IT416: TOPICS IN DEEP LEARNING

Assignment 4 : Implementation of Artificial Neural Network with Cross-Validation and Regularization

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1 LEARNING OUTCOME

At the end of this assignment you will learn how to train the Artifical Neural Network , analyze the performance for different hidden layers and use cross-validation techniques to find the model with best predictive performance

2 PROBLEM DESCRIPTION

Implement Artificial Neural Network on the mentioned Dataset. Use Cross-Validation Techniques to find the best model.

3 IMPLEMENTATION

3.1 Task 1 (Neural Network)

- Implement an Artificial Neural Network
- Vary the Hidden Layers and Neurons to analyze difference in performance if any. The configuration can be 4-5-1 , 4-10-1 and 4-5-10-5-1 , where 4 is the no. of neurons in the first layer and 1 is the no. of neurons in the output layer.
- Visualize the Performance (MSE vs No. of epochs) and find the Network with the best performance
- After getting your best model, predict on the Test Data and show the error

3.2 Task 2 (Neural Network with Cross Validation)

- Implement an Artificial Neural Network
- Vary the Network capacity as mentioned in Task 1.
- Train and evaluate the Model using the training data by implementing 10-fold Cross Validation. *See Instructions*
- Visualize the Performance (MSE vs No. of Epochs) and find the Model with the best performance (minimum loss) . Plot proper Cross-Validation-Curves
- After getting your best model, predict on the Test Data and show the error

3.3 Task 3 (Regularization)

- Add L2 Regularization on the weights of the Neural Network
- Vary Alpha values in range 10^{-6}, 10^{-5}, 10^{-4}, ... 10^{-1}, 1
- For each possible alpha , Train and evaluate the Model using the training data using 10-fold Cross Validation.(Make validations sets within the training data) . Plot proper Cross-Validation-Curves (MSE vs Alpha)
- Visualize the Performance (MSE vs no.of epochs) and find the Model with the best performance (minimum loss)
- After getting your best model, predict on the Test Data and show the error

3.4 Task 4 (Overfitting and Underfitting)

- Design neural network in a way such that, you reach overfitting and underfitting conditions. (2 Neural Networks for each conditions)
- Visualize proper curves and indicate why it is a case of overfitting/underfitting. (2 curves for each condition)

3.5 Points to note

- Comment on all the visualizations you make. Proper Explanation is needed.
- Compare the MSE values for the best model which you got from all the tasks mentioned above (task 1, task 2 and task 3)
- Comment on whether there are benefits when you used Cross Validation Techniques for evaluating performance of the model and why.

3.6 Instructions

- You can use functions from Sklearn for the implementation of above tasks.
- Dataset link: Click Here

- Use the combination of X_train.csv and X_val.csv for Cross-Validation purposes. Make validation sets within the combined data.

- You can use functions from Tensorflow 2 for the implementation of the neural network.

4 SUBMISSION

- You have to submit your assignment in Google Colab notebook (.ipynb file) with proper comments and explanation of your approach.

- Your filename should be named as **LabAssignment4_StudentId** . If your id is 202011001 then filename will be **LabAssignment4_202011001.ipynb**

- The submission deadline for this assignment is **25th September 2020 11:59 pm**