

Project 3 Writeup

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- WU1** Plot the normalized eigenvalues (include the plot in your writeup). How many eigenvectors do you have to include before you've accounted for 90% of the variance? 95%? (Hint: see function `cumsum`.)
- WU2** Do these look like digits? Should they? Why or why not? (Include the plot in your write-up.)
- WU3** Yes, you could have fewer support vectors (e.g. 2 vectors). Currently, two of the SV's represent the blue class and one represents the red class (and all of the SV's have the same margin). We could remove one of the SV's of the blue class and still get the same output.
- WU4** You get these little blobs because you are summing up the normal distributions around each point. As we turn up gamma, the variance increases and the kernel essentially vanishes. When we up gamma up to 400, we get a little decision boundary around each example (i.e. each decision boundary surrounds exactly one example) (see Figure 1).

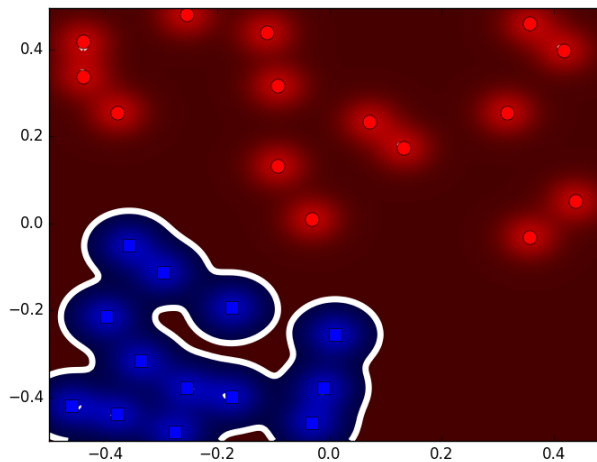


Figure 1: SVM with RBF kernel using $\gamma = 450$.

- WU5** There are a lot of red support vectors on the blue side of the decision boundary because this data is not linearly separable.
- WU6** The 0/1 loss on the training data is not zero because it misclassifies one blue point (in lower right hand corner). The hinge loss on the training data is also not zero because there are many points inside the margin.
- WU7** When training an RBF kernel on this data, the smallest gamma for which we could get a good decision boundary was $\gamma = 2$. A good decision boundary is defined by a low number of points being used as support vectors and a wider margin (see Figure 2).

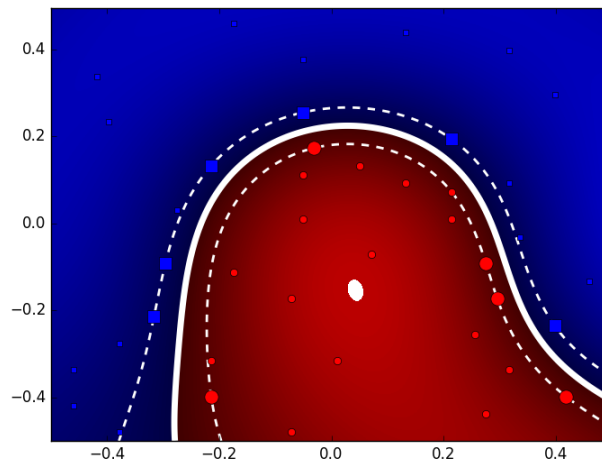


Figure 2: Complex dataset with RBF kernel using $\gamma = 2$.