**ENGR 102**

**Lab #3B**

Activity: Writing your Programs – To Do individually, in lab or outside

You are to write the following programs, each of which should be done individually. However, you may talk with others in lab about how to go about doing each of them. Once the programs are written, you should create a single .zip file of all the programs and submit them.

**Program 1: [50 Points]**

This assignment is meant to give you practice with the request information-gather input-perform computation-output result program structure.

Begin with **Program #1** from the previous two individual assignment(s) **Lab # 2B**. You are to convert 4 of the calculations from that assignment into 4 new programs that each read in data from the user, and output the answer. You should use the same variables as before, but instead of just assigning values to each, you should input values as appropriate.

Please note the following:

1. Your input statements should provide a clear prompt asking the user for information.
2. Your output should be descriptive of what the result is.
3. You can make these 4 separate programs, (e.g. labeled as 1a, 1b, 1c, 1d).

Here are the 4 calculations to convert to interactive programs:

1. The kinetic energy of an object with a given mass and velocity
2. The shear stress for a given normal stress that is applied to a material with a given cohesion and angle of internal friction (see Mohr-Coulomb failure criterion)
3. The production of a well after a given number of days, for a given initial production rate, decline rate, and hyperbolic constant.
4. The average length of an M/M/1 queue with given arrival and service rates.

**Program 2: [50 Points]**

This program is meant to help you get practice with writing programs to perform more complex numerical calculations, and specifically to give you practice with vector calculations.

Write a program that calculates the angle between two points, as seen by an observer.

Your program should read in:

* The 3D position of an observer
* The 3D position of the first observed point
* The 3D position of the second observed point

Then, it should calculate and output, *in degrees*, the angle between the points from the viewer’s perspective. The steps for doing this are:

* Read in the points from the user. Assume the points will be some (x, y, z) coordinates.
* Calculate the two vectors from the observer to each of the observed points
* Normalize the vectors
* Calculate the dot product between the vectors
* Use that to calculate the angle between the two observed points. Note that the dot product of two normalized vectors gives the cosine of the angle between those vectors.
* Outputs the answer in degrees

Before beginning coding, you should stop and think briefly about the variables you will need for your program.