

CMSC 201 Fall 2017

Lab 08 – 2D Lists

Assignment: Lab 08 – 2D Lists

Due Date: **During discussion**, October 23rd through October 26th

Value: 10 points (8 points during lab, 2 points for Pre Lab quiz)

This week's lab will put into practice the new concepts you learned about lists: lists of lists (two-dimensional lists), mutability, and passing lists to functions.

(Having concepts explained in a new and different way can often lead to a better understanding, so make sure to pay attention as your TA explains.)

Part 1A: Review – Traversing Lists

Remember from previous assignments that we can access the items in a list sequentially using a `while` loop. This process is called **traversing** and is used when we want to do the same thing to each element of a list. We can use a counter or looping variable as an index and increment this variable after each loop. In the body of the `while` loop we can include any code that we want to run based on the value of each element of the list.

In this example from Pre-Lab 5, the given code would traverse the `names` list below, printing out that each person is awesome:

```
# this variable can be called anything
# it starts at zero because that's the first index
index = 0
while index < len(names):
    print( names[index], "is awesome!")
    index += 1
```

Part 1B (Review) – Visualizing 2D Lists

In Python, two-dimensional lists (or 2D lists, as we'll call them from now on) are simply lists of lists. We've worked with lists of integers, lists of strings, and others – a list of lists isn't much different.

If we visualize the 2D list, we can think of each "sublist" as a row of the board and each element of a "sublist" as part of a column.

We initialize a 2D list as follows:

```
my2DList = [ [13,18,21], [30,40,50], [77,88,99] ]
```

We can draw the list as a table or matrix as shown below. (Note that the gray boxes represent the indices of the list. Remember, indexing starts at 0!)

	0	1	2
0	13	18	21
1	30	40	50
2	77	88	99

Part 1C (Review) – Accessing 2D Lists

We access 2D lists in a way very similar to the way that we access lists in general. The general format to access an element of a 2D List is:

`listName[row][column]`

For example, if we wanted to access the value 21 in the example above, we would use `my2DList[0][2]`

Notice that the row index always comes before the column index. If we think about how we accessed the value 21 above:

- (1) We move to the element of the larger list that is at index 0
 - Because each element is a list itself, `my2DList[0]` will be the first row (or “sublist”) of the 2D list
- (2) We can then index into this list and access its 3rd element by using the index 2: `my2DList[0][2]`
 - This gives us the 3rd element of the first list, the value 21

We already know that we can use `len()` to determine the number of items in a list. This means that `len(my2DList)` will be the number of rows in `my2DList`, not the total number of items. This is because the elements of `my2DList` are the “rows” of the list, not each individual element.

If we want the number of items in an individual row, we would use `len(my2DList[rowNum])` instead, because `my2DList[rowNum]` is simply a list of individual elements.

Part 1D (Review) - Mutating 2D Lists

We can change the contents of a list in two ways:

- (1) Assigning a new value to a current element of a list.
- (2) Appending to or removing from a list.

To update the contents of a list, we simply assign an a new value to a specific index. For example, we can run the following line of code on the list below:

```
my2DList[0][2] = 25
```

	0	1	2
0	13	18	21
1	30	40	50
2	77	88	99

After this code is run the list looks like this (the change is highlighted for you):

	0	1	2
0	13	18	25
1	30	40	50
2	77	88	99

We can also use `append()` and `remove()`, similarly to how we used them for one-dimensional lists. We can call these functions on the entire list to allow us to add or remove a row. We can also call them on the list at a specific index (a specific row) to add or remove from that row of the list. It is important to note that all rows of a 2D list do not need to be the same length.

For example, the following is a valid definition of a 2D list:

```
myUnbalancedList = [ ["A", 1], [2.3, 5.6, "hello"], \
                    ["pizza"] ]
```

	0	1	2
0	"A"	1	
1	2.3	5.6	"hello"
2	"pizza"		

Also notice that like with one-dimensional lists, all elements of the list do not need to be of the same type. This makes sense if we remember that we are dealing with a list of lists.

Here are some examples of using `append()` and `remove()`, on `my2DList`.

We last left our list like this:

	0	1	2
0	13	18	25
1	30	40	50
2	77	88	99

This line of code will add a new row to the end of our list:

```
my2DList.append( [101,121] )
```

	0	1	2
0	13	18	25
1	30	40	50
2	77	88	99
3	101	121	

This line of code will remove the value `40` from the second row (index 1). This causes the value `50` to shift over, and shortens the second row's length.

```
my2DList[1].remove(40)
```

	0	1	2
0	13	18	25
1	30	50	
2	77	88	99
3	101	121	

Note that `my2DList.remove(50)` would not work on the list. There is no value `50` in the main list – it only exists within the second row.

In the same way, the membership “`in`” will only look one “level” deep. If we asked Python: `13 in my2DList` it would return `False`. We would need to ask `13 in my2DList[0]` for the result to be `True`.

Part 2: Exercise

In this lab, you'll be downloading a file and completing it by writing the code necessary to complete two functions that make use of a 2D list.

The program you'll be finishing uses a two-dimensional list to store a number of sentences, with each word stored as a separate element of an interior list. Once complete, the program will print out the sentences, the length of each sentence, and the sentences' total length.

Tasks

Starting:

- Copy the `given_sent.py` file from Dr. Gibson's `pub` directory
 - It should have been renamed to be `sentences.py`
- Complete the file header comment at the top

Functions:

- Write the `while` loop to complete `printSentences()`
- Write the `while` loop for `tallyPassage()`
- Write the function call for `tallyPassage()`
- Uncomment the `print()` function call in `main()`

General:

- Run and test your code as needed
- Show your work to your TA

Part 3A: Downloading the File

First, create the `lab08` folder using the `mkdir` command -- the folder needs to be inside your `Labs` folder as well.

Next, copy a file into your `lab08` folder using the `cp` command.

```
cp /afs/umbc.edu/users/k/k/k38/pub/cs201/given_sent.py sentences.py
```

This will copy the file `given_sent.py` from Dr. Gibson's public folder into your current folder, and will change the file's name to `sentences.py` instead.

The first thing you should do in your file is complete the file header comment, filling in your name, section number, email, and the date.

Part 3B: Finishing the Functions

At this point, if you try to run the file, it will only print out the header for the student roster list, and nothing else. That is because the file is only partially completed for you.

You will need to update the file to complete the two function definitions, and one function call. If you open the file, you should see comments boxed in by # signs – these are where you need to write new code. Read the function header comments to see the details about the two functions.

You'll need to **think carefully** about the two-dimensional **sentences** list and how its contents are organized (and how you can access them). It might be helpful to draw a visual representation, and to label the indexes.

For **printSentences()** and **tallyPassages()**, you'll need to write a **while** loop. Make sure to **pay attention** to what the function does before and after your code, as well as things like variable names.

Once both functions are complete, you need to call **tallyPassages ()** down in **main()**, as well as uncommenting the **print()** statement below it. You shouldn't need to write any other code.

(See the next page for sample output.)

Here is some sample output of the completed program.
There is no user input, and yours should be identical once it's complete.

```
bash-4.1$ python sentences.py
Sentences:
-----
Here comes a good dog
True Grit is a great dog
True Grit is our UMBC mascot
True Grit deserves a tennis ball
Sentence 0 has 17 characters
Sentence 1 has 19 characters
Sentence 2 has 23 characters
Sentence 3 has 27 characters
The sentences have a total of 86 characters
```

Part 4: Completing Your Lab

Since this is an in-person lab, you do not need to use the `submit` command to complete your lab. Instead, raise your hand to let your TA know that you are finished.

They will come over and check your work – they may ask you to run your program for them, and they may also want to see your code. Once they've checked your work, they'll give you a score for the lab, and you are free to leave.

Starting:

- Copy the `given_sent.py` file from Dr. Gibson's `pub` directory
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Functions:

- Write the `while` loop to complete `printSentences()`
- Write the `while` loop for `tallyPassage()`
- Write the function call for `tallyPassage()`
- Uncomment the `print()` function call in `main()`

General:

- Run and test your code as needed
- Show your work to your TA

IMPORTANT: If you leave the lab without the TA checking your work, you will receive a **zero** for this week's lab. Make sure you have been given a grade before you leave!