https://github.com/Christian-Martens-UNCC/ECGR-4105/tree/main/Homework_0-Linear_Regression

Problem 1:

1. For explanatory variable 1, $y = 5.92784428 - 2.03830369x_1$
   For explanatory variable 2, $y = 0.73605389 + 0.55761016x_2$
   For explanatory variable 3, $y = 2.87138935 - 0.52046993x_3$

2.

Fig. 2 - Linear Regressions for Fig.1

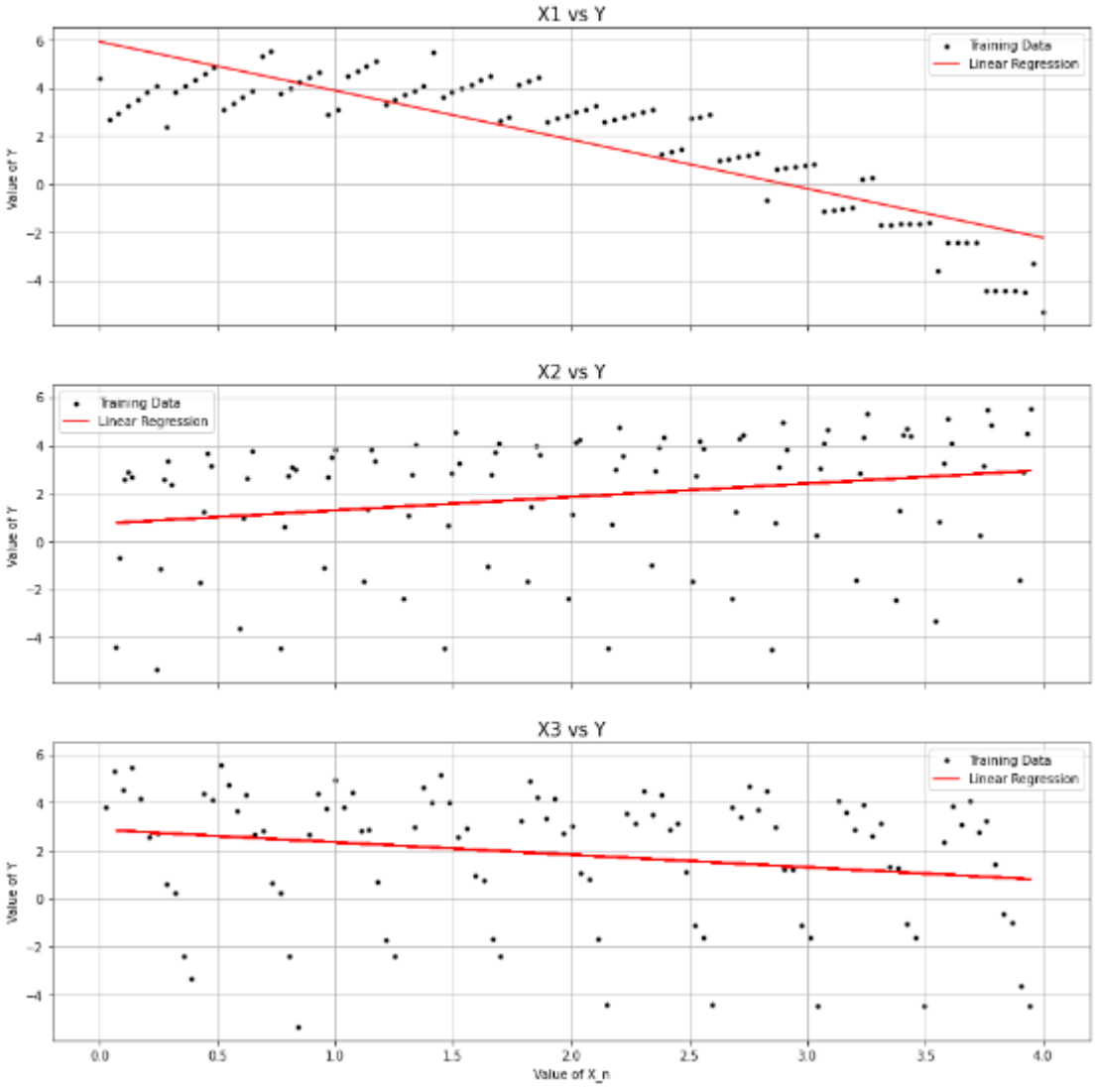
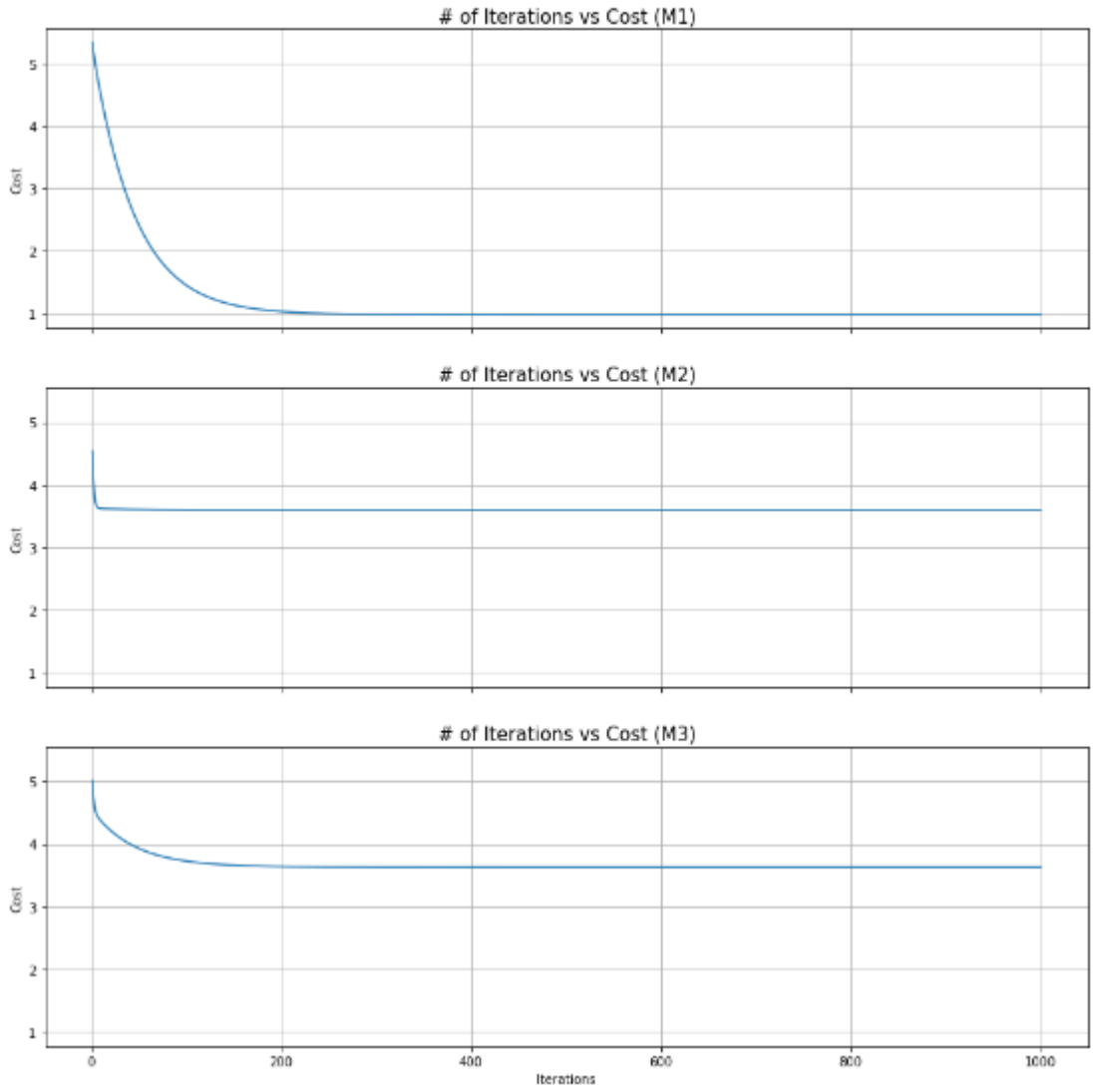


Fig. 3 - Number of Iterations VS Cost Function



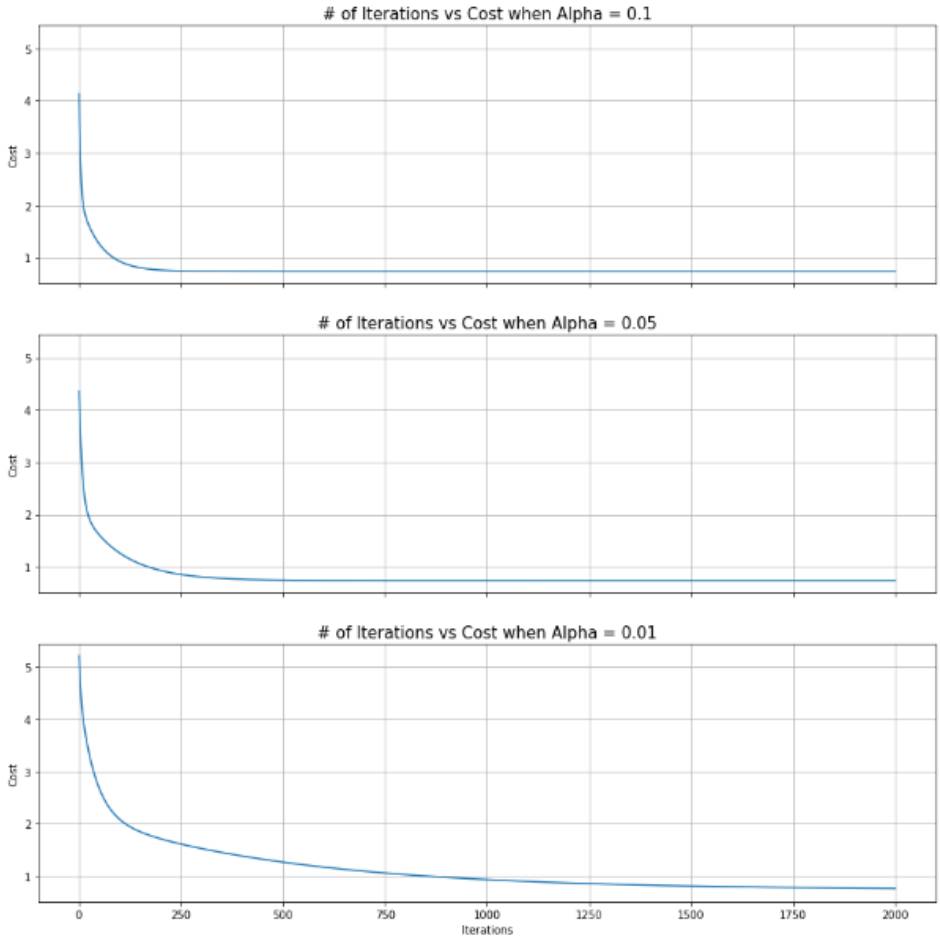
3. The first explanatory variable has the lowest loss/cost for explaining the output Y.
4. With the learning rates that I used (0.2, 0.1, 0.05, and 0.01), none of the losses, given a high count of iterations, varied. However, this is not always the case and, depending on the complexity of the data being used, sometimes a higher value for the learning rate can cause the loss function to not converge. Additionally, it was found that the higher learning rate models needed less iterations to converge to the optimal cost function.

Problem 2:

1. The best linear model that I found satisfies the equation $y = 5.31416716 - 2.00371927x_1 + 0.53256334x_2 - 0.26560186x_3$

2.

Fig. 7 - Number of Iterations VS Convergence of the Cost Function (M4) with Variable Alphas



3. With the learning rates that I used (0.1, 0.05, and 0.01), I found that the loss function when the learning rates equated to 0.1 and 0.05 equated. The loss function of the 0.01 learning rate function was slightly greater, but this is likely due to it not having enough iterations to reach the loss convergence of roughly 0.7385. Additionally, it was found that the higher learning rate models needed less iterations to converge to the optimal cost function.
4. The predicted values for Y given the following inputs are:

   [1, 1, 1] => 3.5774093686567574 ~= 3.57741

   [2, 0, 4] => 0.24432117148325494 ~= 0.24432

   [3, 2, 1] => 0.10253417186972869 ~= 0.10253