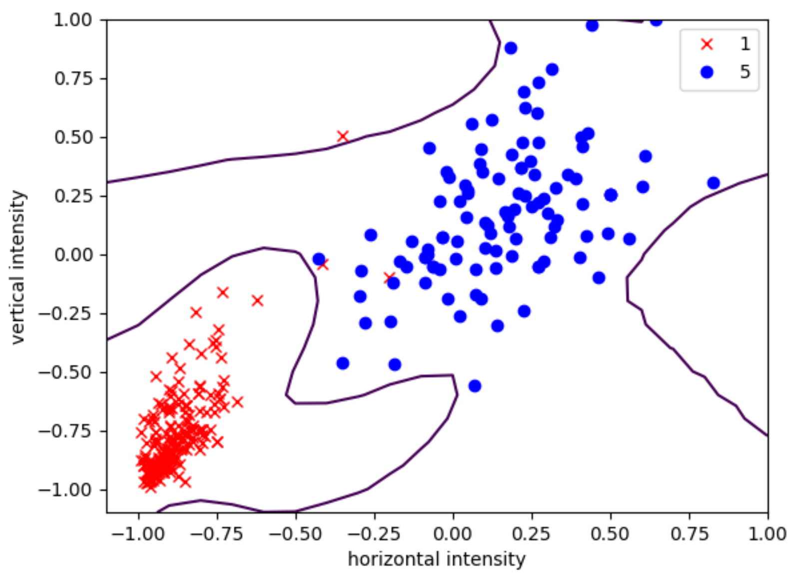
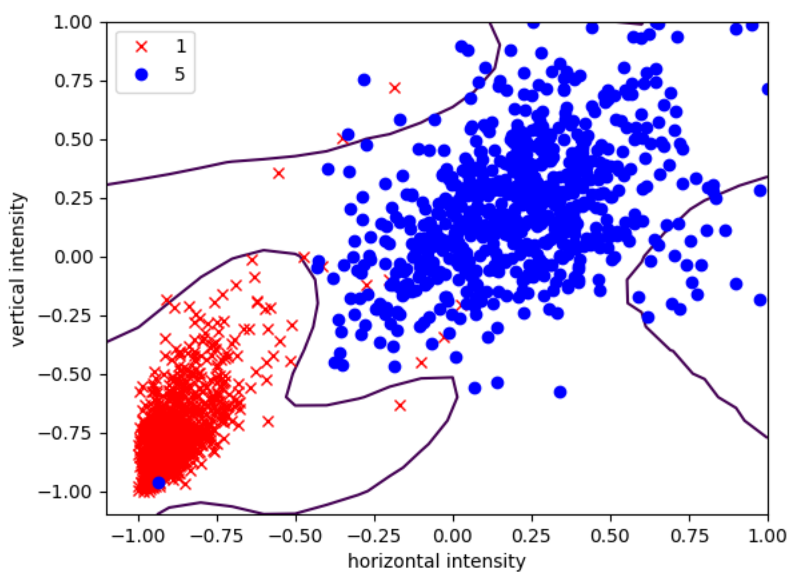
1. The dimensions of Z are 45
2. training data:

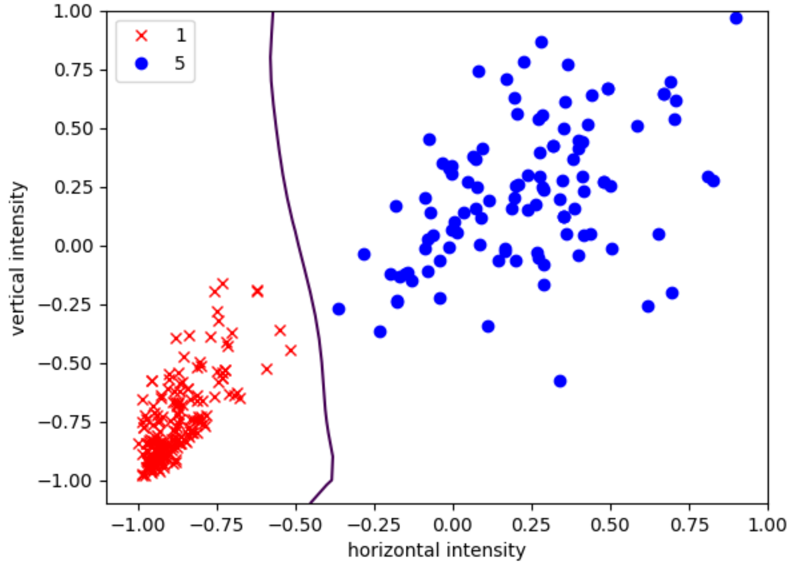


testing data:

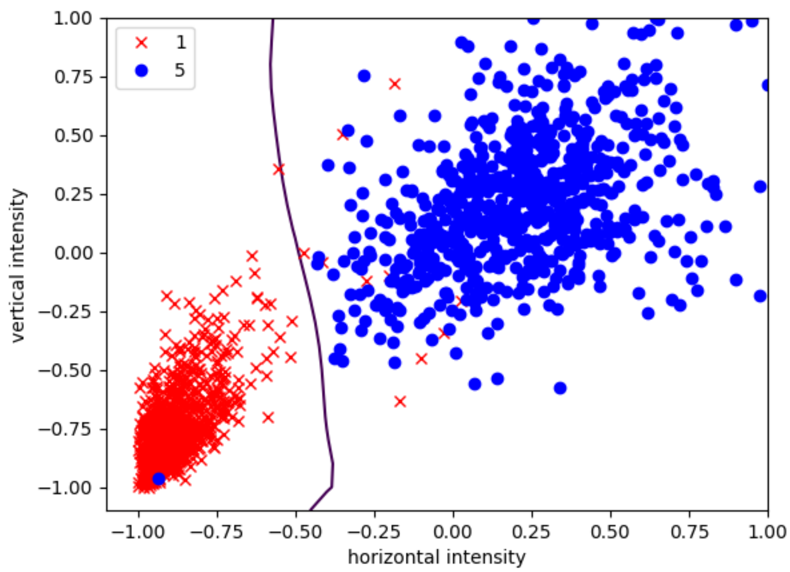


The data appears to be **overfitted**

3. training data:

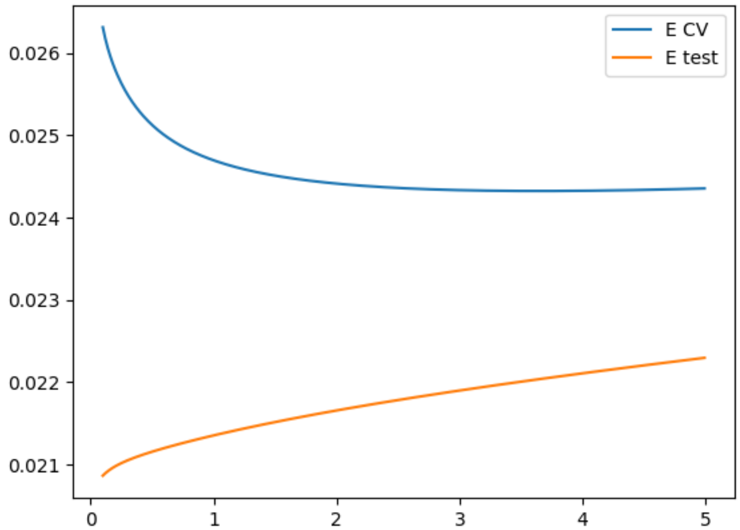


testing data:



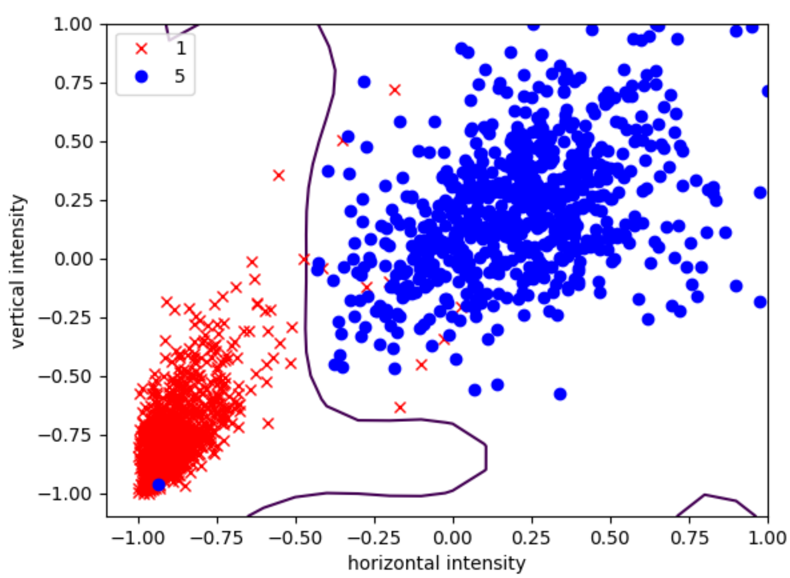
Data is regularized, there doesn't appear to be any under or overfitting.

4. Plot:



I chose my values for $\lambda \in \{0, 0.01, 0.02, ..., 5\}$, behavior wise, it appears that as the regularizer increases, the cross validation error decreases, while the regression error onthe test set increases as the regularizer increases.

5. Plot with $\lambda = 0.57$:



6. With regularizer $\lambda = 0.57$, the estimate for out of sample error using $E_{test}(w_{reg}(\lambda^*))$ is $E_{test} = 0.031$, a good and low rate for an error bar. We can use this to estimate and claim that $E_{out} \approx 0.031$.

7. No, E_{cv} is an unbiased estimate of E_{test}, Despite E_{cv} and E_{test} coming from the same dataset, what is used to determine E_{cv} does not touch on E_{test} at all, so both values don't know about the other.

8. No, E_{test} is not an unbiased estimate of E_{out}, we have used data snooping in the way that we scaled and normalized the entire dataset before separating the training and testing set. This caused the testing set to be affected by the training set in some way because of our normalization, leading to a biased estimate for E_{out}.