ENGR 102 - Lab Assignment #1B

Fall 2019

You are to write two programs, as described below. When these programs are completed, you should submit both files to eCampus. Be sure that each file contains the appropriate header information.

Program 1

☑ *Gain familiarity with finding engineering equations and writing simple Python programs to perform these calculations.*

FYI: in the Zachry Engineering Quad you will find 50 different equations relevant to many aspects of engineering. (ENGR102 Scavenger Hunt Part 1: photograph each of the following equations in the E-quad!)[1]

Write a program that outputs each of the following on subsequent lines. We will ignore units in these equations. Part of this task is to find the required formulas! (Write your sources down as comments in your code.) The program output should be the result of a calculation. For instance, if the task is to print the area of a square with side length 5:

Yes: `print(5*5)` (Python is calculating the value from the formula.)

No: `print(25)` (You calculated the value, and Python only prints the answer)

You should have 7 lines of output, giving each of the following. If you do not have a result for one of these, print an empty line, or the text "no answer" in that line.

a) Your name and UIN

b) A sentence giving an interesting fact about yourself

c) The voltage across a conductor with resistance 20 and a current of 5.
(Ohm's Law states that the current through a conductor between two points is directly proportional to the voltage across the two points.)

d) The kinetic energy of an object with mass 100 and velocity 21
(The Kinetic Energy of an object is the energy that it possesses due to its motion. The standard unit of kinetic energy is the joule.)

e) The Reynolds number for a fluid with velocity 100 and kinematic viscosity 1.2, with characteristic linear dimension 2.5.
(The Reynolds Number is an important dimensionless quantity in fluid mechanics that is used to predict flow patterns in different fluid flow situations. It is the ratio of inertial forces to viscous forces.)

f) The energy radiated per unit surface area (across all wavelengths) for a black body with a temperature of 2200. Use 5.67 x 10-8 for the Stefan-Boltzmann constant.
(The Stefan-Boltzmann Law describes the power radiated from a black body in terms of its temperature. Specifically, the total energy radiated per unit surface area of a black body across all wavelengths per unit time is proportional to the fourth power of the black body's thermodynamic temperature.)

g) The shear stress when a normal stress of 20 is applied to a material with cohesion 2 and angle of internal friction 35 degrees
(The Mohr-Coulomb Failure Criterion represents the linear envelope obtained from a plot of the shear strength of a material versus the applied normal stress. The general Mohr–Coulomb theory is a model describing the response of brittle materials, like concrete or rubble piles, to stresses (shear and normal). Most classical engineering materials follow this rule in at least a portion of their shear failure envelope.)

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[1] Only if you want to – no prizes associated with this. Actually it's hot outside; I don't want sweaty photos.

Program 2

☑ *Create computational Python programs and consider and evaluate limits numerically.*

You are to write a program that produces several evaluations. Later in the course, we will see other ways of doing this more efficiently, but for now you should perform these evaluations by creating a sequence of print statements that output the desired numbers.

Some functions are difficult to evaluate at particular values (e.g., where infinity or division by 0 are involved), but can be understood by evaluating them at values that approach 0 or approach infinity. You are going to investigate three of these. For the three functions listed below, your program should:

a) First, print out a line of text at the beginning stating what is being shown in the following lines.

e.g. print: This shows the function 5*x/(x-2) evaluated close to x=1

b) Second, print out a sequence of 6 numbers, representing evaluating the function at 6 different values.

e.g. evaluating 5*x/(x-2) at 1.1, 1.01, 1.001, … 1.000001 and outputting results would give:

-6.111111111111112
-5.101010101010101
-5.010010010010008
-5.001000100010001
-5.0001000010000105
-5.00001000001

Notice that the evaluation gets closer and closer to -5, in this case.

Function 1: $f(x) = \frac{\sin x}{x}$ (Not defined at $x = 0$, since sin(0) is 0, and thus it would be evaluating 0/0.)

You are to show calculations for the values of *f(x)* for values of x ranging from 1 to 10^{-5}.

Show the evaluation by successive evaluations of 1/10 of the previous value. That is, first show the value for sin(1)/1, then sin(0.1)/(0.1), etc.

Function 2: $g(x) = \frac{1-\cos x}{x^2}$ (Not defined at $x = 0$, since cos(0) is 1, and thus it would be evaluating to 0/0.)

You are to show calculations for the values of *g(x)* for values of x ranging from 1 to 10^{-5}. Similar to above, show the evaluation by successive evaluations of 1/10 of the previous value.

Function 3: $h(x) = \left(1 + \frac{1}{x}\right)^x$ (Cannot be directly evaluated at infinity. Because, well, it's infinity.)

You are to show calculations for the values of h(x) for values of x ranging from 1 to 10^5. Show the evaluation by successive evaluations of 10 times the previous value. (i.e. evaluate at values of 1, 10, 100, etc.)