

# Code in Place 2023

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"



## Before We Start

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"
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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 Wane", "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 Wane",  
    "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 Clause"]` # `KeyError`
- Using a key to access its associated value (Method 2).
  - `ages.get("Chris")` # 33
  - `ages.get("Santa Clause")` # `None` (The 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 Clause" 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():  
    value = my_dict[key]  
    print(key, value)
```

# `.keys()` is optional. Can just use “my\_dict”.

- **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 <u>not</u> changed when function is done.	For parameters: The original variable value you passed in <u>is</u> 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  
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## 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.)

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# Thank You

Congratulations! You've made it through CIP 2023!



- 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!