Homework 7 **ENGR 130, AU 23**

This assignment has two coding questions and one video to watch and respond to. Submit the code as a .m file and your question responses as a .pdf. Follow all instructions in the Assignment Submission Guide posted in the Canvas Resources area. Failure to do so will result in a reduced (or possibly zero) grade.

Question 1 (6 points)

The code found in the file `HW7_buggy_trajectory` was written in response to the prompt below. However, there are at least 6 errors in the code that prevent it from functioning as intended. Fix the code so that it runs and executes as intended. For each bug that you identify and correct, insert a comment that begins with %*** explaining what the error was.

Prompt: A package of humanitarian aid supplies is being dropped from a plane. The plane and package are flying at a horizontal velocity of v_x = 200 m/s at an altitude of y_o = 1000 m when the package is released. Write a MATLAB script to analyze the path of the package from the moment it is dropped until it reaches a height just under 185 m, where its parachute will deploy. The script should calculate the x (horizontal) and y (vertical) coordinates for every 0.1 seconds until the package passes below 185 m. The following relationships can be used to find the coordinates t seconds after the release:

$$x = v_x t \qquad\qquad y = y_o - \frac{1}{2} g t^2$$

where g is the acceleration due to gravity.

The script should also display a message depending on the horizontal distance traveled by the package between when it is released until parachute deployment. If it travels less than 1400 m, it deploys in Zone 1; if it goes between 1400 and 2800 m, it deploys in Zone 2; and anything over 2800 m is Zone 3.

Question 2 (8 points)

A wind turbine manufacturer wants to market three of their designs to community centers in a multi-state area. They have asked a team of their engineers to determine if the turbines will be capable of generating enough power for this application. The engineers have written MATLAB code focusing on two aspects of the analysis:

1) The turbine must be able to produce power at least one standard deviation above the average daily amount of power required for the center.
2) The amount of power that can be generated depends on many characteristics of the turbines, but of course also depends on the wind speed. The engineers have determined that wind speeds in the region tend to average between 5 and 13 m/s.

The code written to perform this analysis is in the file `HW7_buggy_turbines.m`, but it does not work as intended due to some coding errors. The code is supposed to do the following:

- Load data from a file (`watts.mat`) that contains the power in watts used by a particular community center each day over the past year.
- Calculate and display the daily average power needed by the community center.
- Calculate and display the standard deviation of the power needed. The formula for computing standard deviation, s, within a data set is:

$$s = \pm\sqrt{\frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n}}$$

- where n is the number of data points, x_i are the individual data points, and $\bar{x}$ is the average of the data.

- Calculate and display the minimum power that must be generated by the turbine
- Calculate the power that each of the three turbine designs can generate for wind speeds between 5 and 13 m/s, according to the following relationship (which takes into account inefficiencies in the system):

$$P_{wind} = \frac{1}{6}\rho A V^3$$

  where P is power (in W), ρ is density of the air, 1.225kg/m^3, A is the cross-sectional area of the turbine blades (in m^2), and V is the wind speed (in m/s). The three turbines under consideration have cross-sectional areas of 10 m^2, 70 m^2, and 150 m^2.
- Plot the power generated vs. wind speed for each of the three designs on one graph.

Fix the code so that it runs and executes as intended. The only rule is that you may not remove any element-by-element vector operations. For each bug that you identify and correct, insert a comment that begins with %*** explaining what the error was. There are 8 bugs in the code.

Question 3 (5 points)

Watch the TedTalk linked below ("Where Good Ideas Come From" by Steven Johnson) and for each question below write a response of a few sentences. The length of the video is about 17.5 minutes.

https://www.ted.com/talks/steven_johnson_where_good_ideas_come_from

1) What is one point that the speaker made that was particularly impactful for you? Why did it make an impression on you?
2) What actions will you take, based on the content of this video, to help your teams develop innovative ways to solve problems or create designs?