# ECEN 689 : Project 2

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**Abstract**

Ensemble methods can take a large number of weak learners and aggregate them into a strong classifier. The outputs of the various weak learners are often aggregated either by voting in case of classification or by averaging in case of regression. In this project, we first examine whether strong learners such as neural networks can be aggregated in a similar manner to produce an ensemble classifier with higher performance than a single strong learner with equivalent complexity. We also hope to demonstrate that training the set of individual learners is computationally less expensive than training a single model with equivalent performance.

## I. PROBLEM DESCRIPTION

THE problem involves finding whether strong learners can be combined to produce an ensemble classifier that is "better" than individual classifiers of far greater model complexity. We enforce a constraint that the combined complexity of all the individual learners in the ensemble is similar to the complexity of the individual classifier that we are comparing against.

## II. DATASETS

At present we have decided to use at least the CIFAR-10 dataset to create an image classification task. We will measure the accuracy and the categorical cross-entropy of the models on the test data.

We will chose two more datasets, at least one of which will be text data. In all cases, we hope to have classification tasks as there is little loss in generality by restricting our attention to these tasks.

## III. TASK DIVISION

- Literature survey(Samyuktha)
- Data pre-processing (Samyuktha and Harinath)
- We use three different approaches for aggregating the outputs of the individual neural networks(one approach per person).
- Comparing these results to an equally complex network(each person compares their own approach).
- Theoretical analysis(using PAC learnability theory) and bounds to demonstrate that an ensemble of neural networks probably has better results than a single, complex network. (Harish Kumar)
- All members attempt their approaches on multiple datasets if possible.

## IV. EVALUATION AND SUCCESS CRITERIA

We hope to evaluate the two paradigms(ensemble network vs single network) using multiple evaluation metrics.

- The model performance will be compared using classification accuracy and categorical cross-entropy.
- Model complexity will be compared by the number of parameters since this decides the size of the hypothesis class.
- Training difficulty will be compared by measuring the time it takes to achieve performance on the validation set using the same hardware.

The success criteria for this project would be to obtain a clear demonstration of the metrics leaning towards one paradigm or the other. While we hypothesize that the ensemble methods would do better when it comes to performance, we still want to test this hypothesis empirically.

## V. TIME LINE

- Week 1 (November 25 - December 1): Complete Literature survey and finalize the data sets. Preprocessing the datasets.
- Week 2 (December 2 - December 8): Building ensemble models and testing on the datasets.
- Week 3 (December 9 - December 12): Finalizing results and project report.