CS65: Introduction to Computer Science

Midterm exam discussion

Assignment 3

Dictionary

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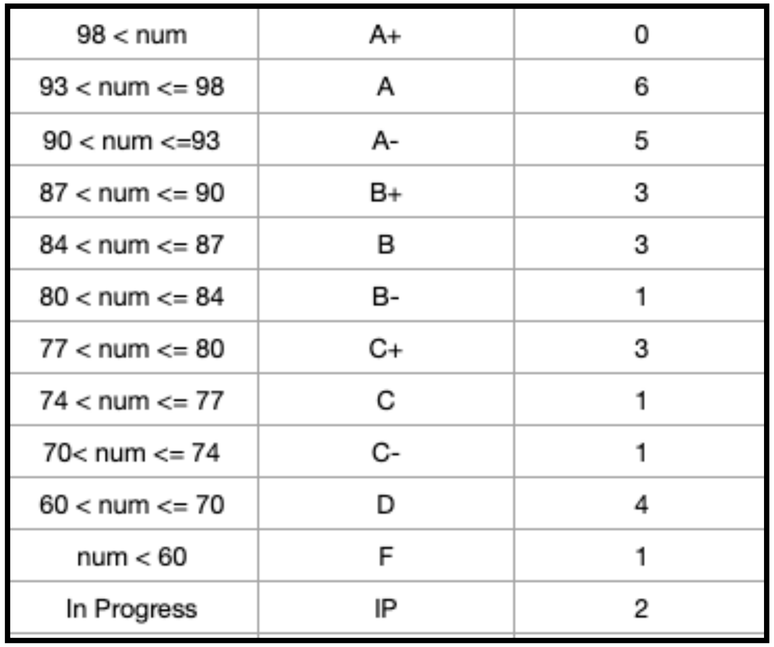
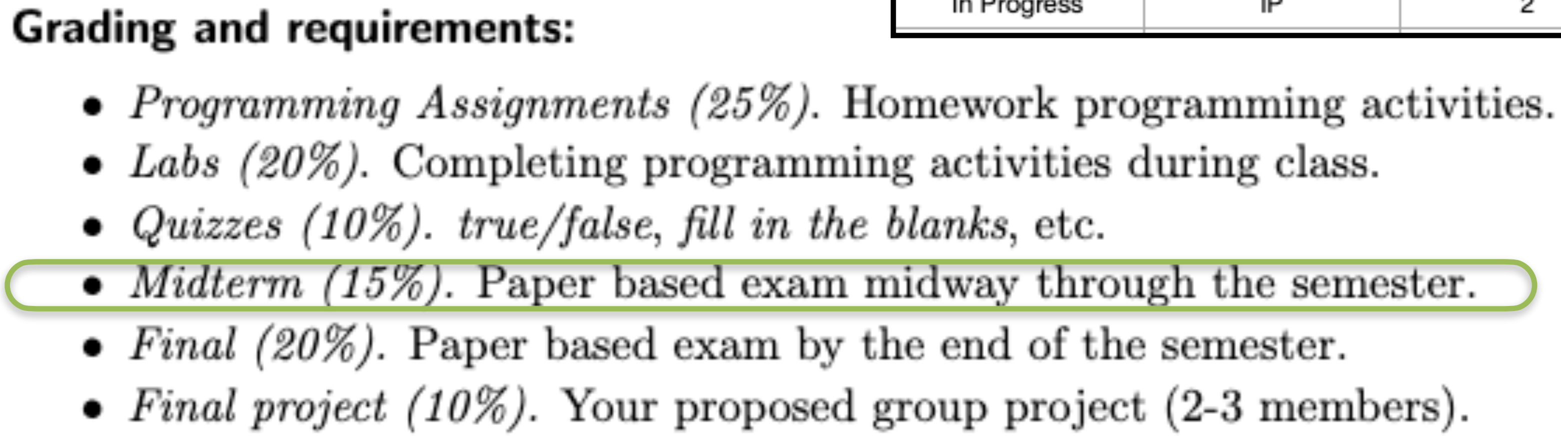
Midterm Exam

- Midterm exam letter grade

- Average score <u>49.91</u> (out of 60)
  - <u>83.18%</u>



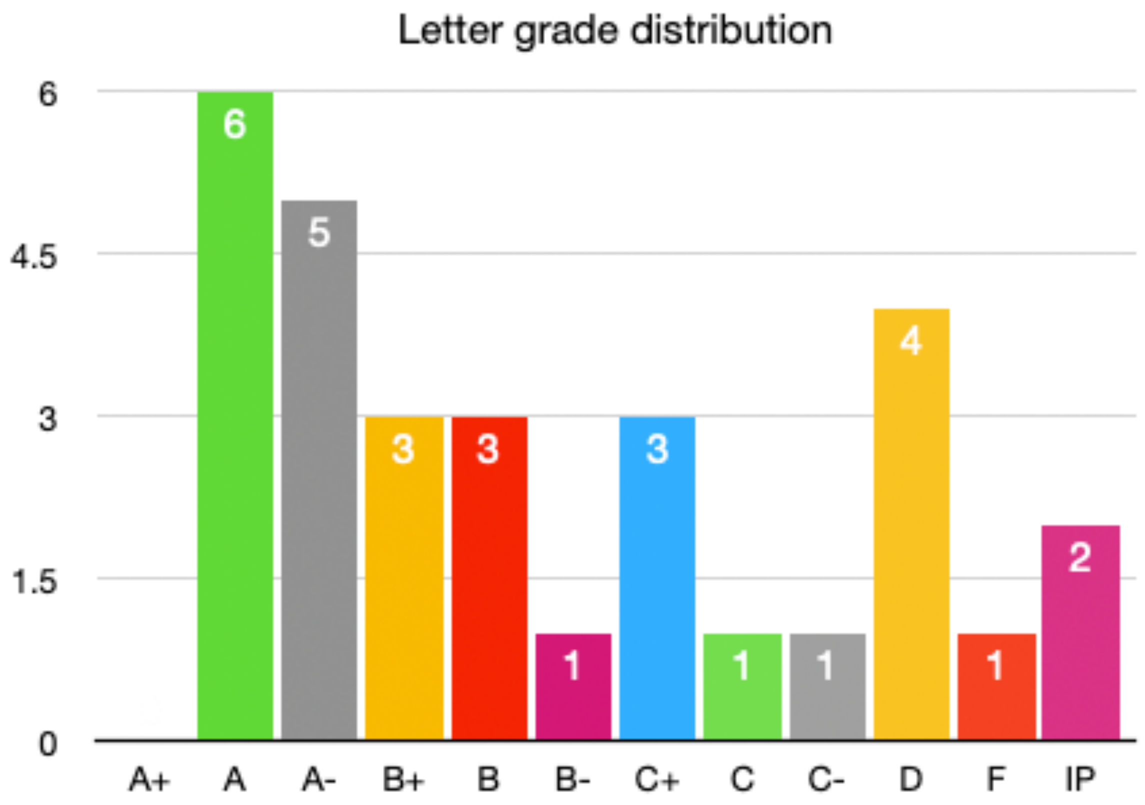
98 < num	A+	0
93 < num <= 98	A	6
90 < num <=93	A-	5
87 < num <= 90	B+	3
84 < num <= 87	B	3
80 < num <= 84	B-	1
77 < num <= 80	C+	3
74 < num <= 77	C	1
70< num <= 74	C-	1
60 < num <= 70	D	4
num < 60	F	1
In Progress	IP	2



Grading and requirements:

- *Programming Assignments (25%).* Homework programming activities.
- *Labs (20%).* Completing programming activities during class.
- *Quizzes (10%). true/false, fill in the blanks,* etc.
- *Midterm (15%).* Paper based exam midway through the semester.
- *Final (20%).* Paper based exam by the end of the semester.
- *Final project (10%).* Your proposed group project (2-3 members).

Midterm Exam



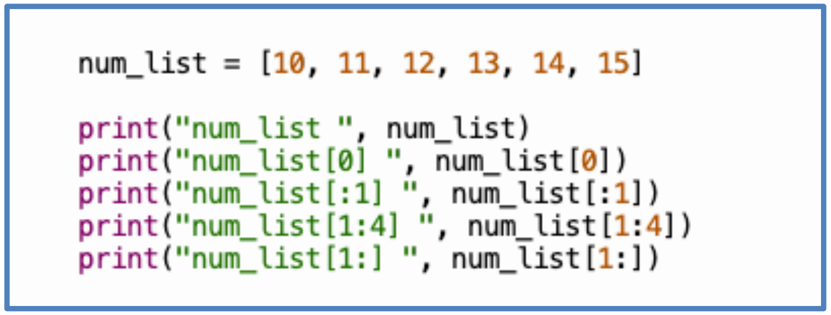
Review: List

- List manipulation
  - Slicing
  - Appending
  - Updating
  - Removing
  - Other methods/operations

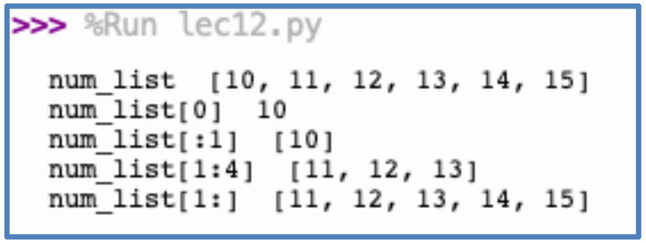
- List of lists
  - Understanding the dimensions
  - Accessing elements
  - Accessing with nested for loops

Review: List Slicing

- Format: *list_variable_name*[start : end]
  - **start :** starting index — if not specified 0 is used
  - **end :** end index — if not specified ***len****(list)* is used



```
num_list = [10, 11, 12, 13, 14, 15]

print("num_list ", num_list)
print("num_list[0] ", num_list[0])
print("num_list[:1] ", num_list[:1])
print("num_list[1:4] ", num_list[1:4])
print("num_list[1:] ", num_list[1:])
```

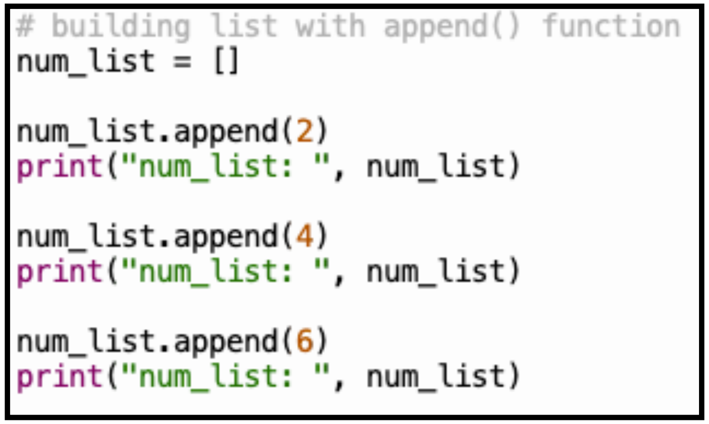


```
>>> %Run lec12.py

 num_list  [10, 11, 12, 13, 14, 15]
 num_list[0]  10
 num_list[:1]  [10]
 num_list[1:4]  [11, 12, 13]
 num_list[1:]  [11, 12, 13, 14, 15]
```

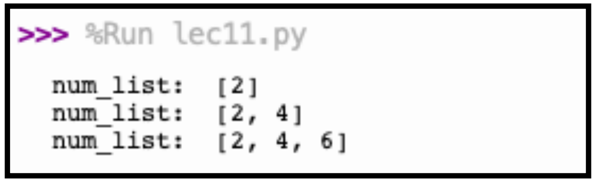
Review: Inserting Items in a List

- Appending elements in an empty list with **. append()** method
  - It is executed by a "." (dot) symbol followed the method name

Sequentially appending items

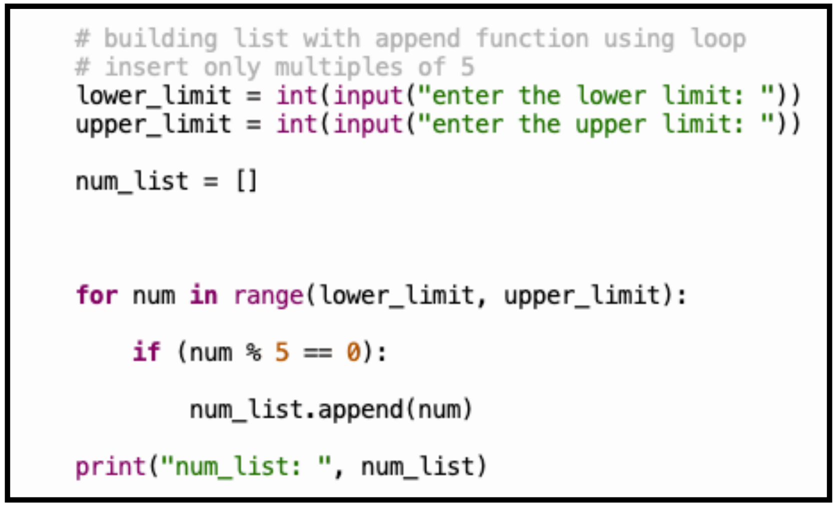


```
# building list with append() function
num_list = []

num_list.append(2)
print("num_list: ", num_list)

num_list.append(4)
print("num_list: ", num_list)

num_list.append(6)
print("num_list: ", num_list)
```

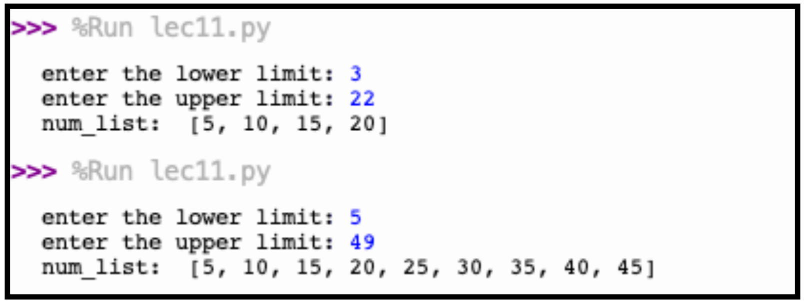


```
>>> %Run lec11.py

  num_list:  [2]
  num_list:  [2, 4]
  num_list:  [2, 4, 6]
```

Appending items with for loop



```
# building list with append function using loop
# insert only multiples of 5
lower_limit = int(input("enter the lower limit: "))
upper_limit = int(input("enter the upper limit: "))

num_list = []


for num in range(lower_limit, upper_limit):

    if (num % 5 == 0):

        num_list.append(num)

print("num_list: ", num_list)
```



```
>>> %Run lec11.py

  enter the lower limit: 3
  enter the upper limit: 22
  num_list:  [5, 10, 15, 20]

>>> %Run lec11.py

  enter the lower limit: 5
  enter the upper limit: 49
  num_list:  [5, 10, 15, 20, 25, 30, 35, 40, 45]
```

Review: Changing Items in a List

- Changing specific items in a list

Sequentially updating items

```python
num_list = [10, -1, -2, -3, 20, -4, 30]

print("Before modification num_list is ", num_list)

num_list[1] = 0
num_list[2] = 0
num_list[3] = 0
num_list[4] = 40
```

```
>>> %Run lec12.py

 Before modification num_list is  [10, -1, -2, -3, 20, -4, 30]
 After modification num_list is  [10, 0, 0, 0, 40, -4, 30]
```

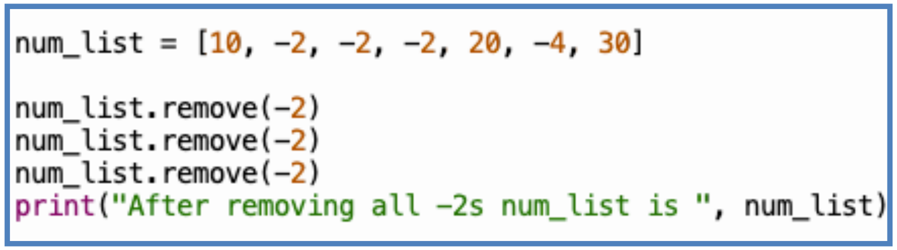
Updating items with for loop

```python
# modifying list based on a criteria

num_list = [10, -1, -2, -3, 20, -4, 30]

list_size = len(num_list)

print("Before modification num_list is ", num_list)
for i in range(list_size):

    if (num_list[i] < 0):

        #print("Found negative num at index: ", i)

        num_list[i] = 0

print("After modification num_list is ", num_list)
```

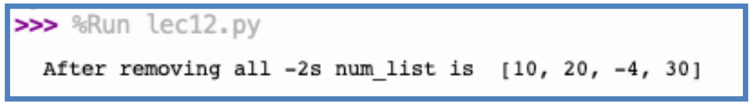
```
>>> %Run lec11.py

 Before modification num_list is  [10, -1, -2, -3, 20, -4, 30]
 After modification num_list is  [10, 0, 0, 0, 20, 0, 30]
```

Review: Removing Items from a List

Version 1: .remove() method

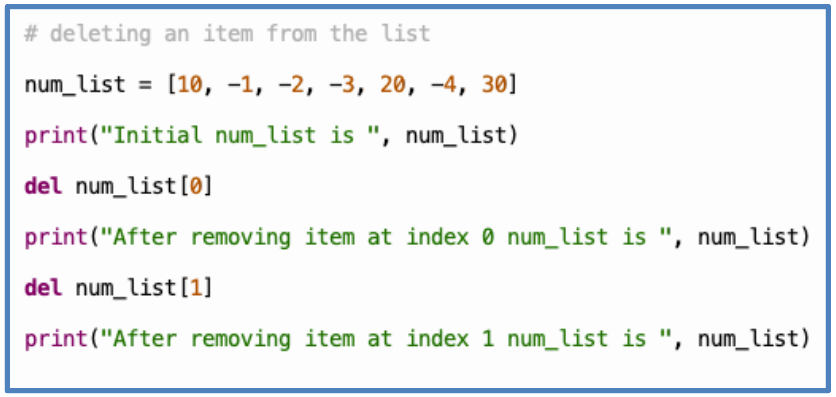


```python
num_list = [10, -2, -2, -2, 20, -4, 30]

num_list.remove(-2)
num_list.remove(-2)
num_list.remove(-2)
print("After removing all -2s num_list is ", num_list)
```

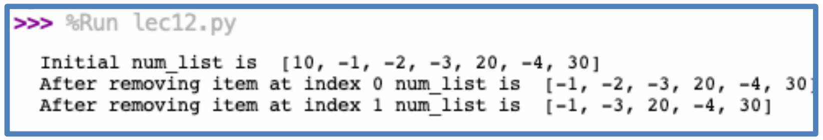


```
>>> %Run lec12.py

  After removing all -2s num_list is  [10, 20, -4, 30]
```

Version 2: del keyword

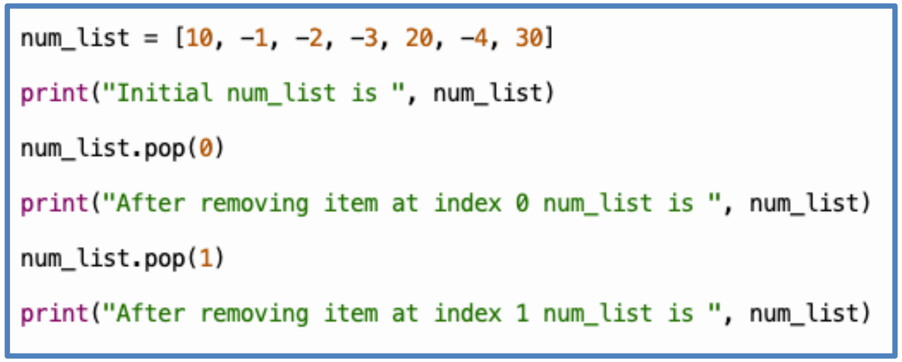


```python
# deleting an item from the list

num_list = [10, -1, -2, -3, 20, -4, 30]

print("Initial num_list is ", num_list)

del num_list[0]

print("After removing item at index 0 num_list is ", num_list)

del num_list[1]

print("After removing item at index 1 num_list is ", num_list)
```

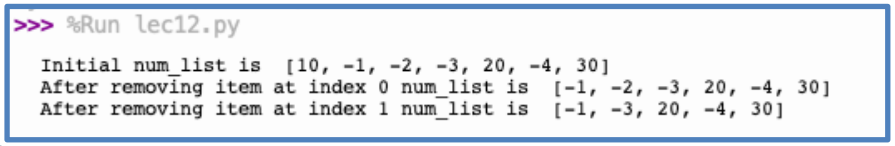


```
>>> %Run lec12.py

  Initial num_list is  [10, -1, -2, -3, 20, -4, 30]
  After removing item at index 0 num_list is  [-1, -2, -3, 20, -4, 30
  After removing item at index 1 num_list is  [-1, -3, 20, -4, 30]
```

Version 3: .pop() method

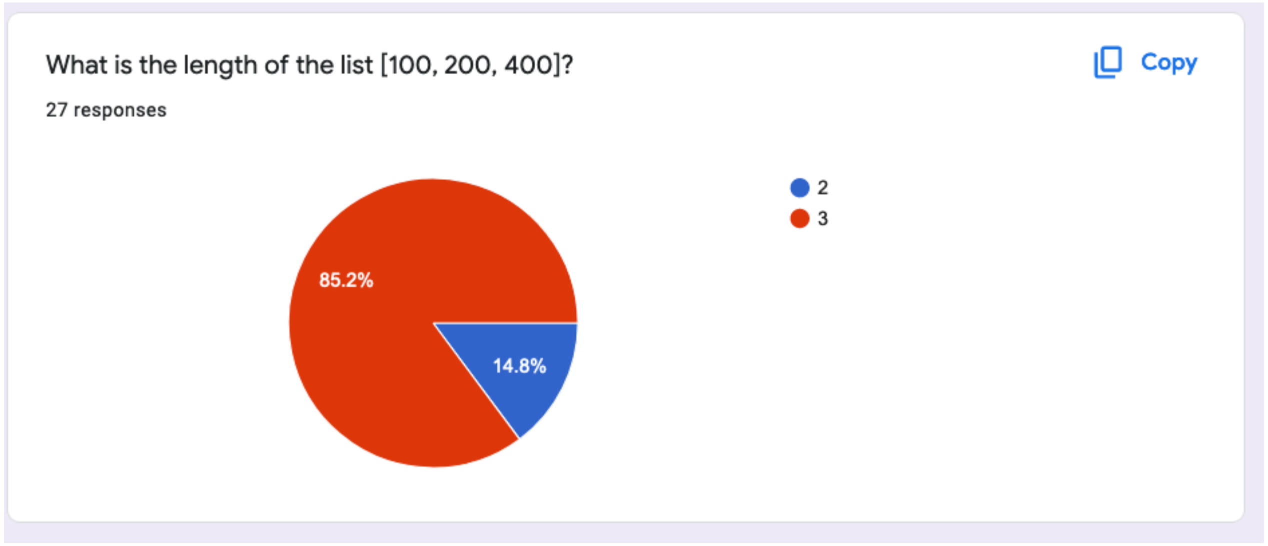


```python
num_list = [10, -1, -2, -3, 20, -4, 30]

print("Initial num_list is ", num_list)

num_list.pop(0)

print("After removing item at index 0 num_list is ", num_list)

num_list.pop(1)

print("After removing item at index 1 num_list is ", num_list)
```



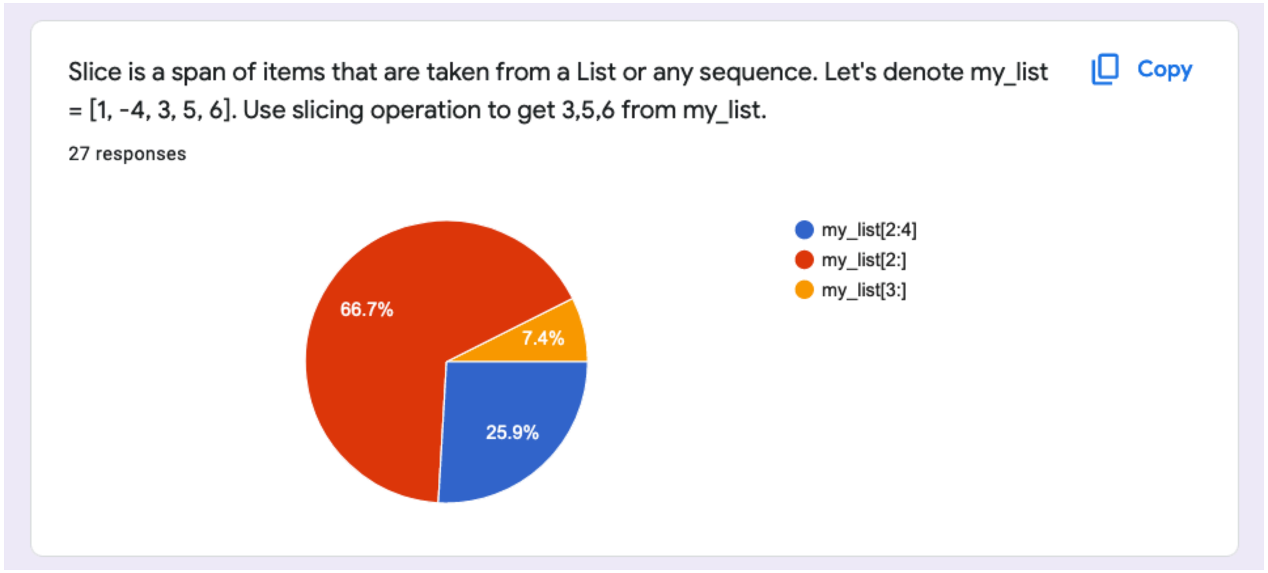
```
>>> %Run lec12.py

  Initial num_list is  [10, -1, -2, -3, 20, -4, 30]
  After removing item at index 0 num_list is  [-1, -2, -3, 20, -4, 30]
  After removing item at index 1 num_list is  [-1, -3, 20, -4, 30]
```

Review: Poll from Tuesday's class



What is the length of the list [100, 200, 400]?

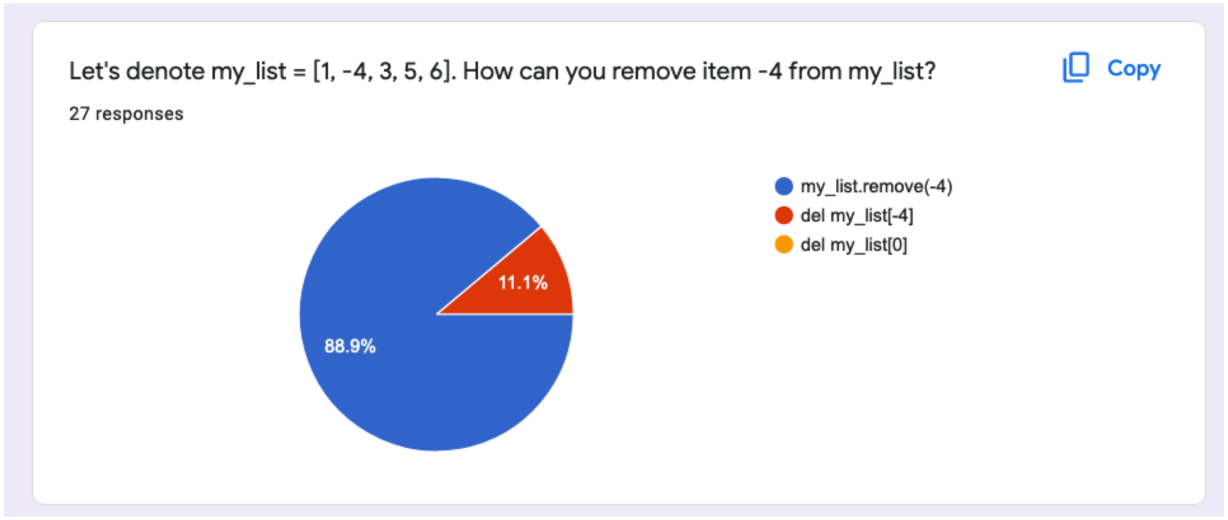
27 responses



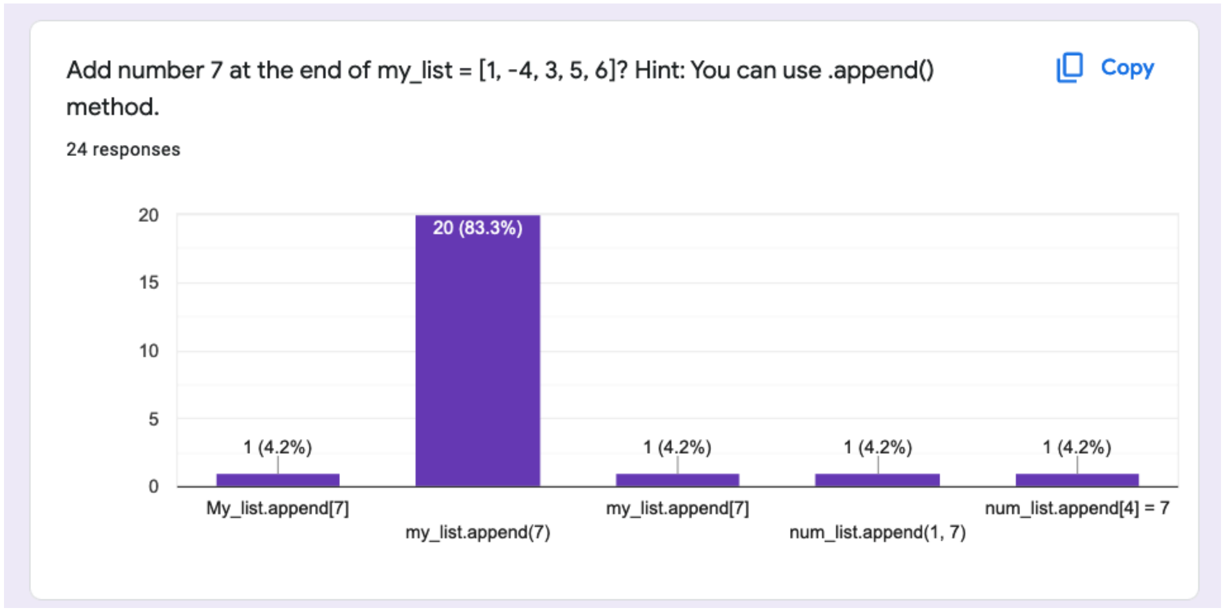
Slice is a span of items that are taken from a List or any sequence. Let's denote my_list = [1, -4, 3, 5, 6]. Use slicing operation to get 3,5,6 from my_list.

27 responses

Review: Poll from Tuesday's class

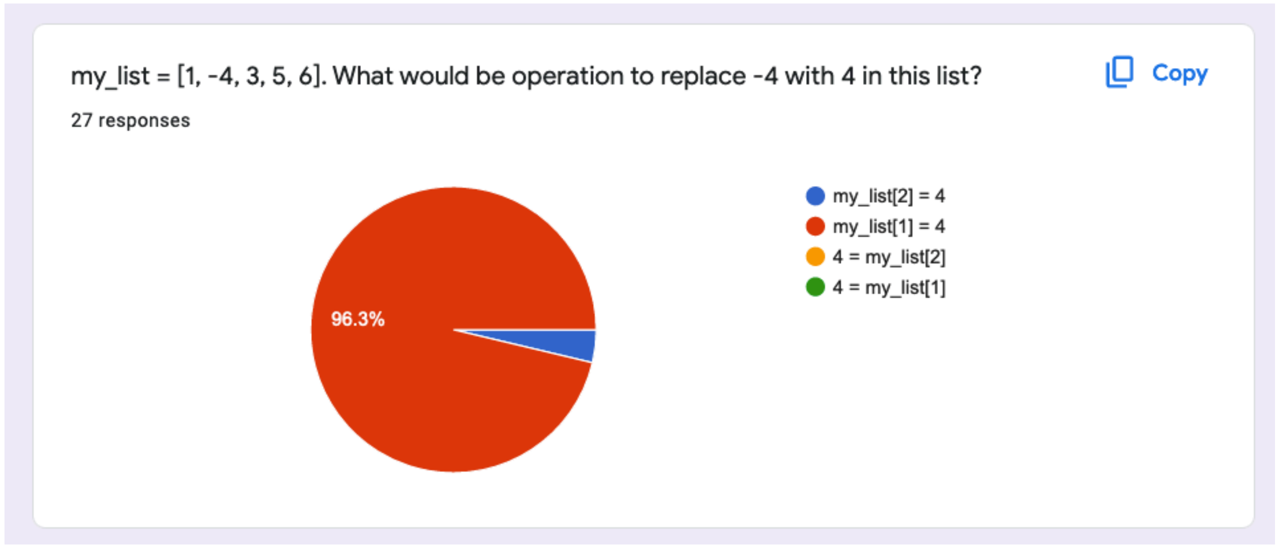

Let's denote my_list = [1, -4, 3, 5, 6]. How can you remove item -4 from my_list?

27 responses

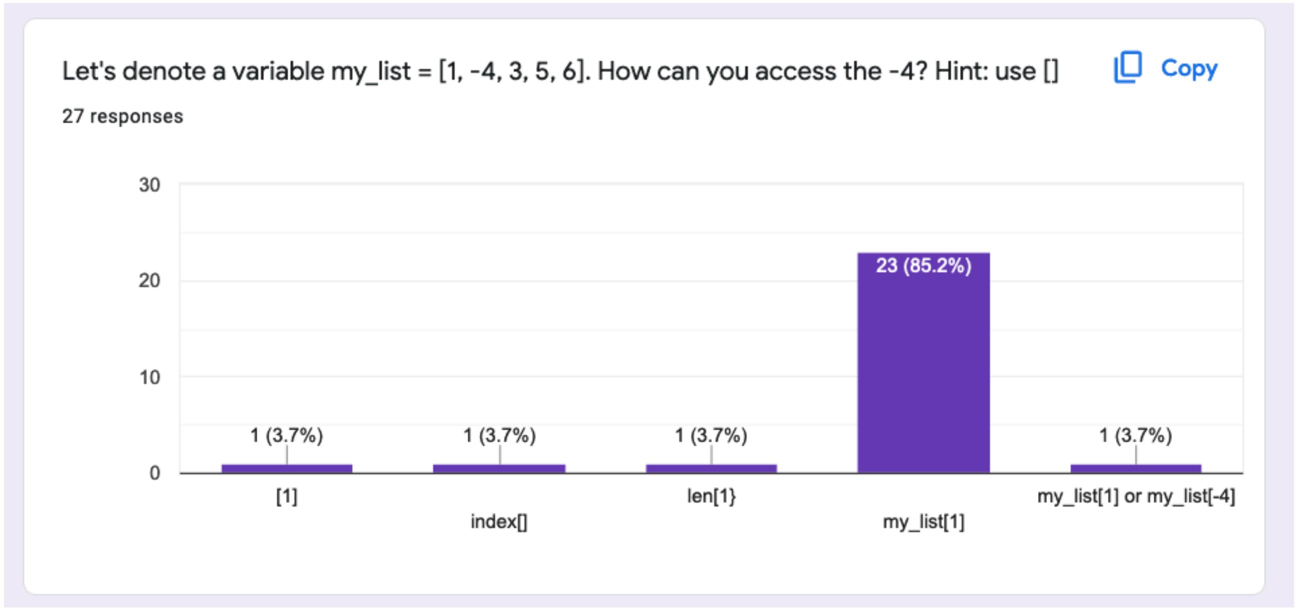

Add number 7 at the end of my_list = [1, -4, 3, 5, 6]? Hint: You can use .append() method.

24 responses

Review: Poll from Tuesday's class


my_list = [1, -4, 3, 5, 6]. What would be operation to replace -4 with 4 in this list?

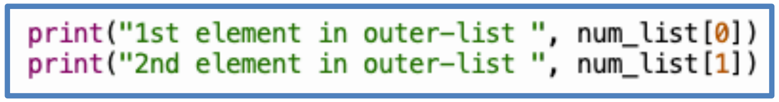
27 responses


Let's denote a variable my_list = [1, -4, 3, 5, 6]. How can you access the -4? Hint: use []

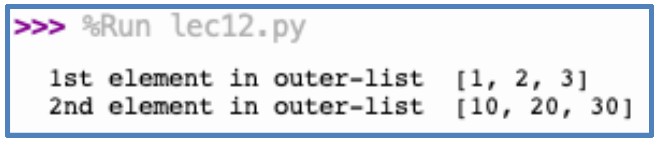
27 responses

Review: Accessing the ‘List of Lists’

- Access element in each dimension
    - outer dimension

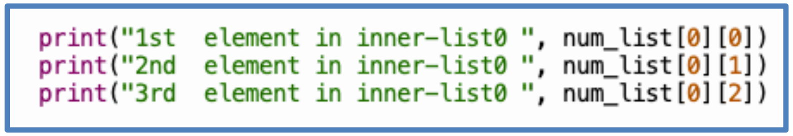


```
print("1st element in outer-list ", num_list[0])
print("2nd element in outer-list ", num_list[1])
```

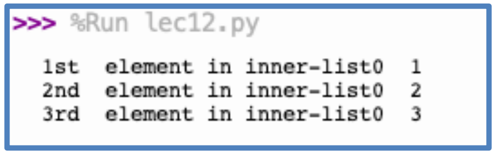


```
>>> %Run lec12.py

 1st element in outer-list  [1, 2, 3]
 2nd element in outer-list  [10, 20, 30]
```

- inner dimension



```
print("1st  element in inner-list0 ", num_list[0][0])
print("2nd  element in inner-list0 ", num_list[0][1])
print("3rd  element in inner-list0 ", num_list[0][2])
```

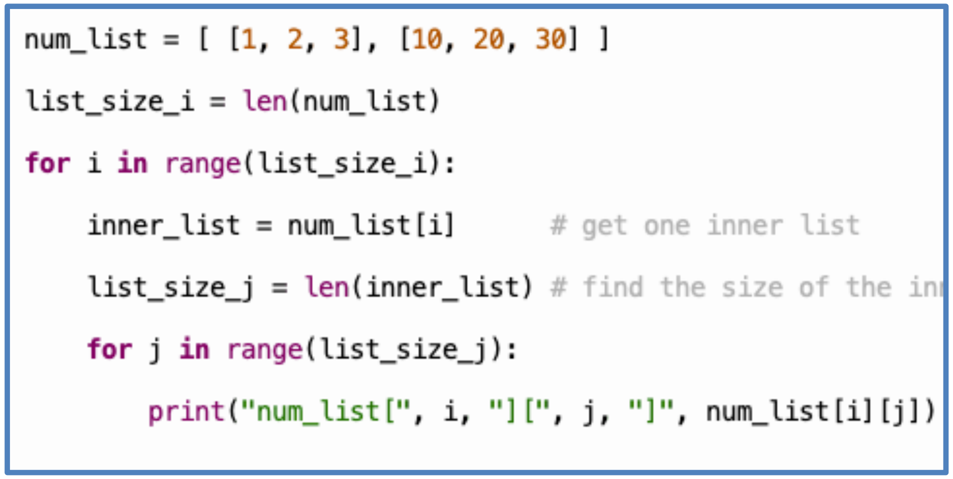


```
>>> %Run lec12.py

 1st  element in inner-list0  1
 2nd  element in inner-list0  2
 3rd  element in inner-list0  3
```

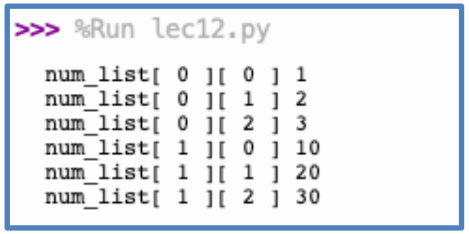
- **Step 1:** Create an index for each dimension
- **Step 2:** Nest loops
- **Step 3:** Access each element using indexing

Review: List of Lists and Nested Index Loops

Version 1 (more lines but easy to understand)

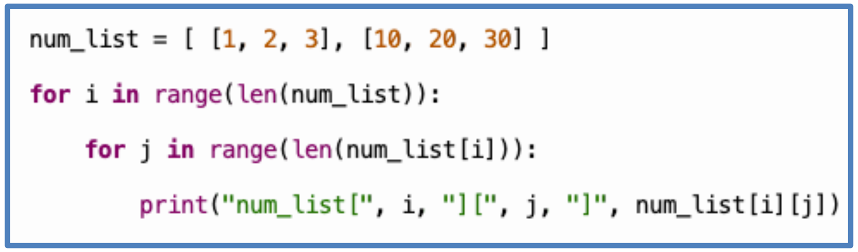


```
num_list = [ [1, 2, 3], [10, 20, 30] ]

list_size_i = len(num_list)

for i in range(list_size_i):

    inner_list = num_list[i]       # get one inner list

    list_size_j = len(inner_list) # find the size of the in

    for j in range(list_size_j):

        print("num_list[", i, "][", j, "]", num_list[i][j])
```

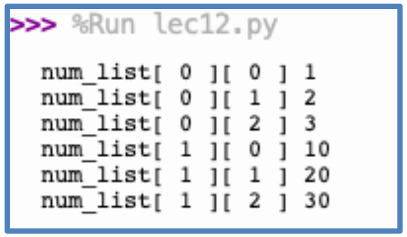


```
>>> %Run lec12.py

 num_list[ 0 ][ 0 ] 1
 num_list[ 0 ][ 1 ] 2
 num_list[ 0 ][ 2 ] 3
 num_list[ 1 ][ 0 ] 10
 num_list[ 1 ][ 1 ] 20
 num_list[ 1 ][ 2 ] 30
```

Version 2 (less lines of code)



```
num_list = [ [1, 2, 3], [10, 20, 30] ]

for i in range(len(num_list)):

    for j in range(len(num_list[i])):

        print("num_list[", i, "][", j, "]", num_list[i][j])
```



```
>>> %Run lec12.py

 num_list[ 0 ][ 0 ] 1
 num_list[ 0 ][ 1 ] 2
 num_list[ 0 ][ 2 ] 3
 num_list[ 1 ][ 0 ] 10
 num_list[ 1 ][ 1 ] 20
 num_list[ 1 ][ 2 ] 30
```

Assignment 3

- Post-midterm — focus will be more on assignments + final project
  - Assignments 3, 4 and final project

Assignment 3

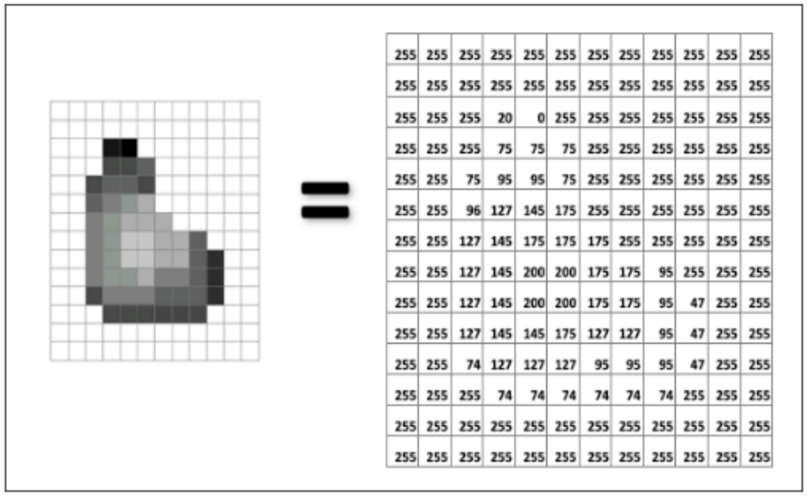
- Task 1 (List manipulation)
  - Removing invalid items from the color-triplet

- Task 2 (Dictionary manipulation)
  - Finding the mapping

Assignment 3: Task 1 (List manipulation)

Subtask 3 (30 points): Color Correction

Computer vision researchers (including myself) analyze images to find meaningful content in them. An image is commonly represented by a three-channel grid matrix containing integer numbers. The figure below shows one such channel of an image. Each integer number represents an intensity value. These intensity values ranges between **0** and **255**. A large number signifies a brighter intensity, while a low number corresponds to a darker intensity.



255	255	255	255	255	255	255	255	255	255	255	255
255	255	255	255	255	255	255	255	255	255	255	255
255	255	255	20	0	255	255	255	255	255	255	255
255	255	255	75	75	75	255	255	255	255	255	255
255	255	75	95	95	75	255	255	255	255	255	255
255	255	96	127	145	175	255	255	255	255	255	255
255	255	127	145	175	175	175	255	255	255	255	255
255	255	127	145	200	200	175	175	95	255	255	255
255	255	127	145	200	200	175	175	95	47	255	255
255	255	127	145	145	175	127	127	95	47	255	255
255	255	74	127	127	127	95	95	95	47	255	255
255	255	255	74	74	74	74	74	74	255	255	255
255	255	255	255	255	255	255	255	255	255	255	255
255	255	255	255	255	255	255	255	255	255	255	255

A toy image and computer's internal representation as a grid of intensity values.

Let us assume you are given these intensity values as list of triplets (red, green, blue). Unfortunately, some of these triples got corrupted and values outside the valid range (between 0 and 255). Your program will receive a list of lists. Each inner list is a triplet representing three color values: one for red intensity, one for green intensity, and finally one for the blue intensity. For example, [[100, 0, 0], [40, -156, 0], [0, 156, 0], [40, 156, 500], [0, 0, 250]] represents a list of five color-triplets. **You should write three separate functions as instructed below.** Each function will perform a separate operation and accordingly will return a different list.

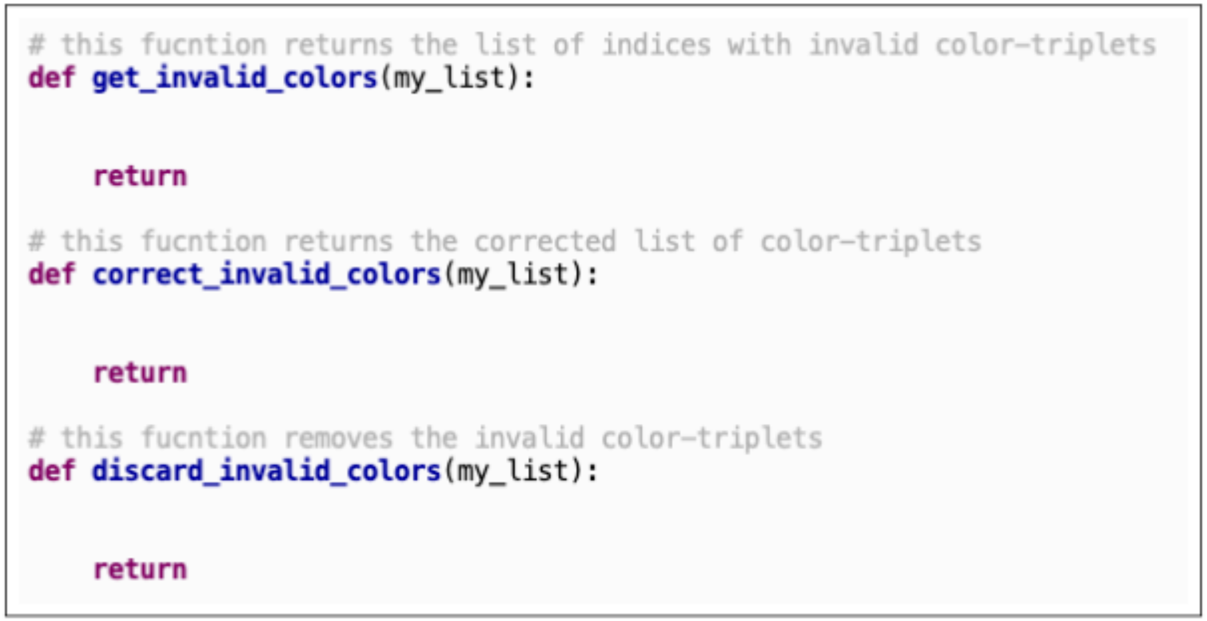
Assignment 3: Task 1 (List manipulation)

- *get_invalid_colors()*: If any intensity value inside a triplet has either a negative value (less than zero) or a positive value greater than 255, you should return the indices of those triplets inside the list. For example, given an input list of [[100, 0, 0], [40, -156, 0], [0, 156, 0], [40, 156, 500], [0, 0, 250]], your program should return list [**1, 3**] since indices at 1 and 3 contain two color-triplets with either a negative intensity or intensity value greater than 255.

- *correct_invalid_colors()*: If any intensity value inside a color-triplet has a negative value, you should replace that value with **0**. On the other hand, if any intensity value inside a color-triplet has a positive value greater than 255, you should replace that value with **255**. For example, given an input list of [[100, 0, 0], [40, -156, 0], [0, 156, 0], [40, 156, 500], [0, 0, 250]], your program should return [[100, 0, 0], [40, **0**, 0], [0, 156, 0], [40, 156, **255**], [0, 0, 250]].

- *discard_invalid_colors()*: If any intensity value inside a triplet has either a negative value (less than zero) or a positive value greater than 255, you should remove that color-triplet. For example, given an input list of [[100, 0, 0], [40, -156, 0], [0, 156, 0], [40, 156, 500], [0, 0, 250]], your program should return [[100, 0, 0], [0, 156, 0], [0, 0, 250]].

Assignment 3: Task 1 (List manipulation)



```python
# this fucntion returns the list of indices with invalid color-triplets
def get_invalid_colors(my_list):


    return

# this fucntion returns the corrected list of color-triplets
def correct_invalid_colors(my_list):


    return

# this fucntion removes the invalid color-triplets
def discard_invalid_colors(my_list):


    return
```

Figure: empty function definitions for the color correction task.

While writing your python program, you should consider using various list operations or methods (eg, *.append()*, *.remove()*, *.pop()*, *del*) as discussed during class. Empty python files have been uploaded, which you may find useful.

Topic

- Dictionary:
    - What is it?
    - Why do we need it?

Dictionary

- **List**: Access a position using **only numeric index**

```
student_id_list = [1002, 1003, 1004, 1005]
student_id_list[0]
student_id_list[1]
student_id_list[2]
student_id_list[3]
```

- **Dictionary**: Access an element using (eg number, string, character) as index (keys) to associate to something else (values)

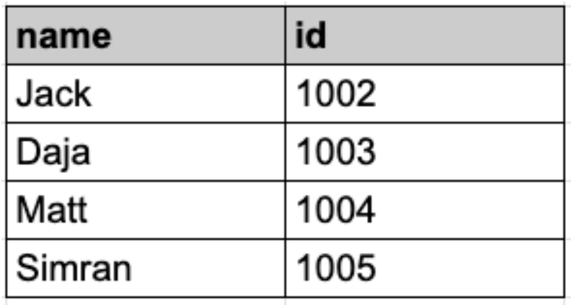
- Dictionary is an object that stores a collection of data
  - collection of key-value pairs
  - variable_name = { key_1 : value_1, key_2 : value_2, …, key_N : value_N }

id	name
1002	Jack
1003	Daja
1004	Matt
1005	Simran

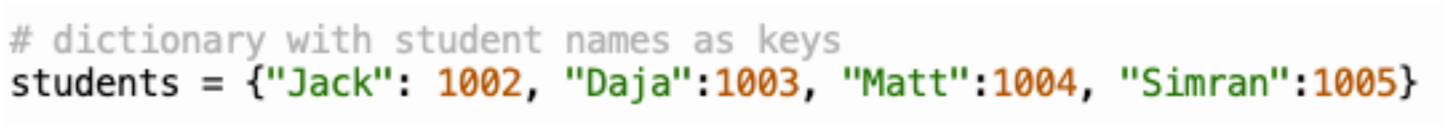
```
# dictionary with student ids as keys
students = {1002:"Jack", 1003:"Daja", 1004:"Matt", 1005:"Simran"}
```

Dictionary

- Dictionary is collection of key-value pairs or mapping between them
- variable_name = { key_1 : value_1, key_2 : value_2, ..., key_N : value_N }
- The keys **must be unique**
    - Unlike previous example, keys below are **names**



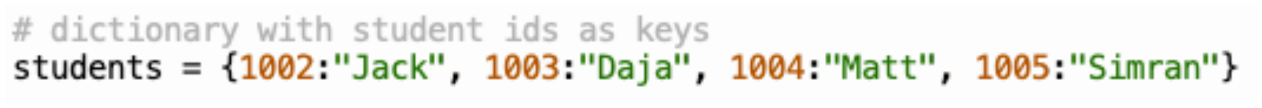
name	id
Jack	1002
Daja	1003
Matt	1004
Simran	1005



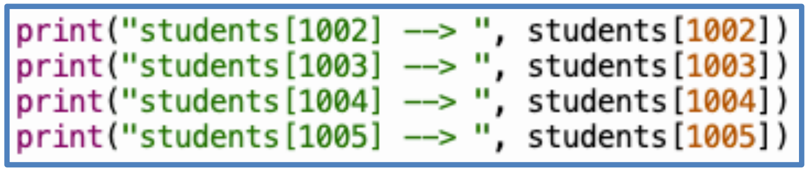
```
# dictionary with student names as keys
students = {"Jack": 1002, "Daja":1003, "Matt":1004, "Simran":1005}
```

Retrieving a Value from a Dictionary

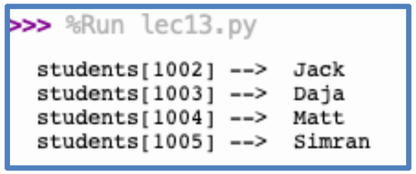
- Given *variable_name* = { key_1 : value_1, key_2 : value_2, …, key_N : value_N }
- Use the syntax: *variable_name*[key]
- Since keys are **unique**, accessing via a key will return a specific value



```
# dictionary with student ids as keys
students = {1002:"Jack", 1003:"Daja", 1004:"Matt", 1005:"Simran"}
```



```
print("students[1002] --> ", students[1002])
print("students[1003] --> ", students[1003])
print("students[1004] --> ", students[1004])
print("students[1005] --> ", students[1005])
```



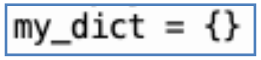
```
>>> %Run lec13.py

 students[1002] -->  Jack
 students[1003] -->  Daja
 students[1004] -->  Matt
 students[1005] -->  Simran
```

- Do you find any similarity with anything else?

Creating a Dictionary

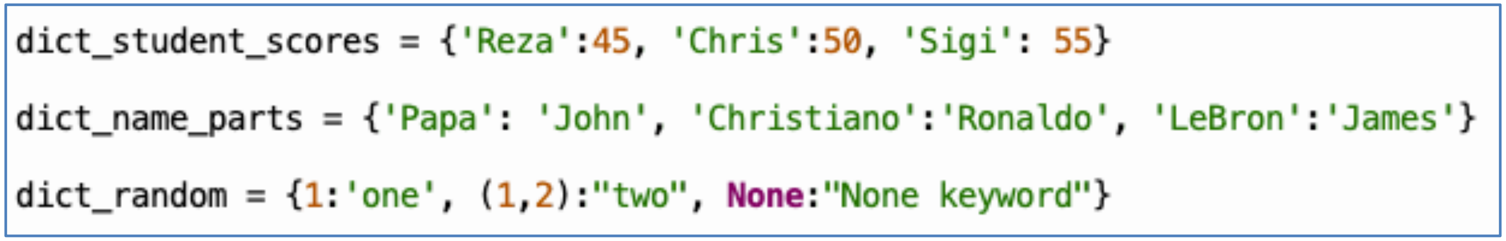
- There are several ways a dictionary can be created

- **Approach 1:** an empty dictionary



```
my_dict = {}
```

- **Approach 2:** with predefined entries

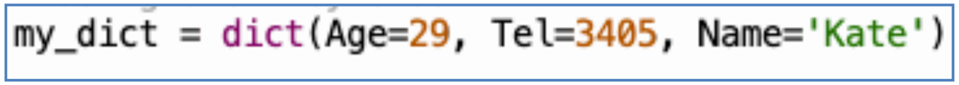


```
dict_student_scores = {'Reza':45, 'Chris':50, 'Sigi': 55}

dict_name_parts = {'Papa': 'John', 'Christiano':'Ronaldo', 'LeBron':'James'}

dict_random = {1:'one', (1,2):"two", None:"None keyword"}
```

Creating a Dictionary

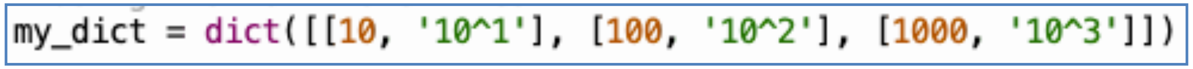
- There are several ways a dictionary can be created

- **Approach 3:** with **dict** function with keyword args, unquoted-strings



```
my_dict = dict(Age=29, Tel=3405, Name='Kate')
```

- **Approach 4:** with **dict** function and list of two entries



```
my_dict = dict([[10, '10^1'], [100, '10^2'], [1000, '10^3']])
```