Code in Place 2024

Stanford CS106A

Section - Week 6

Lists & Dictionaries

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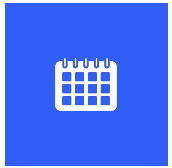
Today's Agenda



1. Check-In

How are we all doing?

2. Course Announcements

Final Project

3. Concepts Review

Lists, Dictionaries, Mutability

4. Practice Problems

"Index Game", "List Practice", "Heads Up"

Check-In

Welcome to our final live Section!

- What was your favorite problem, section, topic, or memory from your time in the course?

Course Announcements

Final Project

- Start thinking about ideas for a program you might want to build.
  - Open ended, anything you can imagine.
  - Can be something utilitarian, or something creative and fun.
  - An animation or game on the console or canvas.
  - Little app you can use in your personal life for family/work/study/etc.

- CIP 2020 Showcase:
  - https://compedu.stanford.edu/codeinplace/public/

- CIP 2021 Showcase:
  - https://codeinplace.stanford.edu/2021/showcase/

Please share your submitted project in our Section Forum, so we can all admire your wonderful creation!

Concepts Review

Intro to Data Structures: Lists & Dictionaries

- **Data Structure**
  - Special container for organizing, processing, retrieving, and storing data.
  - Examples: list, tuple, dictionary, set, tree, stack, queue, graph

- **List**
  - An ordered collection of values.
  - `games = [“Elden Ring”, “Zelda”, “Diablo 4”, “Genshin Impact”]`

- **Dictionary**
  - An unordered collection of key/value pairs.
  - `movie_scores = {“Godfather”: 97, “Avatar”: 82, “Morbius”: 16}`

Lists

- The elements of a list are **indexed, starting from 0**.

```
superheroes = [“Batman”, “Superman”, “Spider-Man”, “Iron Man”]
```

Index	0	1	2	3
Element	“Batman”	“Superman”	“Spider-Man”	“Iron Man”

- Accessing individual elements:

```
>>> superheroes[0]
“Batman”

>>> superheroes[2]
“Spider-Man”

>>> superheroes[-1]                    # Count in reverse.
“Iron Man”
```

Lists: Basics

- List creation
  - `empty_list = []`
  - `letters = [“a”, “b”, “c”, “d”, “e”]`
- Assigning new values to elements
  - `letters = [“a”, “b”, “c”, “d”, “e”]`
  - `letters[3] = “x”  # letters -> [“a”, “b”, “c”, “x”, “e”]`
- Length of list
  - `letters = [“a”, “b”, “c”, “d”, “e”]`
  - `len(letters)  # 5`
- Check if an element is in a list using the Python keyword “`in`”.
  - `if “b” in letters  # True`
  - `if “z” in letters  # False`

Lists: Other Useful Functions

- `list.append(elem)`
  - Add element to end of list.
- `list.pop()`
  - Remove element from end of list. Returns the element that was removed.
- `list.pop(index)`
  - Remove element from list at specified index.
- `list.remove(elem)`
  - Remove first occurrence of an element.
- `del list[index]`
  - Remove an element from a list at specified index. Doesn't return anything.
- `list1.extend(list2)`
  - Add all elements from list2 to the end of list1.
- . . . .and many other useful functions in the Python Docs!

Lists: How to Loop

- How do you loop over the following list?

```
letters = [“a”, “b”, “c”, “d”, “e”]
```

- **Method 1:** Using range().

```
for i in range(len(letters)):          # len(letters) is 5
     print(letters[i])
```

- **Method 2:** Using “for-each” pattern.

```
for elem in letters:
     print(elem)
```

Pop Quiz!

“Rose”	“Donna”	“Martha”	“Amy”	“Clara”	“Bill”	“Yasmin”

1. What index is “Amy”?
2. What index is “Rose”?
3. What index is “Bill”? (answer with a positive index)
4. What index is “Bill”? (answer with a negative index)
5. What is the length of the list?

Dictionaries

- Dictionaries are similar to lists. They associate a key with a value.
  - Keys must be unique. Keys must be immutable types.

```
secret_identities = {“Batman”: “Bruce Wayne”, “Superman”: “Clark Kent”,
“Spider-Man”: “Peter Parker”, “Iron Man”: “Tony Stark”}
```

- In Python, you can also create a dictionary with the following formatting:

```
secret_identities = {
      “Batman”: “Bruce Wayne”,
      “Superman”: “Clark Kent”,
      “Spider-Man”: “Peter Parker”,
      “Iron Man”: “Tony Stark”
}
```

Dictionaries: Basics

```
empty_dict = {}
ages = {“Chris”: 33, “Julie”: 22, “Mehran”: 50}
```

- Using a key to access its associated value (Method 1).
  - `ages[“Chris”]` `# 33`
  - `ages[“Santa Claus”]` `# KeyError`
- Using a key to access its associated value (Method 2).
  - `ages.get(“Chris”)` `# 33`
  - `ages.get(“Santa Claus”)` `# None (They keyword “None” is for null values.)`
- Set a value to a key
  - `ages[“Bronya”] = 25` `# Will create a new key/value pair`
  - `ages[“Mehran”] = 18` `# Will overwrite the existing value of 50`
- Check if a key is in the dictionary using the Python keyword “`in`”.
  - `if “Julie” in ages` `# True`
  - `if “Santa Claus” in ages` `# False`

Dictionaries: Other Useful Functions

- `len(dict)`
  - Returns the number of key/value pairs in the dictionary.
- `dict.pop(key)`
  - Removes key/value pair with the given key. Returns value from that pair.
- `del dict[key]`
  - Removes key/value pair with the given key. Doesn't return anything.
- `dict.keys()`
  - Returns something similar to a range of keys in the dictionary.
- `dict.values()`
  - Returns something similar to a range of values in the dictionary.
- . . . .and many other useful functions in the Python Docs!

Dictionaries: How to Loop

- **Method 1:** for-each key

```
for key in my_dict.keys():        # .keys() is optional.  Can just use “my_dict”.
      value = my_dict[key]
      print(key, value)
```

- **Method 2:** for-each value

```
for value in my_dict.values():
      print(value)
```

- **Method 3:** for-each tuple of (key, value)

```
for key, value in my_dict.items():
      print(key)
      print(value)
```

Mutability

- Different Types have different behaviors when **passed as parameters** to another function.

Types that are "immutable"	**Types that are "mutable"**
`int, float, bool, string`	`list, dictionary, canvas`
For parameters: The original variable value you passed in is not changed when function is done.	For parameters: The original variable value you passed in is changed when function is done.

Mutability: Examples

- **Strings are immutable:**

```
def main():
      message = “Hello”
      print(message)                # “Hello”
      depart(message)
      print(message)                # “Hello”

def depart(message):                # Pass in string as a parameter.
      message = “Goodbye”
```

- **Canvas is mutable:**

```
def main():
      my_canvas = Canvas(300, 300)
      draw_circle(my_canvas)                          # Canvas is a mutable type.

def draw_circle(canvas):                              # Pass in a Canvas as a parameter.
      canvas.create_oval(0, 0, 50, 50, “blue”)        # The Canvas WILL be modified.
```

Mutability: Lists Are Mutable

- When you pass a list as a parameter, you are passing a reference to the actual list.
  - A reference is like getting a URL to the list.
    - Example: If I give you a URL to an editable Google Doc file, you can access the file using the URL and even make changes to it.
  - In a function, changes to values in list persist after the function ends.

```
def add_ten(num_list):
      for i in range(len(num_list)):
            num_list[i] += 10

def main():
      values = [6, 7, 8, 9]
      add_ten(values)               # Pass in a list as a parameter.
      print(values)                 # Output: [16, 17, 18, 19]
```

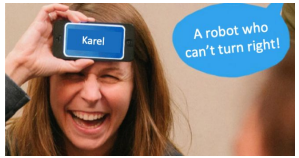
Mutability: Dictionaries Are Mutable

- Keys must be immutable types (e.g. `int, float, bool, string`).
  - Keys cannot be changed "in place".
  - If you want to change a key, you must remove the key/value pair from dictionary and then add a key/value pair with new key.
- Values can be mutable or immutable types.
  - Values can be changed "in place".
- Dictionaries are mutable.
  - Changes made to a dictionary in a function persist after the function is done.

```
def have_birthday(dict, name):
      dict[name] += 1

def main():
      ages = {"Chris": 33, "Julie": 22, "Mehran": 50}
      print(ages)                          # Mehran's value is 50.
      have_birthday(ages, "Mehran")
      print(ages)                          # Mehran's value is 51.
```

Section Exercise: “Heads Up”



Take a list of words from a file and use it to recreate a console-based version of the “Heads Up” game!

Input

Karel
For Loop
While Loop
If Statement
Else
Function
Parameter
Return Value
CS106A

Output

The word to guess: Karel
(Hit “enter” to get the next word.)

The word to guess: For Loop
(Hit “enter” to get the next word.)

The word to guess: While Loop
(Hit “enter” to get the next word.)

Thank You

Congratulations! You've made it through CIP 2024!

- I learned so much from you!
- Feel free to connect with me on LinkedIn.
  - https://www.linkedin.com/in/dwctsai/
  - Would appreciate endorsements for any Skills in my profile.

Please look forward to some final posts in the Section Forum!