**Homework 1**

GitHub: <https://github.com/pballou/ECGR_4105/tree/master/Homework/homework_1>

1. No pre-processing. Part a trained on only 6 input variables, and part b used 11. The loss is huge because there was no input scaling, and I had to use a very small alpha
   1. alpha = .00000000001

Training cost: 1606259143218.0923

Testing cost: 1944119106864.634

Chart

Description automatically generated

* 1. alpha = .0000000001

Training cost: 1606703724154.2678

Testing cost: 1940242093479.1543

Chart

Description automatically generated with medium confidence

1. Used min max for normalization and standard scaler for standardization
   1. Part a: While standardizing and regularizing produced much better results than problem 1, the standardized set produced less loss than the regularized.
      1. Standardized results

Standard scaler training cost: 8.603522950138437e-11

Standard scaler testing cost: 9.390932165456731e-11

Chart

Description automatically generated

* + 1. Regularized results

Min max training cost: 0.0005081286497741986

Min max testing cost: 0.0007631190873710804

Chart, line chart

Description automatically generated

* 1. Part b: While standardizing and regularizing produced much better results than problem 1, again, the standardized set produced less loss than the regularized.
     1. Standardized results

Standard scaler training cost part b: 6.462262312601764e-10

Standard scaler testing cost part b: 7.131091466141552e-10

Chart

Description automatically generated with medium confidence

* + 1. Regularized results

Min max training cost part b: 0.001434780826566402

Min max testing cost part b: 0.0015886939687538653

Chart, line chart

Description automatically generated

1. This problem was the same as 2, except I added penalty parameters to the gradient descent function
   1. Part a: Adding the penalty parameters actually made the loss increase slightly compared to 2a. I think the original model was optimally trained for this dataset already, so adding the penalties probably made it underfit. The standard scaler produced a lower loss than the min max in part a and b.
      1. Standardized results

Standard scaler training cost: 1.1257937437554153e-09

Standard scaler testing cost: 1.2092123592210432e-09

Chart

Description automatically generated

* 1. Part b: The standard scaler produced a lower loss than the min max, and again, overall was slightly worse than 2b
     1. Standardized results

Standard scaler training cost part b: 2.8337931624083455e-09

Standard scaler testing cost part b: 2.9944181125407805e-09

Chart

Description automatically generated with medium confidence