15-110 Hw3 - Written + Programming
Fall 2024

Name:

AndrewID:

Complete the following problems in the fillable PDF, or print out the PDF, write your answers by hand, and scan the results. Also complete the programming problems in the starter file hw3.py from the course website.

When you are finished, upload your hw3.pdf to **Hw3 - Written** on Gradescope, and upload your hw3.py file to **Hw3 - Programming** on Gradescope. Make sure to check the autograder feedback after you submit!

Written Problems

#1 - Hw2 Code Review - 5pts

It isn't always good enough just to write code that works. It's also important to write code that is **clear** and **robust** - easy to understand and ready to handle a variety of inputs.

To help you learn how to write good code, we will have a few **code reviews** this semester where you will meet with a course TA to go over the code you wrote for a previous assignment. The TA will point out things you're doing well and areas where your code can be cleaner (even if it works already!).

To receive five points for the Hw2 code review, sign up for and attend a code review session with a TA the weekend after Week 6 of classes. We'll release more details about how to sign up for and attend these sessions via Piazza.

#2 - 2D Lists - 5pts

Can attempt after Lists and Methods lecture

The following function produces a 2D list. In the box below, write the value of `result`, the 2D list returned by `mysteryFunction(4, 5)`.

```python
def mysteryFunction(x, y):
    myList = []
    for i in range(x):
        innerList = []
        j = 0
        while j < y:
            if j <= i:
                innerList.append("o")
            else:
                innerList.insert(0, "-")
            j = j + 1
        myList.append(innerList)
    return myList

result = mysteryFunction(4, 5)
```

#3 - Recursion Tracing - 10pts

Can attempt after Recursion lecture

Trace the following code, then fill out the table below to indicate all the **recursive function calls** that are made and which **value** is returned by each function call. You may not need all of the rows.

```python
def sumOfDigits(n):
    if n == 0:
        return 0
    else:
        return n % 10 + sumOfDigits(n // 10)

sumOfDigits(4527)
```

Note: in the second column, make sure to indicate the actual returned **value**, not a set of arguments, a function call, or an expression.

Function Call	Returned Value
`sumOfDigits(4527)`	

#4 - Linear Search Debugging - 10pts

Can attempt after Recursion II & Search Algorithms lecture

The following three functions all attempt to implement the algorithm linear search, but with a twist: instead of identifying whether or not the target occurs in the list, each function returns the first index where the item occurs, or -1 if it never shows up. However, only one of the three implementations is fully correct.

Identify which of the three functions is correct, then explain on the next page both what is wrong with the other two and how they can both be fixed.

Note: for this code-reading problem, you are allowed (and encouraged!) to run the code directly to see how it works. Try using the debugging approaches you learned before!

```
def linearSearchA(lst, target):
    i = 0
    while i < len(lst):
        if lst[i] == target:
            return i
        i = i + 1
    return -1

def linearSearchB(lst, target):
    for i in range(len(lst)):
        if lst[i] == target:
            return i
        return -1

# Initially called with index = 0
def linearSearchC(lst, target, index):
    if lst[0] == target:
        return index
    elif len(lst) == 0:
        return -1
    else:
        return linearSearchC(lst[1:], target, index + 1)
```

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Which implementation is correct?

- ☐ linearSearchA
- ☐ linearSearchB
- ☐ linearSearchC

Why are the other two incorrect, and how can they be fixed? Be sure to identify which lines you would change and specifically what you would change them to.

#5 - Binary Search - 10pts

Can attempt after Recursion II & Search Algorithms lecture

In the following table, write out the recursive calls that our implementation of `binarySearch` from lecture would make while searching the given list for the given item. Make sure to write out the **function call**, not the result. You might not need to use all the rows.

For example, if you were to trace `binarySearch([1, 2, 3, 4, 5], 1)`, you'd get:
Recursive Call 1: `binarySearch([1, 2], 1)`
Recursive Call 2: `binarySearch([1], 1)`

Q1: Search for 5

Original Call	`binarySearch([1, 5, 8, 8, 9, 11, 11, 16, 18, 19], 5)`
Recursive Call 1	
Recursive Call 2	
Recursive Call 3	
Recursive Call 4	
Recursive Call 5	

Q2: Search for 14

Original Call	`binarySearch([0, 5, 7, 8, 9, 11, 11, 15, 15, 19], 14)`
Recursive Call 1	
Recursive Call 2	
Recursive Call 3	
Recursive Call 4	
Recursive Call 5	

#6 - Dictionary Keys and Values - 10pts

Can attempt after Dictionaries lecture

Given the following set of code:

```python
d = { "dog" : 4, "cat" : 7, "bird" : 10 }
d["axolotl"] = d["bird"] - 1
for k in d:
    d[k] = d[k] * 2
d.pop("dog")
```

What are the **keys** of the dictionary d after this code has run?

For each of the keys you listed above, what is its **value** associated with that key after the code has run?

Write a line you could add to the end of this code that would add the key-value pair ("frog": 99) to the dictionary d.

Programming Problems

For each of these problems (unless otherwise specified), write the needed code directly in the Python file in the corresponding function definition.

All programming problems may also be checked by running 'Run current script' on the starter file, which calls the function `testAll()` to run test cases on all programs.

#1 - `onlyPositive(lst)` - 10pts

Can attempt after Lists and Methods lecture

Write a function `onlyPositive(lst)` that takes as input a **2D list** and returns a new 1D list that contains only the positive elements of the original list, in the order they originally occurred. You may assume the list only has numbers in it.

Example: `onlyPositive([[1, 2, 3], [4, 5, 6]])` returns `[1, 2, 3, 4, 5, 6]`, `onlyPositive([[0, 1, 2], [-2, -1, 0], [10, 9, -9]]` returns `[1, 2, 10, 9]`, and `onlyPositive([[-4, -3], [-2, -1]])` returns `[ ]`.

#2 - `addToEach(lst, s)` - 10pts

Can attempt after References and Memory lecture

Write a mutating function `addToEach(lst, s)` which takes a list of strings `lst` and a string `s` and **mutates** the list so that every element has `s` concatenated to it. The function must return `None` once done. For example, if `a = ["how", "are", "you"]`, calling the function `addToEach(a, "yah")` will return `None`, but will also change a to hold `["howyah", "areyah", "youyah"]`.

#3 - `recursiveLongestString(lst)` - 10pts

Can attempt after Recursion lecture

Write a function `recursiveLongestString(lst)` that takes a list of strings as input and returns the longest string in the list. You may assume the list contains at least one element and there will not be a tie. This function must use **recursion** in a meaningful way; a solution that uses a loop or the built-in max function will receive no points.

For example, `recursiveLongestString(["a", "bb", "ccc"])` returns `"ccc"`, and `recursiveLongestString(["hi", "its", "fantastic", "here"])` returns `"fantastic"`.

Hint: what properties does the recursive result have if the function works as expected?

Another hint: consider what the **base case** for this algorithm should be. It isn't the usual list base case where the list is empty, because an empty list can't have a longest string. What should it be instead?

#4 - `getBookByAuthor(bookInfo, author)` - 10pts

Can attempt after Dictionaries lecture

Dictionaries are very good at searching for keys, but not so good at searching for values. Write the function `getBookByAuthor(bookInfo, author)` which takes two inputs. The first input is a dictionary `bookInfo` which maps book titles (strings) to author names (also strings). The second input is an author name (a string). The function returns the book associated with that author or `None` if the author does not appear in the dataset. You are guaranteed that no author will appear more than once in the dictionary.

For example, calling the function on `{ "The Hobbit" : "JRR Tolkein", "Dewdrop" : "Katie ONeill", "A Game of Thrones" : "George RR Martin" }` and `"Katie ONeill"` would return `"Dewdrop"`.

Hint: you basically want to implement **linear search** over a dictionary instead of a list. Make sure you use the right kind of loop for a dictionary!

#5 - `makeIMDB(actorList, movieList)` - 10pts

Can attempt after Dictionaries lecture

Write the function `makeIMDB(actorList, movieList)` that takes two lists, a list of actor names and a list of movie names (both lists of strings), and returns a dictionary mapping names of actors to names of movies. You may assume that the two lists match up, i.e., each actor is at the same index as their movie.

You should use a **loop** to construct the dictionary. You'll need to loop over both the `actorList` and the `movieList` *at the same time* to access the key and value together. To do this, use the **same loop control variable** on both lists in each iteration. Which type of loop will allow you to do this?

If a person occurs in `actorList` multiple times (in other words, if they were in multiple movies), you should map their name to the **first** movie they were paired with. For example, given the names `["Ni Ni", "Sofia Vergara", "Ni Ni"]` and the movies `["Suddenly Seventeen", "Hot Pursuit", "Love Will Tear Us Apart"]`, the function would return the dictionary `{"Ni Ni" : "Suddenly Seventeen", "Sofia Vergara" : "Hot Pursuit" }`.