ENGR 102 - Lab Assignment #2B

Fall 2020

You are to write two programs (though one of them has 3 versions), as described below. Remember to document your code with comments, and print labels and units when applicable. When these programs are completed, submit all files to eCampus. Remember the appropriate header information.

Program 1

☑ *Create and use variables to store calculated or given values, and to store information that will be printed to the user.*

Begin with Program #1 of the previous assignment (1b). Convert that program to a new program that produces identical output. However, for each calculation, you are now to create variables for all values that are either *constants* or *values that might vary* in the calculation. As an example, if you previously had a line:

```
print(3+2)
```

you should change it to a sequence of assignments, such as:

```
a = 3
b = 2
c = a+b
print(c)
```

Please note the following:

a) Your print statements should each print just a single variable.
b) You should pick good names for your variables.
c) You do not have to perform the entire computation in one line; you can use multiple lines to perform the computation.
d) It is OK to introduce variables to hold values that are not a "final" value. For example, if you were computing the area of a circle, you might store the radius in one variable, then the radius squared in another variable, and then later multiply that by pi to compute the area.

As a reminder, your program was to print the following 7 lines:

a) Your name and UIN
b) A sentence giving some interesting fact about yourself
c) The voltage across a conductor with resistance 20 and a current of 5.
d) The kinetic energy of an object with mass 100 and velocity 21
e) The Reynolds number for a fluid with velocity 100 and kinematic viscosity 1.2, with characteristic linear dimension 2.5.
f) The energy radiated per unit surface area (across all wavelengths) for a black body with temperature 2200. Use 5.67 x 10-8 for the Stefan-Boltzmann constant.
g) The shear stress when a normal stress of 30 is applied to a material with cohesion 2 and angle of internal friction 35 degrees

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Program 2

☑ *Identify and create appropriate variables for use in a Python program.*
☑ *Perform linear interpolation based on three-dimensional values.*
☑ *Create nicely formatted output to the program user.*

In the earlier team project (Lab 02), your team created a program that interpolated between two values. This was a one dimensional (1D) interpolation, since you were interpolating only a single value, the distance on the track. You are now going to extend that program to linearly interpolate between two points in 3D.

Let's assume that each of the position variables (x, y, z) varies linearly with time (t). Therefore, time (t) is the independent variable in each case. This means we can perform linear interpolation three separate times to get what we need. This can be done in three steps: 1) linearly interpolate between (t_1, x_1) and (t_2, x_2) for t_0 with x_0 as the result; 2) repeat for (t_1, y_1) and (t_2, y_2) for t_0 with y_0 as the result; 3) repeat for (t_1, z_1) and (t_2, z_2) for t_0 with z_0 as the result. The result will be (x_0, y_0, z_0) associated with time t_0.

a) Write a program that takes two observed 3D positions at two points in time, and then calculates the 3D position at a third point in time. You should output the x, y, and z values for that position on separate lines. Begin by identifying the variables you will use, the names for those variables, and the computations that should occur for those variables. Then, write a program that will output the 3D position of the interpolated point on 3 separate lines. Save this as Program2a.

   For this initial program, store the following data values as variables:

   At time 13, the observed position was (1, 3, 7)

   At time 84, the observed position was (23, -5, 10)

   Find the position at time 50

   Example output (yours does not have to look identical):

```
Time of interest = 50 seconds
x0 = 12.464788732394366 m
y0 = -1.169014084507042 m
z0 = 8.56338028169014 m
```

b) Now, copy Program2a into a new program, Program2b. Modify the program as follows:

   - When outputting the position, follow the output by a line of dashes ("----------").
   - Instead of computing the interpolation at one point and printing the result, compute it at 5 points. Copy the portion of the code (cut and paste the code) that is needed to recompute the interpolation 5 times. You should now interpolate at the times in increments of 1 unit, starting at time 50 (i.e. at times 50, 51, 52, 53, 54), outputting the result each time. The line of dashes will separate each computation.

     Note: later we will see how we can do this more efficiently, without cutting-and-pasting code, but for now, cut-and-paste is fine.

   Example output, first two times only (yours does not have to look identical):

```
Time of interest = 50 seconds
x0 = 12.464788732394366 m
y0 = -1.169014084507042 m
z0 = 8.56338028169014 m
------------------------------
Time of interest = 51 seconds
x0 = 12.774647887323942 m
y0 = -1.281690140845071 m
z0 = 8.605633802816902 m
------------------------------
```

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c) Finally, copy Program2b into a new program, Program2c. Modify the program as follows:

- Create a variable for the starting time of interpolation, and another for the ending time of interpolation.
- Display the results from interpolation at 6 points, evenly spaced from the beginning time to the ending time, inclusive.
- Experiment on your own with assigning different values to those variables and verify that you are in fact interpolating correctly from one point to another.
- For the version you save and turn in, use variable values that show an interpolation from time 20 to 60.

Example output, first two times only (yours does not have to look identical):

```
Time of interest = 20 seconds
x0 = 3.169014084507042 m
y0 = 2.211267605633803 m
z0 = 7.295774647887324 m
------------------------------
Time of interest = 27.5 seconds
x0 = 5.492957746478873 m
y0 = 1.3661971830985915 m
z0 = 7.612676056338028 m
------------------------------
```