Final Exam

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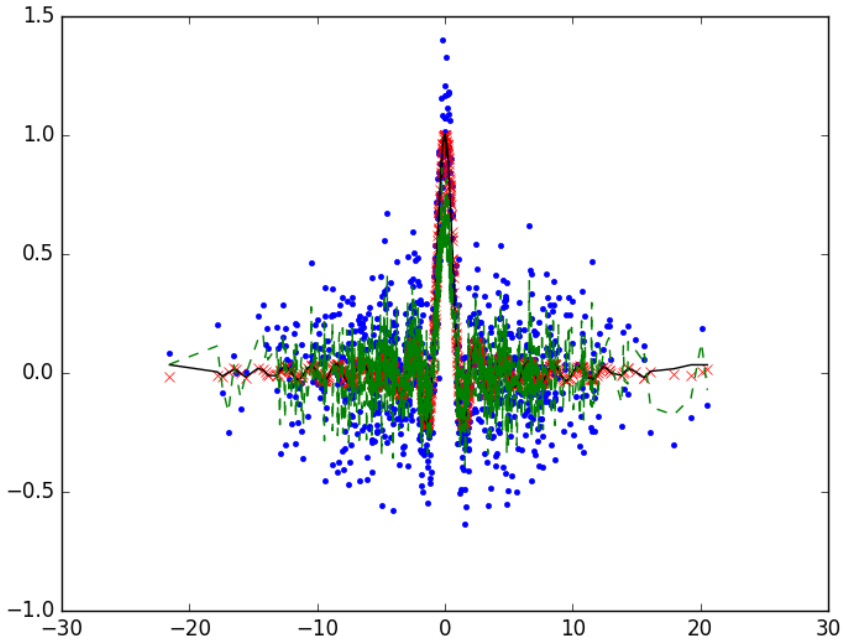
Question 1.

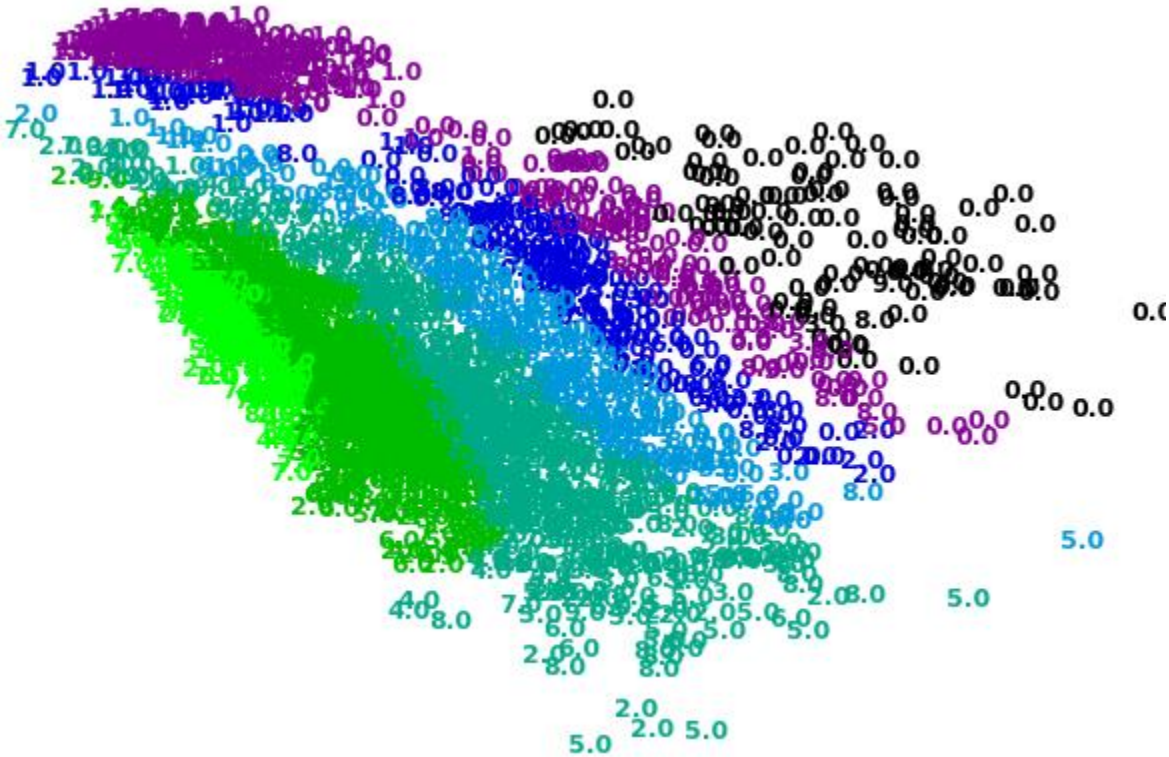
The first question had me using a program for the sinc function, and used a Support Vector Machine with Regression to find the best hyperparameters. I needed to set the parameters for 1000, and report my results. The results look a little weird because I ran the program in the command line. The accuracy of the machine was .999484 on the testing set, so it must be doing something right. Just from the three lines there, I can already tell that the hyper parameters C and epsilon are definitely related, but I'm just not sure how. If I had more SVM data, I could probably figure it out a bit more. The first figure is the command line output, and the second figure is the plot of the sinc curve that the machine returned.

Question 2

I ran the code to find the best set of hyper-parameters for the digits dataset. The program had to be slightly modified, because there weren't any hyperparameters given for the best scenario. However, looking over the multiple lines of SVM data in the third figure, one suggest that epsilon and gamma are both inversely proportionate with the testing CV score. While I ended up not finding the best hyperparameters, in this support vector machine I can tell how some of the hyperparameters affect the CV score of the algorithm. However, with this dataset, the algorithm doesn't run very well, only having a CV score of .346 for the training set and .329 for the testing set. Figure 3 is the actual plot that the code throws, showing the accuracy of the algorithm through color, and Figure 4 shows the actual code output.

```
(work) C:\Users\Me\Downloads>SVM.sinc.py
C 0.03125, epsilon 0.0, gamma 3.0517578125e-05. Testing set CV score: -0.2087
20
C 0.03125, epsilon 0.0, gamma 2.0. Testing set CV score: 0.107068
C 0.125, epsilon 0.0, gamma 2.0. Testing set CV score: 0.155202
*..
Warning: using -h 0 may be faster
*
optimization finished, #iter = 2881
obj = -1.129315, rho = -0.034119
nSV = 818, nBSV = 252
[LibSVM]Training set score: 0.999491
Testing set score: 0.999484
```


1.5
1.0
0.5
0.0
−0.5
−1.0
−30
−20
−10
0
10
20
30



```
C 4096.0, epsilon 1.8, gamma 0.125. Testing set CV score: 0.328267
C 4096.0, epsilon 1.8, gamma 0.25. Testing set CV score: 0.312890
C 4096.0, epsilon 1.9, gamma 0.015625. Testing set CV score: 0.327119
C 4096.0, epsilon 1.9, gamma 0.03125. Testing set CV score: 0.332447
C 4096.0, epsilon 1.9, gamma 0.0625. Testing set CV score: 0.320224
C 4096.0, epsilon 1.9, gamma 0.125. Testing set CV score: 0.317598
C 4096.0, epsilon 1.9, gamma 0.25. Testing set CV score: 0.317109
C 4096.0, epsilon 2.0, gamma 0.015625. Testing set CV score: 0.328037
C 4096.0, epsilon 2.0, gamma 0.03125. Testing set CV score: 0.331482
C 4096.0, epsilon 2.0, gamma 0.0625. Testing set CV score: 0.328746
C 4096.0, epsilon 2.0, gamma 0.125. Testing set CV score: 0.315196
C 4096.0, epsilon 2.0, gamma 0.25. Testing set CV score: 0.304688
C 4096.0, epsilon 2.1, gamma 0.015625. Testing set CV score: 0.326112
C 4096.0, epsilon 2.1, gamma 0.03125. Testing set CV score: 0.330982
C 4096.0, epsilon 2.1, gamma 0.0625. Testing set CV score: 0.323314
C 4096.0, epsilon 2.1, gamma 0.125. Testing set CV score: 0.311321
C 4096.0, epsilon 2.1, gamma 0.25. Testing set CV score: 0.297471
C 4096.0, epsilon 2.2, gamma 0.015625. Testing set CV score: 0.327103
C 4096.0, epsilon 2.2, gamma 0.03125. Testing set CV score: 0.327793
C 4096.0, epsilon 2.2, gamma 0.0625. Testing set CV score: 0.320294
C 4096.0, epsilon 2.2, gamma 0.125. Testing set CV score: 0.305266
C 4096.0, epsilon 2.2, gamma 0.25. Testing set CV score: 0.301100
C 4096.0, epsilon 2.3, gamma 0.015625. Testing set CV score: 0.325161
C 4096.0, epsilon 2.3, gamma 0.03125. Testing set CV score: 0.322741
C 4096.0, epsilon 2.3, gamma 0.0625. Testing set CV score: 0.314650
C 4096.0, epsilon 2.3, gamma 0.125. Testing set CV score: 0.301487
C 4096.0, epsilon 2.3, gamma 0.25. Testing set CV score: 0.291557
C 4096.0, epsilon 2.4, gamma 0.015625. Testing set CV score: 0.325096
C 4096.0, epsilon 2.4, gamma 0.03125. Testing set CV score: 0.311086
C 4096.0, epsilon 2.4, gamma 0.0625. Testing set CV score: 0.310961
C 4096.0, epsilon 2.4, gamma 0.125. Testing set CV score: 0.298987
C 4096.0, epsilon 2.4, gamma 0.25. Testing set CV score: 0.295552
C 4096.0, epsilon 2.5, gamma 0.015625. Testing set CV score: 0.319527
C 4096.0, epsilon 2.5, gamma 0.03125. Testing set CV score: 0.318107
C 4096.0, epsilon 2.5, gamma 0.0625. Testing set CV score: 0.305127
C 4096.0, epsilon 2.5, gamma 0.125. Testing set CV score: 0.291277
C 4096.0, epsilon 2.5, gamma 0.25. Testing set CV score: 0.278546
.............*....*
optimization finished, #iter = 18963
obj = -656858.498163, rho = -14.903063
nSV = 3392, nBSV = 3382
[LibSVM]Training set score: 0.346997
Testing set score: 0.329830
```