PRNN 2023 - Assignment2

Prathosh A. P.

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1 SVMs

- **p1:** For the classification problems given in A1, implement SVMs both with and without slack formulations. Experiment with at least 3 Kernels and grid search on hyper-parameters on different kernels and report your observations (you can use standard python library, LibSVM and need not implement SMO). For multi-class classification, implement a one-vs-rest approach.
- **p2:** Implement FLDA for the classification problems in A1 and report the metrics as in A1.
- **p3:** For the regression problem **p1** in A1, overfit the data with over-parameterized models (at least 3). In the next part, impose different types of regularizers (L2, L1, and a combination of both) and plot the bias-variance curves.

2 Neural Networks

- **p4:** Construct a Multi-layer Perception (MLP) or a feed-forward neural network to work on the K-MNIST dataset. Experiment with at least 3 settings of the number of hidden layers and Neurons. Explicitly code the Error Backpropagation algorithm as a class and use it on MLPs with different architectures and loss functions (CE, squared error loss). For this part, you should only use Numpy. Report the accuracy and F1 scores with all the considered configurations.
- **p5:** Construct a CNN for the K-MNIST dataset and code the back-propagation algorithm with weight sharing and local-receptive fields. Experiment with 3 different architectures and report the accuracy.
- **p6:** For the above problem, build a big-enough CNN architecture that would overfit the K-MNIST data. Impose L2 and early-stopping as regularizers and plot the bias-variance curves. Perturb each of the input images with additive Gaussian noise and report its regularization impact.

- **p7:** Train an MLP on the PCA counterpart of the K_{MINST} dataset and report your observations. **DATA:KannadaMNISTPCA.csv**

General Instructions:

1. All the data files can be found here - data
2. For **p1:p3**, the last column in the csv file in the target variable, for **p4** it is the folder name and **p5**, it is the first column of the csv file.
3. You are supposed to submit a single Jupiter notebook with all the solutions made into separate blocks.
4. No ML library other than **numpy** and **matplotlib** should be used, failing which will attract zero marks.
5. A 4-6 page report has to be submitted that would list all the experiments, results, and your observations. It should be in double-column format in latex as specified here template. IISc has a subscription to overleaf and the report should be in the exact same format.
6. Use matplotlib for plotting the loss and RoC curves.
7. The final evaluation **does not** depend on the accuracy metrics but is based on the **quality of your experiments and observations thereof**.
8. We will run a plagiarism check on both your report and the codes. Any suspicion of copying would lead to a harsh penalty from negative marks in the assignment to a failing grade in the course, depending upon the severity. Therefore, kindly refrain from copying others' codes and/or reports.