ENGR 102 - Lab Assignment #7

Fall 2020

General course learning outcomes:

- demonstrate the use of basic programming techniques in the construction of computer programs, including techniques to collect, store, and manipulate data within a computer program.
- apply programming techniques to solve problems in engineering.
- complete a team programming assignment that ties together concepts learned in the class.

This week is a mixed practice, focusing on looping, but including: user-input/output, conditionals, lists, for-loops and/or while-loops. Do not use SymPy, and do not use "break".

Warm-ups:

Activity 1 *(10-minutes)*:

Create a list of strings, such as: ['arroyo', 'elephantine', 'toy', 'shines']. Write a Python program to count the number of strings where the string length is 2 or more, and the first and last character are the same.

Activity 2 *(10-minutes)*:

Accept a sentence as input, and calculate the number of times a certain letter (also user-supplied) is contained in that sentence.

Activity 3: The Expandables - to do in lab (team)

☑ *Use for and/or while looping structures in Python*
☑ *Use concept of tolerance in engineering problems*

The Maclaurin series expansion for 1/(1-x) on an interval from -1 < x < 1 is as follows:

$$\frac{1}{1-x} = \sum_{n=0}^{\infty} x^n = 1 + x + x^2 + x^3 + x^4 + \cdots + x^n$$

Write Python code which asks for input of a value of x on the interval -1 < x < 1, and which computes an approximation to 1/(1-x) using the using the series expansion summation. The summation should be continued until the term to be added to the summation is less than 10^{-6} in absolute value. Hint: Note that every term in the series is x raised to a power (i.e., the first two terms are simply $x^0=1$ and $x^1=x$).

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Activity 4: Rise of the Widget - to do in lab (team)

☑ *Store and write lists in Python, and loop through values.*

You manage a plant, and as a part of your duties, you measure production each day in number of widgets. You want a program where you can enter the number of widgets produced daily for an arbitrary number of days, and have reported whether production is rising or falling over various periods. Specifically, you would like the report to include ranges from 1-day intervals up to the maximum possible interval (determined from the user input).

For example, if the widget production was entered for 5 consecutive days, and the production levels were 13, 15, 17, 15, 18, you might output something like:

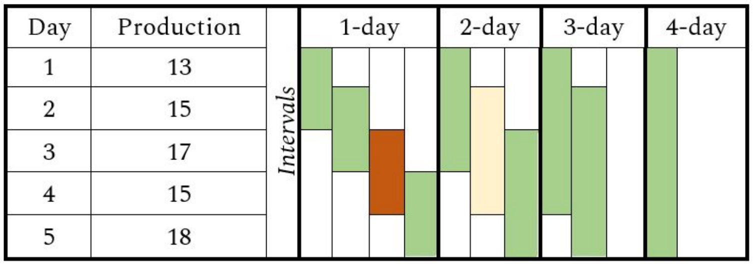
```
For 1-day intervals 75.0% were increasing and 25.0% were decreasing

For 2-day intervals 66.7% were increasing and 0.0% were decreasing

For 3-day intervals 100.0% were increasing and 0.0% were decreasing

For 4-day intervals 100.0% were increasing and 0.0% were decreasing
```

The first line reports the four one-day intervals, where Day 1-2 (13-15), Day 2-3 (15-17) and Day 4-5 (15-18) were increasing, and Day 3-4 (17-15) was decreasing.

The second line reports the three two-day intervals, where Day 1-3 (13-17) and Day 3-5 (17-18) were increasing, while Day 2-4 (15-15) was neither increasing nor decreasing.

The third and fourth lines report that both four-day intervals, Day 1-4 and Day 2-5 were increasing, and the maximum interval (Day 1-5) was increasing.

I've included a chart below to help you visualize what is being reported. The number of days of production input will affect the number of intervals to be calculated and the possible interval lengths.



Day	Production
1	13
2	15
3	17
4	15
5	18

A. Remember to plan! Consider exactly how you will make these computations. The looping in this problem is trickier than what you have encountered previously, and formatting the output may be a challenge for you. Remember to use the methods we have discussed for testing, and using incremental development.

B. Take input for an arbitrary number of days, and stop when the user enters a negative number. Be descriptive.

C. Your program output should report, for each possible interval, from 1 day to the maximum, what percentage of intervals had increasing production and what percentage had decreasing production. *Print the output with 1 digit after the decimal.*

There is more than one way to get one decimal place after the number. One option is for your team to look up and learn the command for formatting floating-point output *(zyBook 3.9 may be helpful here)*. Another option is for your team to come up with a set of steps to create this string, yourselves.

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Additional Practice *(Optional)*

AP-1:

Square each even number in a list, and cube each odd number.

AP-2:

Write a Python program to insert an element before every element in a list.

AP-3:

Insert an even number before every odd number in a list—but only if the number before the odd number isn't already even.

AP-4:

Write a Python program to print the numbers of a specified list after removing even numbers from it.

AP-5:

Check whether a list contains a specific sublist.

```
e.g., list_a= [1, 2, 2, 5, 3, 2], sub_list=[2,3]  → False
e.g., list_a= [1, 2, 2, 5, 3, 2], sub_list=[5,3]  → True
```

AP-6:

Remove duplicates from a list.

```
e.g., [1, 2, 2, 5, 3, 2]  → [1, 2, 5, 3]
```

AP-7: Cows and Bulls

Randomly generate a 4-digit number. Ask the user to guess a 4-digit number. For every digit that the user guessed correctly in the correct place, they have a "cow". For every digit the user guessed correctly in the wrong place is a "bull." Every time the user makes a guess, tell them how many "cows" and "bulls" they have. Once the user guesses the correct number, the game is over. Keep track of the number of guesses the user makes throughout the game and tell the user at the end.

Say the number generated by the computer is 1038. An example interaction could look like this:

```
Welcome to the Cows and Bulls Game!
Enter a number:
 >>> 1234
 2 cows, 0 bulls
 >>> 1356
 1 cow, 1 bull
 ...
```

Until the user guesses the number.