INTRODUCTION TO MACHINE LEARNING

HOMEWORK #4

REPORT

1- If we are given with "d" dimension and size of a data set N then we need to have d+1 variables. "d" comes from total dimensions we have and +1 is our bias.
"***a quadratic programming problem with d+1 variables***"

2-

- Accuracy = 34.4793% (692/2007) (classification)
- In sample error for 10 classifiers respectively:
  0.030393622321873443
  0.012954658694569009
  0.046836073741903336
  0.0752366716492277
  0.08769307424015944
  0.07972097658196313
  0.08121574489287493
  0.07274539113104135
  0.08271051320378675
  0.08570004982561036
- Total number of support vector machines: 6179

Highest in-sample error comes from the classifier ***4 versus all classifier***.

3- Smallest in-sample error comes from the classifier ***1 versus all classifier***.

5- Model accuracy with C = 0.0001
Accuracy = 27.3543% (549/2007) (classification)
In sample error for 10 classifiers respectively: 0.08320876930742402
0.003487792725460887 0.048829098156452415 0.08271051320378675
0.09965122072745392 0.07972097658196313 0.08470353761833582
0.07324364723467862 0.08271051320378675 0.08819133034379671
Total number of support vector machines: 7204

Model accuracy with C = 0.001

Accuracy = 32.0877% (644/2007) (classification)

In sample error for 10 classifiers respectively: 0.04285002491280518
0.009466865969108122 0.04235176880916791 0.07623318385650224
0.09965122072745392 0.07972097658196313 0.08470353761833582
0.07324364723467862 0.08271051320378675 0.08819133034379671

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Model accuracy with C = 0.01

Accuracy = 34.4793% (692/2007) (classification)

In sample error for 10 classifiers respectively: 0.030393622321873443
0.012954658694569009 0.046836073741903336 0.0752366716492277
0.08769307424015944 0.07972097658196313 0.08121574489287493
0.07274539113104135 0.08271051320378675 0.08570004982561036

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Model accuracy with C = 0.1

Accuracy = 39.2128% (787/2007) (classification)

In sample error for 10 classifiers respectively: 0.030393622321873443
0.01245640259093174 0.057299451918286 0.07125062282012955 0.09516691579471849
0.07972097658196313 0.08221225710014948 0.05680119581464873
0.08271051320378675 0.039860488290981565

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Model accuracy with C = 1

Accuracy = 39.2626% (788/2007) (classification)

In sample error for 10 classifiers respectively: 0.026905829596412557
0.01195814648729447 0.06527154957648232 0.07125062282012955
0.09516691579471849 0.07972097658196313 0.0817140009965122
0.039860488290981565 0.08271051320378675 0.05281514698555057

Maximum C achieves the smallest in-sample error.

6- Model accuracy with C = 0.0001

Accuracy = 32.7853% (658/2007) (classification)

In sample error for 10 classifiers respectively: 0.037867463876432486
0.006975585450921774 0.07224713502740408 0.0737419033383159 0.0931738913801694
0.07972097658196313 0.08470353761833582 0.06477329347284504
0.08271051320378675 0.07623318385650224

Total number of support vector machines: 6243

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Model accuracy with C = 0.001

Accuracy = 34.8779% (700/2007) (classification)

In sample error for 10 classifiers respectively: 0.03089187842551071
0.009466865969108122 0.0787244643746886 0.07324364723467862
0.08918784255107125 0.07922272047832586 0.07922272047832586
0.060787244643746886 0.08271051320378675 0.06776283009466866

Total number of support vector machines: 6006

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Model accuracy with C = 0.01

Accuracy = 35.8246% (719/2007) (classification)

In sample error for 10 classifiers respectively: 0.024414549078226207
0.009466865969108122 0.07972097658196313 0.07174887892376682
0.06676631788739412 0.07922272047832586 0.07922272047832586
0.060787244643746886 0.08271051320378675 0.08769307424015944

Total number of support vector machines: 5959

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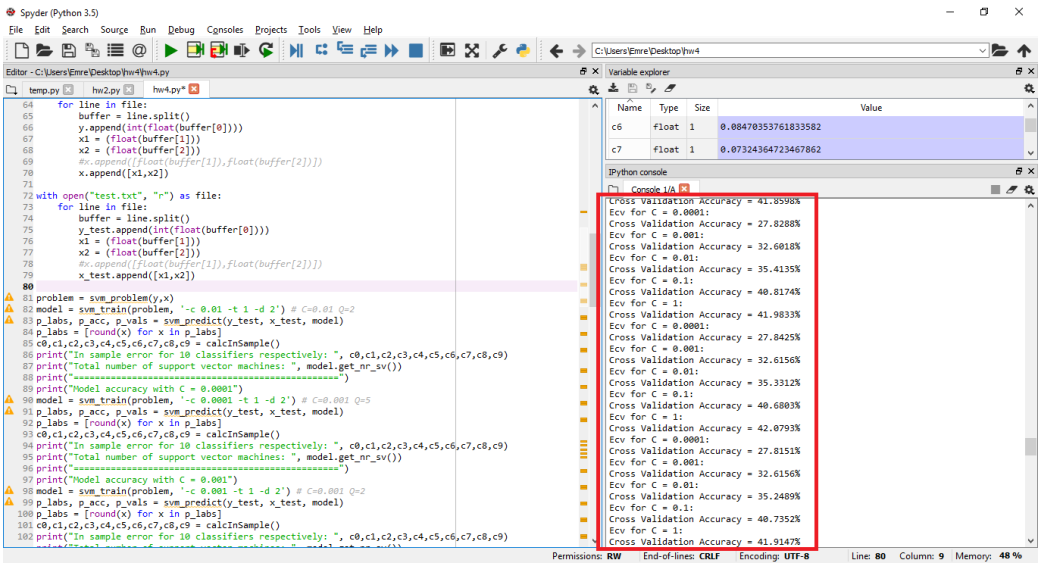
Model accuracy with C = 1

Accuracy = 37.7678% (758/2007) (classification)

In sample error for 10 classifiers respectively: 0.027902341803687097
0.007473841554559043 0.09018435475834578 0.060787244643746886
0.05580468360737419 0.07972097658196313 0.07623318385650224
0.05879422022919781 0.08271051320378675 0.08271051320378675

Total number of support vector machines: 6020

7- C = 1 is selected most often during Cross-Validation runs.



8-

9- Model accuracy with C = 0.01
Accuracy = 32.7354% (657/2007) (classification)
In sample error for 10 classifiers respectively: 0.03188839063278525
0.013452914798206279 0.04235176880916791 0.07722969606377678
0.09965122072745392 0.07972097658196313 0.08420528151469855
0.07324364723467862 0.08271051320378675 0.08819133034379671
Total number of support vector machines: 6472
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Model accuracy with C = 1
Accuracy = 37.9173% (761/2007) (classification)
In sample error for 10 classifiers respectively: 0.037867463876432486
0.013951170901843548 0.04783258594917788 0.06975585450921774
0.0981564524165421 0.0787244643746886 0.08370702541106129 0.05331340308918784
0.08271051320378675 0.05480817140009965
Total number of support vector machines: 5863
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Model accuracy with C = 100

Accuracy = 39.5615% (794/2007) (classification)
In sample error for 10 classifiers respectively: 0.03288490284005979
0.012954658694569009 0.05480817140009965 0.06925759840558046
0.0981564524165421 0.07822620827105133 0.0817140009965122 0.03288490284005979
0.08121574489287493 0.0622820129546587
Total number of support vector machines: 5692
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Model accuracy with C = 10000
Accuracy = 39.8605% (800/2007) (classification)
In sample error for 10 classifiers respectively: 0.03288490284005979
0.012954658694569009 0.06178375685102142 0.06776283009466866
0.09765819631290483 0.0737419033383159 0.0787244643746886 0.036372695565520675
0.0802192326856004 0.059292476332835076
Total number of support vector machines: 5694
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Model accuracy with C = 1000000
Accuracy = 40.2093% (807/2007) (classification)
In sample error for 10 classifiers respectively: 0.03238664673642252 0.0114598903836572
0.07174887892376682 0.07025411061285501 0.0787244643746886 0.06676631788739412
0.06975585450921774 0.060787244643746886 0.0787244643746886 0.057299451918286
Total number of support vector machines: 5677
In-sample error is lowest at C= 10^6.