Fashion MNIST Classification Using Deep Neural Networks

Introduction

This project aims to classify images from the Fashion MNIST dataset using a deep neural network. The dataset consists of 70,000 grayscale images (28x28 pixels) categorized into 10 classes representing different clothing items such as T-shirts, trousers, sneakers, and coats. The model is trained to recognize these categories using a multi-layer neural network.

Dataset and Preprocessing

- **The dataset is loaded and split into training (60,000 images) and testing (10,000 images) sets.**
- **Images are normalized by scaling pixel values to the range [0,1] to improve model performance.**
- **Labels are converted to one-hot encoded format for categorical classification.**

Model Architecture

The neural network consists of the following layers:

1. **Flatten Layer: Converts 28x28 images into a 1D array.**
2. **Dense Layer (512 neurons, ReLU activation): First hidden layer for feature extraction.**
3. **Dense Layer (256 neurons, ReLU activation): Second hidden layer to refine extracted features.**
4. **Dense Layer (128 neurons, ReLU activation): Third hidden layer for deeper learning.**
5. **Dense Layer (10 neurons, Softmax activation): Output layer for classification into 10 categories.**

Training and Optimization

- **The model is compiled using the Adam optimizer and categorical crossentropy loss function.**
- **The dataset is trained for 15 epochs with a batch size of 32.**
- **TensorBoard logging is implemented to monitor training progress.**

Evaluation and Results

- **The model achieved high accuracy on the test dataset, indicating good generalization.**
- **The final model is saved for future predictions and reusability.**
- **A plot of training and validation accuracy over epochs is generated to visualize performance trends.**

Model Validation and Consistency Check

- **The saved model is reloaded, and its structure and parameters are compared with the original model.**

- **Model weights are verified for consistency, ensuring no data corruption during saving and loading.**

Prediction on New Images

- **A function is implemented to predict and visualize classifications on test images.**
- **The model accurately predicts the class of a given image, validating its effectiveness.**

Conclusion

This project successfully classifies Fashion MNIST images using a deep neural network. The model demonstrates high accuracy and consistency in recognizing different clothing categories. The implementation includes data preprocessing, model training, validation, and prediction functions, making it a comprehensive approach to image classification using deep learning.