**Machine Learning: Section 6100**

**HW 9**

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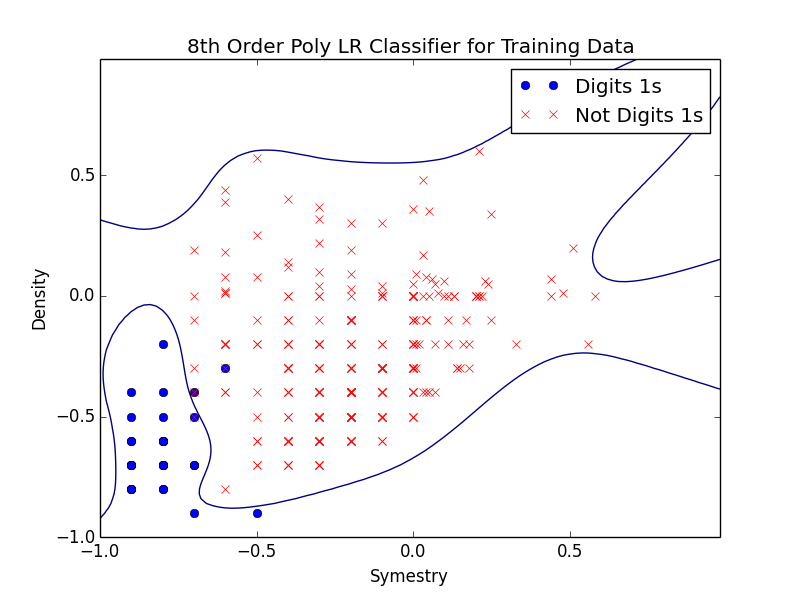
1. **8th Order Polynomial**

The dimensions of Z are , where 300 is the sample size of training data, 45 is the number of features constructed polynomials.

1. **Overfitting**

I used the ***scikit-learn*** package for polynomial transformation, linear regression, cross validation and regularization in following questions.

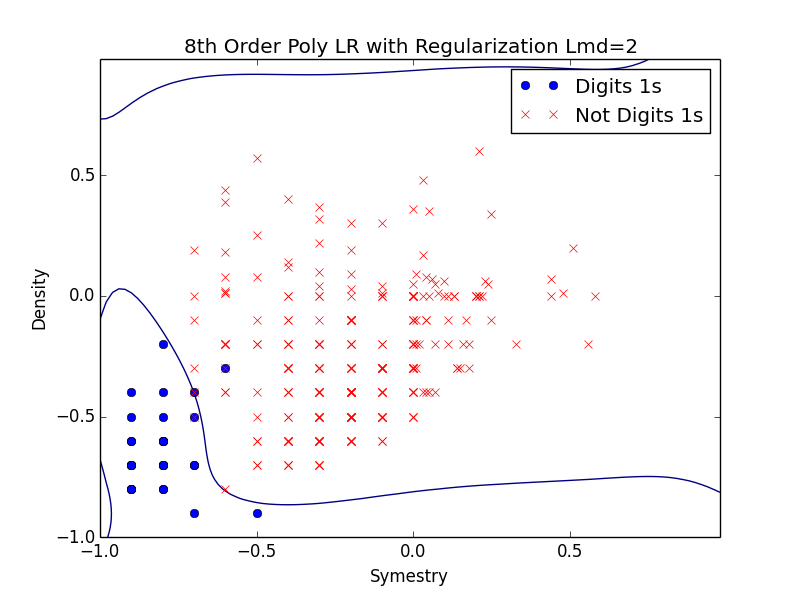
The following figure shows the classification decision boundary without any regularization:



I think it is overfitting, since the decision boundary is too complex.

1. **Regularization**

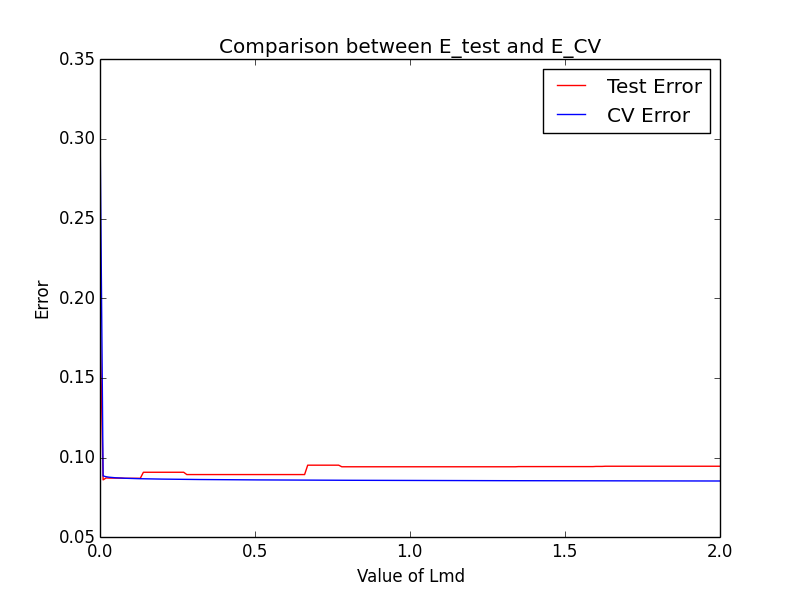
The plot with Ridge regularization () is as below:



It is much better than that in part 2 where no regularization is performed. However, there still might be overfitting issued.

1. **Cross Validation**

The following figure plots the and with different value of using leave one cross validation. When there is no regularization, the CV error is large due to Equation 4.13.

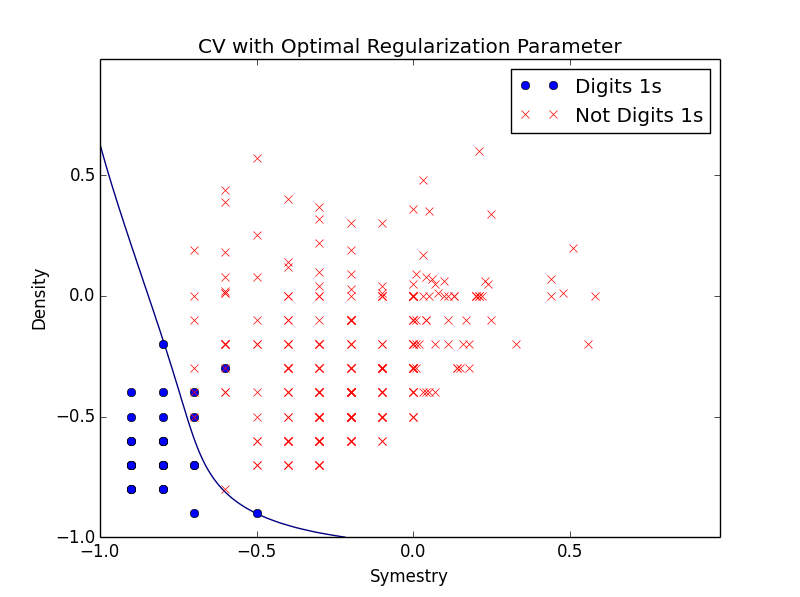


It can be seen that and have the same trend at this range of . doesn’t change too much as the value of increases above a certain value but

goes up a little bit as too much regularization is placed.

1. **Pick**

In part 4, the optimal value based on . The corresponding leaving one out CV regression gives a decision boundary as below:



This one looks much better in terms of the complexity of proposed classifier.

1. **Estimate**

