Building a Neural Network for Image Classification

Objective

Your task is to build and train a neural network for image classification using the CIFAR-10 dataset. The goal is to classify images into one of the 10 categories (airplane, automobile, bird, cat, deer, dog, frog, horse, ship, truck). The specific objective is to achieve an accuracy of at least 80% on the test dataset.

Dataset

You will use the CIFAR-10 dataset, which is a well-known dataset for image classification tasks. It consists of 60,000 32x32 color images in 10 classes, with 6,000 images per class.

- Dataset Name: CIFAR-10
- Link: The dataset is available directly from the Keras datasets module.

Steps to Complete the Project

Data Loading and Preparation

Load the CIFAR-10 dataset using Keras.

Preprocess the images by normalizing the pixel values.

Build the Neural Network

Define the neural network architecture using Keras. The network should include convolutional layers followed by fully connected layers.

Compile the model with an appropriate optimizer and loss function for multi-class classification.

Train the Model

Train the model on the training data. Make sure to use validation data to monitor the model's performance and prevent overfitting.

Evaluate the Model

Evaluate the model on the test data using accuracy as the metric. Ensure your model achieves an accuracy of at least 80%.

Plot the training and validation accuracy and loss.

Make Predictions

Use the trained model to make predictions on new images.

Analyze the predictions and the corresponding probabilities.

Performance Analysis and Interpretation

Add a section where you analyze the model's performance and interpret the results. Discuss any potential issues such as overfitting or class imbalance. Reflect on the effectiveness of your model and suggest any possible improvements.