In this assignment we will explore computing derivatives via different methods.

As usual, you will be judged by the correctness of the answer (50%), the quality of the code (30%), and the quality of the plots (20%).

Problem 1.
Write a python program that computes the absolute error (ie, abs(truth – computed)) of the derivative of the function f(x) = x**3 – 5*x + 2 when evaluated by the forward and central difference method. Use this to create two plots:

1) the plot of the exact value of the derivative over the range -5 to 5, in steps of 0.01. Overlay the approximation using the forward and central difference method.
2) The plot of the error in the approximation from the forward and central difference method.

3) write a function that evaluates f(x) = x**3 – 5*x + 2
4) write a function that evaluates the analytic derivative of f(x)
5) write a function that computed the forward difference of f(x), as a function of h
6) write a function that computes the central difference of f, as a function of h

Problem 2.
A simple harmonic oscillator is defined by the function

Position(t) = (1 meter)*sin(2 pi * (0.02Hz)* t)

A sensor measures the position of this oscillator at 100 Hz over 100 seconds. Like all sensors, it has some noise associated with it. This data can be found in the text file provided to you, with two columns, time and position.

For this problem, we are interested in the velocity of the oscillator, ie the derivative of the position.

1) Calculate the analytic derivative of the function above over the range of the sensor.
2) Write a program that reads in this data and calculates the derivative using the forward and central difference method. Plot this against the analytic derivative.
3) Does the analytic derivative match the computational derivative? What is going on?
4) Figure out a way to clean up the data in a way that gives more reasonable agreement between the analytic and computational derivative.