|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | L1 | | | L2 | | |
| Lambda | Ein | Eout | Zeros | Ein | Eout | Zeros |
| 0 | 0.079 | 0.103 | 8 | 0.079 | 0.103 | 8 |
| 0.0001 | 0.079 | 0.098 | 8 | 0.079 | 0.103 | 8 |
| 0.001 | 0.077 | 0.093 | 13 | 0.078 | 0.093 | 8 |
| 0.005 | 0.081 | 0.089 | 16 | 0.076 | 0.098 | 8 |
| 0.01 | 0.09 | 0.079 | 18 | 0.084 | 0.098 | 8 |
| 0.05 | 0.14 | 0.103 | 32 | 0.112 | 0.117 | 8 |
| 0.1 | 0.188 | 0.136 | 37 | 0.124 | 0.121 | 8 |

(1c)

For the L1 regularizer, as the weight of the regularizer increased, the Ein and Eout initially decreased and then increased. The regularizer initially reduced overfitting in the training set which in turn reduced error in the testing set. This can be seen as the Ein increases while the Eout decreases for Lambda values of 0.001, 0.005, and 0.01. As the Lambda weight increases, the number of zeros in the resulting weight vector also increased.

The L2 regularizer also decreased Ein and Eout as the weight of lambda increased. The number of zeros remained the same for all weights of lambda, as the L2 does not place a weight on the number zeros. This regularizer did not decrease Eout as much as the L1, but did increase Ein more, indicating that this regularizer did not reduce overfitting as much.