Homework 6

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CptS 570 — Machine Learning
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1 Bayesian Optimization with Support Vector Machines

The majority of the hours on this assignment were spent getting the environment all setup between the two libraries of choice: LibSVM (classifier) and Spearmint (automatic hyper-parameter tuner). Though, once one understands how the individual libraries need to be implemented, running them together is not so difficult.

The essential process of running Bayesian optimization for a Support Vector Machine is as follows:

1. Setup objective function (Python), which uses LibSVM classifier with given arguments C and γ and outputs the "inverted" validation accuracy (i.e. return $(1 - training\_accuracy)$) of the classifier on the OCR test data.
2. Start MongoDB daemon on *localhost*.
3. Run Spearmint, passing in our objective function which is trying to be minimized
4. Terminate program after 50th iteration.
5. Collect results.

The resulting hyper-parameter recommendations for our classifier are $\gamma = 0.03$ and $C = 45.1$, which achieves an accuracy of 78.1.

Code has been sent to TA. See Figures 1-3 for the data gained from this experiment.

Figure 1: Graphs representing data in Figure 2.

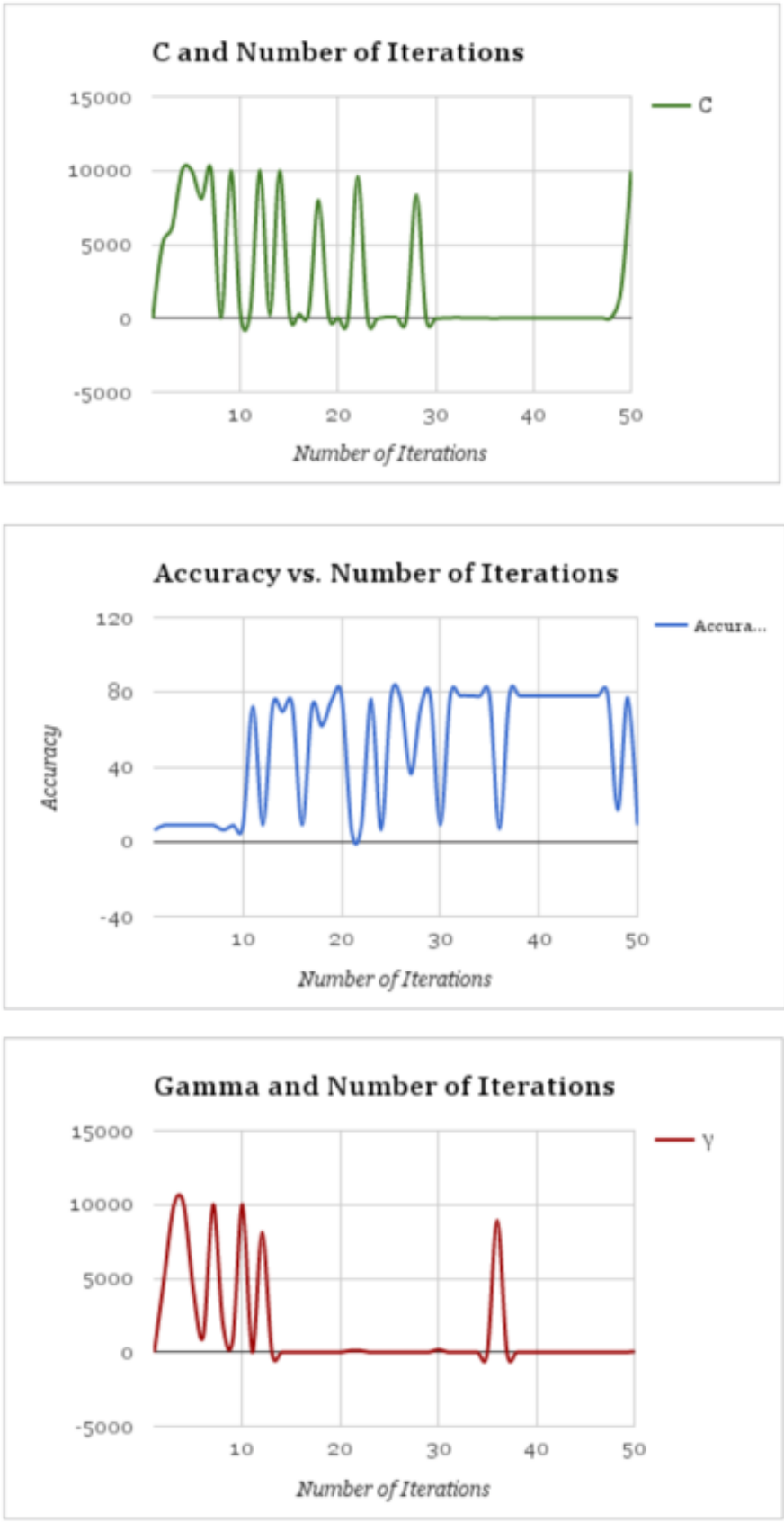

Figure 2: (a) Table spanning all iterations of B.O., with corresponding accuracy of SVM given parameters C and gamma.

Bayesian Optimization Iterations on Support Vector Machine

Number of Iterations	*Accuracy*	*C*	*γ*
1	6.203208556	0.0001	0.0001
2	8.770053476	5000.00005	5000.00005
3	8.770053476	6186.523725	9950.164112
4	8.770053476	10000	9999.630971
5	8.770053476	10000	4111.249181
6	8.770053476	8068.384248	1069.029598
7	8.770053476	10000	10000
8	6.203208556	0.0001	1920.682902
9	8.770053476	10000	778.703039
10	8.770053476	247.46452	10000
11	72.51336898	523.893597	0.0001
12	8.770053476	10000	8124.293384
13	72.62032086	191.949674	0.0001
14	69.51871658	10000	0.0001
15	73.04812834	290.087071	0.000494
16	8.770053476	289.602691	9.692968
17	72.51336898	476.70522	0.000102
18	61.92513369	8001.023045	0.158647
19	75.82887701	279.004868	0.008833
20	77.86096257	45.133164	0.029603
21	6.203208556	0.0001	99.067284
22	8.770053476	9623.413093	102.786
23	76.36363636	28.772487	0.011109
24	6.203208556	0.001646	0.30505
25	77.43315508	86.991002	0.022101
26	76.14973262	67.530454	0.070521
27	36.14973262	5.208092	0.0001
28	71.44385027	8374.263713	0.001217
29	77.54010695	51.760846	0.022035
30	8.770053476	5.156563	169.026392
31	77.54010695	26.053927	0.048331
32	78.07486631	45.133126	0.033815
33	78.07486631	36.334026	0.036374
34	77.7540107	39.622083	0.040978
35	77.86096257	29.768317	0.030393
36	6.631016043	0.075055	8941.040063
37	78.07486631	35.701303	0.032338
38	78.07486631	35.615783	0.032741
39	78.07486631	35.778767	0.032531
40	78.07486631	35.615547	0.032464
41	78.07486631	35.444663	0.032534
42	78.07486631	35.570407	0.032537

Figure 3: (b) Continuation of table in Figure 2(a).

43	78.07486631	35.509448	0.032517
44	78.07486631	35.328645	0.032505
45	78.07486631	35.388314	0.032585
46	78.07486631	35.739234	0.032161
47	78.07486631	35.552231	0.032952
48	16.68449198	86.342439	0.743664
49	77.00534759	2056.305124	0.022109
50	8.770053476	9960.9375	33.726872