```
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% ENGR 130 Homework 12
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```

Problem 1

1. *What is one point that the speaker made that was particularly impactful for you? Why did it make an impression?*

I was particularly impacted by what she said regarding being wrong in school. I was consistently trying to get everything right and even the slightest mistakes made me start to freak out. "When we get something wrong, we think there's something wrong with us" really spoke to me. Almost all of my high school friends thought like this, and it took us a while to get over this feeling. It wasn't a healthy mindset, but there was something so negative associated with being wrong that none of us wanted to break free of it. I saw this reflected in other people in the school where it would impact their friendships and interactions with other people. They would never want to discuss problems with group members or accept anything under a perfect score. They would assume the people on the other side of arguments are ignorant, just like the speaker stated. Schulz very accurately described common beliefs at my high school that many people around me experienced, which is why so much of what she said made a strong impression on me.

2. *What actions will you take, based on the content of this video, to help optimize your approaches to problem solving with other students in future courses or on project teams?*

Going into future situations with groups that involve problem solving, I will be sure to be more accepting of being wrong, and encourage those around me to be more willing to accept the feeling as well. I know that being wrong is a part of who we are as people, it is important to accept this. I will continue to challenge people's beliefs and stand up for what I believe is right, but I will also be sure to accept that it is possible that I am standing up for something that is incorrect, and will do my best to educate myself and get on the right side of whatever topic is being discussed. It is important to challenge beliefs, but also equally important to be open to my own personal beliefs being challenged, and I will definitely bring this to future group projects I am involved in.

Problem 3

A student at CWRU is experimenting on minecraft's laws of physics. They are testing on a falling arrow from various heights in hopes to determine the terminal velocity of an arrow, among many other items. They have seen videos online that claim that it is 100 m/s, and they are looking to prove that belief in this case.

The experiment is run as follows. A hopper system is set up to send items into a chest to act as an in-game timer. The arrow is first dropped from 10000 blocks, then 20000, then 30000. A single block in minecraft corresponds to 1 meter, and each item passed through a hopper corresponds to 0.4 real-world seconds (i.e. 1 item = 0.4 s). In these experiments, the in-game timer used lightning rods passed through the hopper, so 'rods' is used to denote this in the script.

The student is looking to determine the terminal velocity of the arrow and plot its time vs. height data using MATLAB. They are looking to use functions that can take their experiment data as an input as well as a title for the plot, as they want to model many different types of items using this script. Terminal velocity can be found simply by dividing the change in height by change in time, but they would like to use a linear fit model to survey all of the data points. The code should:

- Call a general experiment data function that takes the height data, in-game timer results, and a string variable as inputs, sending the real-world time and terminal velocity to the script as outputs
- The experiment data function should
  - Calculate the real-world time data
  - Plot the data in the format time vs. height to show a positive correlation between the two variables, and the plot should be properly labeled
  - Call a separate Terminal Velocity function
- The terminal velocity function should
  - Check to see if the height and time data are the same size. This should occur by finding the number of rows and columns in each variable, and sending an error if either the number of rows are different or the number of columns are different
  - Calculate the terminal velocity of the object by using a linear fit model, using the first term in the model as the terminal velocity
    - It is important to remember the preconceived terminal velocity of the arrow, as the code should hopefully output something close to or equal to this value

****The code should be applicable to any experiment done in minecraft, so the title of the plot should be variable and using less or more than 3 data points should not disturb how the code functions*

The student got sidetracked halfway through writing the code, and became too engrossed by a minecraft village to write code properly, so there are 5 errors preventing the code from running as intended.

The student's code can be found in the 2nd submitted file, or on the next pages of this document.

Student's Code with Errors

```
%% Problem 3 Code with Errors
clc;
clear;
close all;

% Input Trial Results
height = [10000 20000 30000];
arrow_rods = [262 512 762];

% assign a plot label to send through the function call
title_arrow = "Time Taken for an Arrow to Fall";

% Determine the data for the arrow experiment data
[arrow_time, arrow_terminal] = experiment_data(height, arrow_rods,
'title_arrow');

%% Problem 3 Functions with Error
function [real_time, terminal_velocity] = experiment_data(height, rods, str)
% This function determines the time vector for height and the items
% Terminal
% Format of call: experiment_data(height, rods)
% Inputs: 3 values
%       height - vector of heights the subject was dropped from
%       rods - number of rods outputted based on height data
%       str - string variable for graph name
% Outputs: 2 values
%       time - calculated time vector for the heights
%       terminal_velocity - terminal sped obtained by the object

% Each item pumped through a hopper takes 0.4 seconds
real_time = 0.4*rods;

% plot the height vs the actual time data
plot(real_time, height)
xlabel(Time (s))
ylabel('Height (m)')
title(str)

% use the terminal velocity function to calculate the terminal velocity
terminal_velocity = terminal_v(heihgt, real_time);
end
```

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```matlab
function terminal = terminal_v(height, time)
% This function determines the terminal velocity of a data set
% Format of call: terminal_v(height, time)
% Inputs: 2 vectors
%       height - numerator of slope/velocity unit
%       time - denominator of slope/velocity unit
%  ex. height in meters, time in seconds -> v = m/s
% Output: 1 value
%       terminal - terminal velocity of the object in question

% check to see if the vectors are equal length
[rowx, colx] = size(height);
[rowy, coly] = size(time);
if (rowx ~= rowy) && (colx ~= coly)
   error('Please Use Vectors of equal Dimensions.')
end

% Determine the line of best fit for the data
linear_coef = polyfit(height, time, 1);
terminal = linear_coef(1);
end
```