

EE550 ARTIFICIAL NEURAL NETWORKS

HOMEWORK 4 REPORT

Introduction

In this homework assignment the Winner Take-all Network which is a competitive learning model where the neurons compete each other to be activated, was implemented. Creating sample points and initializing random weights on a unit sphere, we demonstrated that the weights converge in the center after an all-or-nothing learning method. Having obtained weights, it is shown that we were able to categorize the newly arrived data based on the updated weights.

Problem Definition

In this model, the objective is clustering or categorizing the input data. It is achieved by the model itself from the correlations in it. This is to say that the similar input was classified as being in the same category and fire the same output unit.

Our main problem was how to find cluster categories in the input dataset and how to choose the weights accordingly. It is solved by finding the largest output value and then updating for only the winning unit only to make the winning weight closer to current vector.

Analysis

In this project, we are interested in the normalized weights thus the winner was the weight vector who is closest to the input vector ζ . Finding the winner, we only for it. This is achieved in an efficient manner via multiplying with the output vector whose only nonzero value was the winner neuron.

After updating, it is shown that the weights converged to the centers of clusters following a trajectory. It was as expected since the update term is analogous to the gradient descent algorithm where the cost function is iteratively minimized.

Finally, the algorithm's correctness was tested via three inputs each from three clusters. After the test, it was shown that the algorithm is able to correctly cluster the new data. To do this, the active neuron's index was obtained and assigned the color of the weights accordingly via a switch-case condition. When the predictions were plotted, it was shown that they perfectly matched with their clusters.

Open Issues

The model does have some disadvantages. Firstly, it is not robust to failure. As one output neuron is used one category, if an output fails, the category is lost. Next, there is no hierarchy that no category can be defined within a category.

Conclusion

In this homework, we found some representatives that are closest to the given set of patterns via the Winner-Take-All network. Though the algorithm is open to major issues, it introduced

me to the Unsupervised and Competitive Learning methods and thoroughly understand the underlying notion behind them.