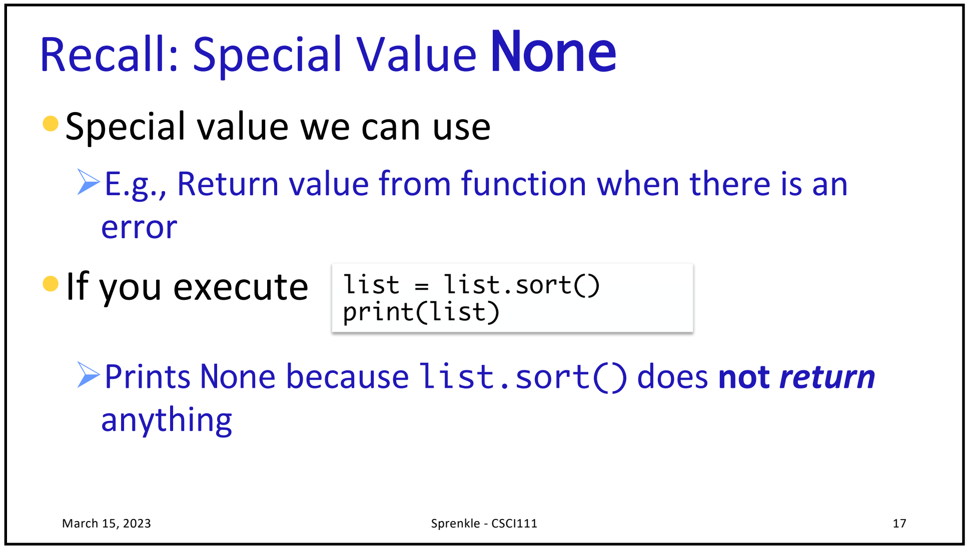
```
if 'friend' in nameToPhoneNum :
    number = nameToPhoneNum['friend']
```

Know mapping exists before trying to access

- Or handle if get returns default

```
number = nameToPhoneNum.get('friend')
if number is None:
    # do something …
```

No phone number exists

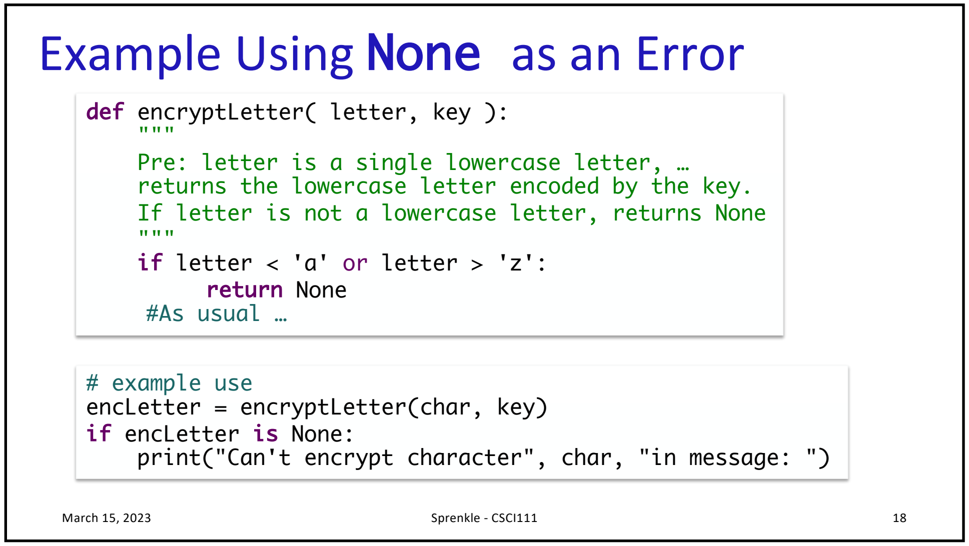


Recall: Special Value **None**

- Special value we can use
  - E.g., Return value from function when there is an error
- If you execute

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

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



Example Using **None** as an Error

```
def encryptLetter( letter, key ):
    """
    Pre: letter is a single lowercase letter, …
    returns the lowercase letter encoded by the key.
    If letter is not a lowercase letter, returns None
    """
    if letter < 'a' or letter > 'z':
         return None
     #As usual …
```

```
# example use
encLetter = encryptLetter(char, key)
if encLetter is None:
    print("Can't encrypt character", char, "in message: ")
```

Inserting Key-Value Pairs

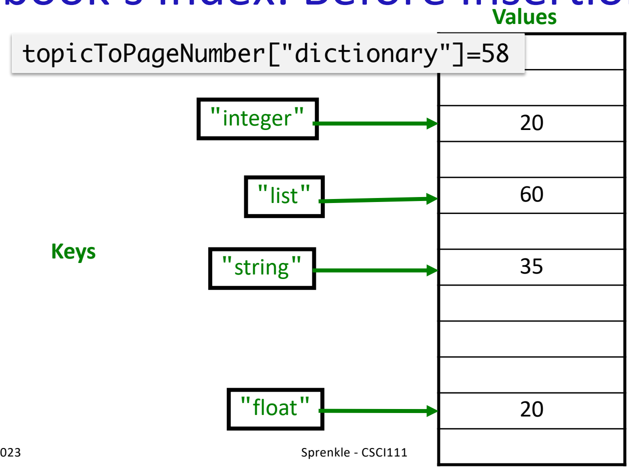
- Syntax:

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

- `charToAscii['a'] = 97`
  - Creates new mapping of 'a' → 97

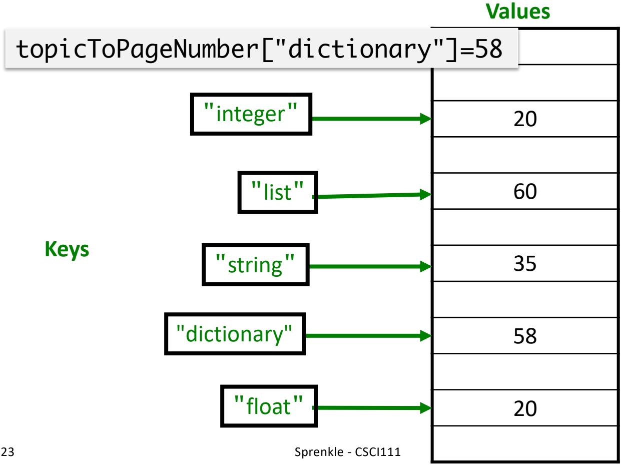
ascii_dictionary.py

Textbook’s Index: Before Insertion



`topicToPageNumber["dictionary"]=58`

Textbook's Index: After Insertion



Values

```
topicToPageNumber["dictionary"]=58
```

Keys

"integer" → 20

"list" → 60

"string" → 35

"dictionary" → 58

"float" → 20

Adding/Modifying Key-Value Pairs

- Syntax:

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

- Example:

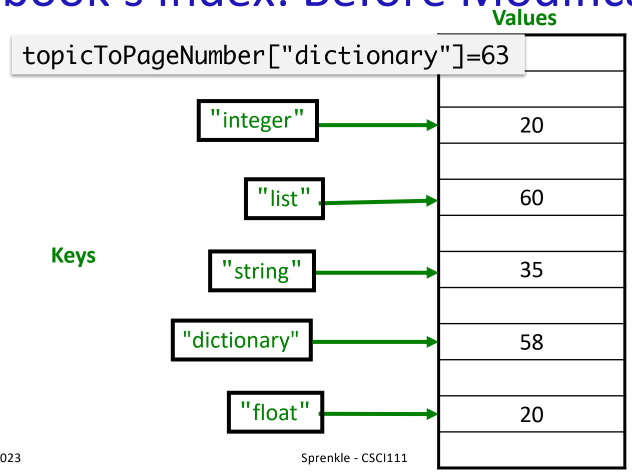
  ```
  nameToPhoneNum['registrar'] = 8455
  ```

  - Adds mapping for `'registrar'` to 8455

  OR

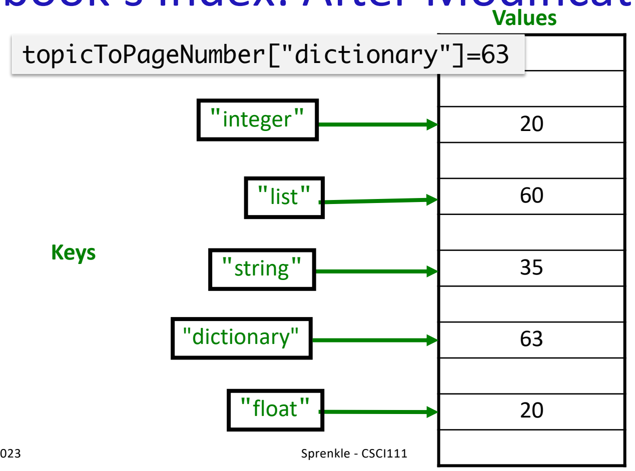
  - If mapping already existed, *modifies* old mapping to 8455

Textbook's Index: Before Modification



`topicToPageNumber["dictionary"]=63`

Textbook's Index: After Modification



`topicToPageNumber["dictionary"]=63`

Methods keys() and values()

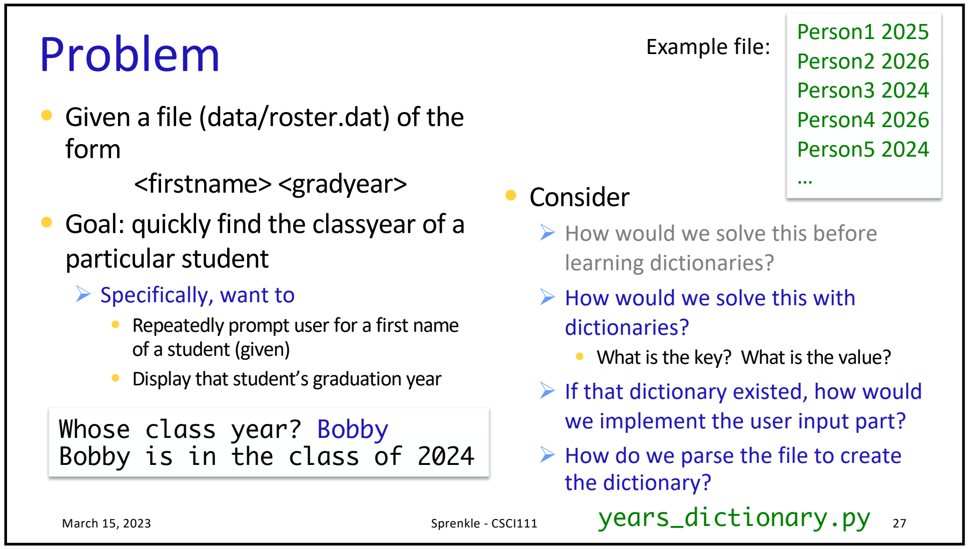
- Don’t return a `list` object
- But can be used similarly to a list
- If you want to make them into a list, use list converter:

```
keys = list(mydict.keys())
```

Using Dictionaries

`using_dictionary.py`

- Demonstrates lots of operations, methods, etc. in using dictionaries



Problem

Example file:

```
Person1 2025
Person2 2026
Person3 2024
Person4 2026
Person5 2024
…
```

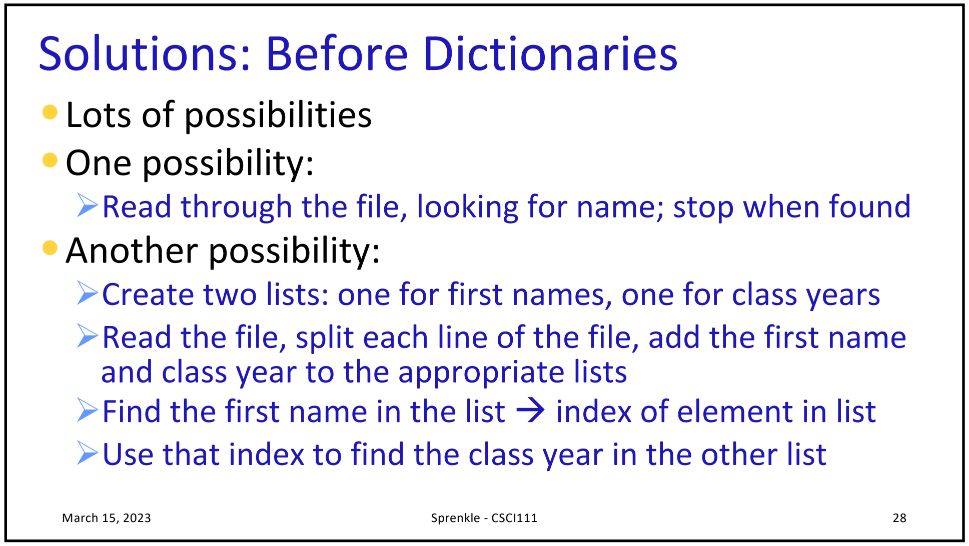
- Given a file (data/roster.dat) of the form

  <firstname> <gradyear>
- Goal: quickly find the classyear of a particular student
  - Specifically, want to
    - Repeatedly prompt user for a first name of a student (given)
    - Display that student's graduation year

```
Whose class year? Bobby
Bobby is in the class of 2024
```

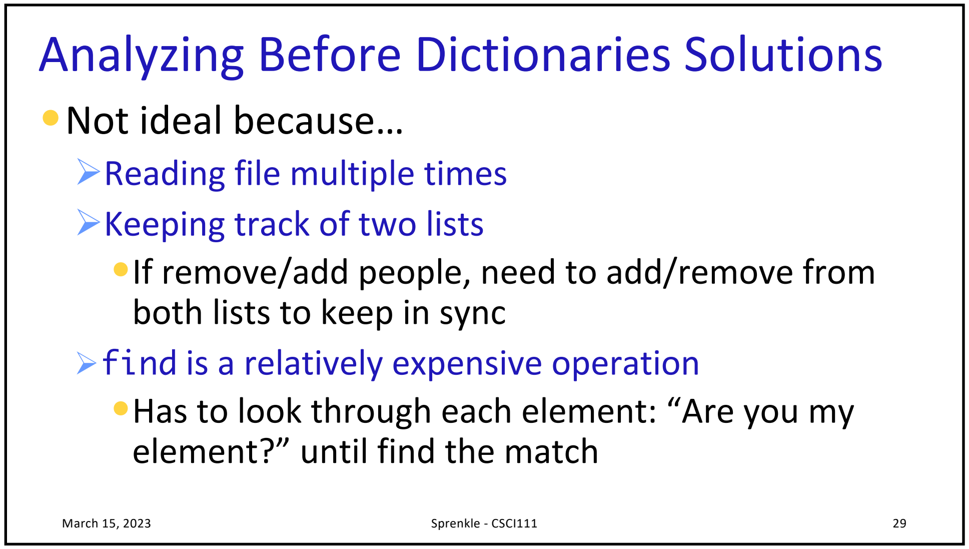
- Consider
  - How would we solve this before learning dictionaries?
  - How would we solve this with dictionaries?
    - What is the key? What is the value?
  - If that dictionary existed, how would we implement the user input part?
  - How do we parse the file to create the dictionary?

years_dictionary.py



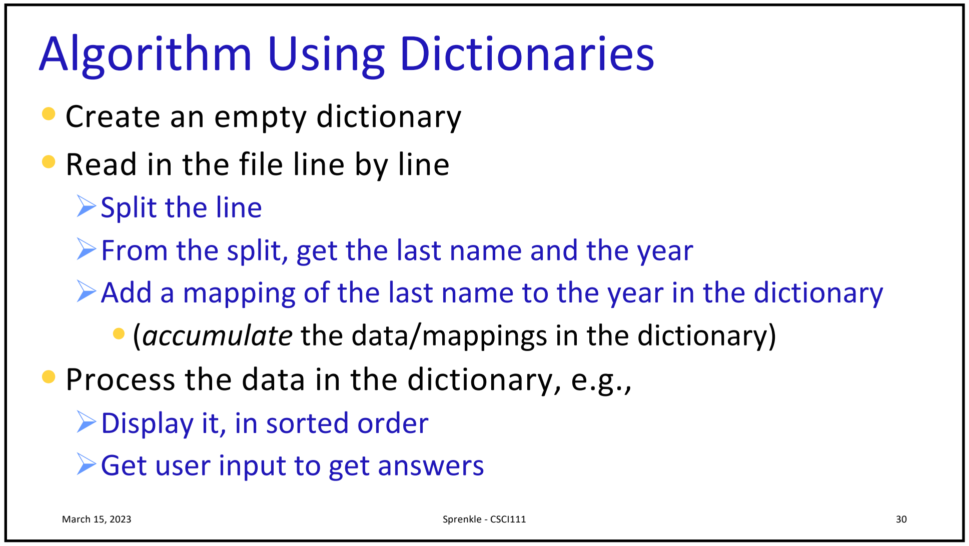
Solutions: Before Dictionaries

- Lots of possibilities
- One possibility:
  - Read through the file, looking for name; stop when found
- Another possibility:
  - Create two lists: one for first names, one for class years
  - Read the file, split each line of the file, add the first name and class year to the appropriate lists
  - Find the first name in the list → index of element in list
  - Use that index to find the class year in the other list



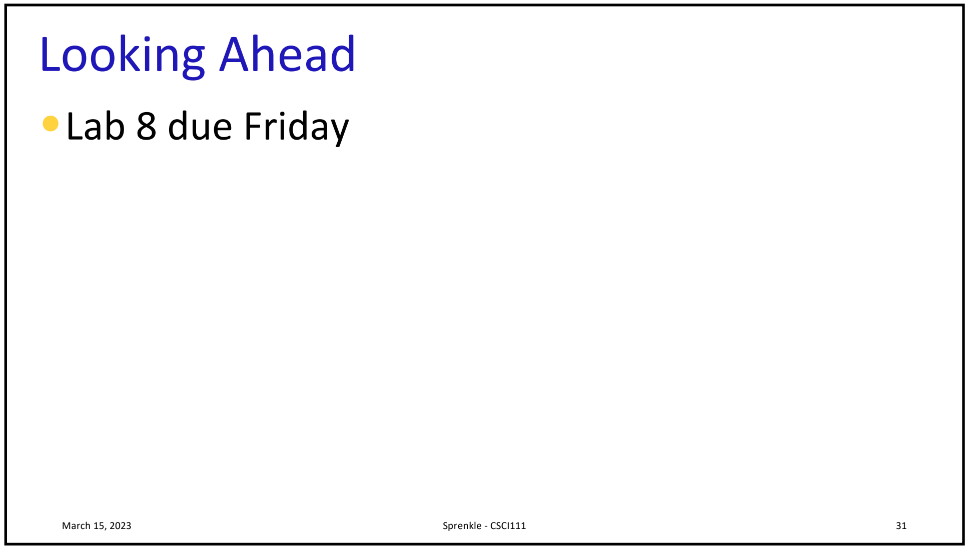
Analyzing Before Dictionaries Solutions

- Not ideal because…
  - Reading file multiple times
  - Keeping track of two lists
    - If remove/add people, need to add/remove from both lists to keep in sync
  - `find` is a relatively expensive operation
    - Has to look through each element: “Are you my element?” until find the match



Algorithm Using Dictionaries

- Create an empty dictionary
- Read in the file line by line
  - Split the line
  - From the split, get the last name and the year
  - Add a mapping of the last name to the year in the dictionary
    - (*accumulate* the data/mappings in the dictionary)
- Process the data in the dictionary, e.g.,
  - Display it, in sorted order
  - Get user input to get answers



Looking Ahead

- Lab 8 due Friday