

Indian Institute of Space Science and Technology – Thiruvananthapuram

MA871 Advanced Kernel Methods

Assignment-III

Date: 02-04-2019

1. Implement the algorithms and analyze the following data: Data1, Data 2
 - (a) Using
 - i. SVM and solve the dual by applying (a) iterative methods (b) SVM SMO.
 - ii. kernel ridge regression, kernel online ridge regression & kernel online SVM regression.
 - (b) Report the optimal kernel used.
 - (c) Report the values of hyperparameters.
 - (d) Plot the decision boundary for all the algorithms. Plot support vectors in the case of SVM.
 - (e) Assess the performance of the algorithms and rank them on the basis of performance. [For ranking, check whether the difference between the results obtained using two algorithms are statistically significant. Use t test for checking the statistical significance.]
 - (f) Compare the performance of batch learning with online learning.
2. Consider the classification Data 4 & Data 6.

- (a) Solve the SVM dual using SVM SMO and iterative method.
- (b) Apply working set methods: (i) chunking (ii) decomposition.
- (c) Report the optimal kernel used.
- (d) Report the working set size.
- (e) Plot the decision boundary and the support vectors.
- (f) Report the stopping criteria used.

3. On Data 3 & Data 5

- (a) Apply KPCA.
- (b) Report the optimal kernel used.
- (c) Report the values of the hyperparameters.
- (d) Report the new values of the data points.
- (e) Apply SVM regression and SVM classification on new points of Data 3 & Data 5 respectively.
- (f) Assess the performance of the model.

4. Develop a model:

- (a) Apply SVM on Data 5 and obtain the support vectors.
- (b) Apply SVM on the support vectors obtained.
- (c) Compare the performance of the two models.

5. Consider online data. Let (x_i, y_i) comes at time $t = i$. Let the data be analysed using kernel ridge regression with the aid of stochastic gradient descent. If $f = \sum_i \alpha_i k_{x_i}$, write the expression of α_5 and α_{10} when $t = 10$, by taking the constant learning rate.

6. Analyze Adult data set using SVM SMO

- (a) Report the optimal kernel and other hyperparameters.
 - (b) Report the values of the parameters.
 - (c) Assess the performance of the model.
7. Consider the data Relative location of CT slices on axial axis
- (a) Apply SVM SMO regression, kernel ridge regression and kernel online learning.
 - (b) Report the optimal kernel and other hyperparameters.
 - (c) Report the values of the parameters.
 - (d) Assess the performance of the models and rank them on the basis of performance.
8. Consider the data Image Segmentation
- (a) Apply KPCA on the data set.
 - (b) Apply SVM SMO on the new points and the old points. Compare the performance with the aid of statistical significance test.
9. Prove that the eigenvectors of a symmetric matrix are orthogonal.

Notes

- Assignment has to be written in latex.
- All the files related with the assignment should be saved in a single folder and send to sumitra@iist.ac.in.
- Last date of submission: 09-04-2019.
- **As far as assignments are concerned, students are expected to observe academic honesty and integrity. Though the students**

can collaborate and discuss, copying directly other students' assignment or allowing your own assignment to be copied constitute academic dishonesty and is highly discouraged.