
Assignment-2

ASSIGNMENT: IMPLEMENTATION OF A THREE HIDDEN LAYER NEURAL NETWORK FOR MULTI-CLASS CLASSIFICATION

In this assignment, you will implement a three hidden layer neural network for multi-class classification. You will generate a synthetic dataset with five classes to train and test your neural network model. Your task involves modifying the provided codebase (https://github.com/debajyotikarmaker/ML/blob/main/05_neural_network.ipynb) to accommodate the multi-class classification problem and evaluating the performance of your model.

Dataset Generation:

- Generate a synthetic dataset containing input features and corresponding class labels.
- Ensure that the dataset has five distinct classes.
- The input features should be suitable for training a neural network.

Task:

- Implement a neural network with three hidden layers to classify the generated dataset.
- Modify the provided code to support multi-class classification with five classes.
- Adjust the network architecture and parameters as necessary for handling the multi-class problem.

Code Modification:

- Extend the NeuralNetwork class provided in the code to support multi-class classification.
- Update the output layer to have five neurons, each corresponding to one class.
- Modify the activation function and loss calculation to suit the multi-class scenario.
- Ensure that the backpropagation algorithm is adapted to handle multiple classes.

Training and Testing:

- Split the generated dataset into training and testing sets.
- Train the neural network using the training data.
- Evaluate the performance of the trained model using the testing data.
- Calculate relevant evaluation metrics such as accuracy, precision, recall, and F1-score for each class and overall.

Documentation:

- Provide a detailed explanation of the modifications made to the code to implement multi-class classification.
- Include comments within the code to describe the purpose of each section and any relevant mathematical formulas.
- Document any challenges faced during implementation and how they were addressed.

Results and Analysis:

- Present the results of training and testing, including performance metrics and any relevant visualizations (e.g., confusion matrix, ROC curves).
- Analyze the performance of the neural network and discuss any observations or insights gained from the experiment.
- Compare the performance of your model with different configurations and hyperparameters.

Conclusion:

- Summarize the key findings of the assignment, highlighting the performance of your multi-class classification model.
- Reflect on the challenges encountered and lessons learned during the implementation.
- Discuss potential improvements or further experiments that could enhance the performance of the neural network for multi-class classification tasks.

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Note:

- You have the flexibility to experiment with different dataset sizes, network architectures, activation functions, and optimization techniques to improve the model's performance.
- Avoid plagiarism or copying of code from external sources. Originality and understanding of the implemented algorithms will be evaluated.