Summary (Fashion Image Classification)

Objective: The project aimed to develop a machine learning model using TensorFlow and Keras to classify images of clothing items from the Fashion MNIST dataset. The dataset contains 60,000 training images and 10,000 test images, each of size 28x28 pixels, across 10 fashion classes (like T-shirts/tops, trousers, Dresses, etc.).

Solution Approach:

1. **Data Preprocessing**
   The images were preprocessed by scaling the pixel values between 0 and 1 to normalize the data. This was necessary to help the model converge faster and achieve better accuracy. Data visualization techniques were used to gain insights into the dataset.

2. **Model Design and Compilation**
   A Sequential Neural Network was created using TensorFlow and Keras. The architecture consisted of three Dense layers:
   - **Flatten Layer:** To transform each 2D image into a 1D vector.
   - **Dense Hidden Layers:** Two dense layers with 128 and 64 neurons respectively, using ReLU activation for non-linearity.
   - **Output Layer:** A final dense layer with 10 neurons and softmax activation to classify the 10 categories.

   The model was compiled with the Adam optimizer, which dynamically adjusted the learning rate to achieve faster convergence. Sparse categorical cross-entropy was chosen as the loss function because it handles integer labels well, and accuracy was selected as the performance metric.

3. **Training the Model**
   The model was trained using a batch size of 64 and over 10 epochs. During training, the model achieved consistent improvement, eventually reaching a training accuracy of 90.9%.

4. **Evaluation and Results**
   The model was evaluated using the test dataset, and it achieved a test accuracy of 88.1%, indicating a minor level of overfitting but good generalization on unseen data. The performance gap between training and test accuracies was relatively small.

5. **Prediction and Visualization**
   Predictions were made using the trained model, and the results were visualized with bar plots to show the model's confidence for each class. Correct predictions were marked in green, while incorrect ones were highlighted in red, making it easier to analyze the model’s decisions.

Conclusion

The project successfully implemented a deep learning model for fashion image classification using TensorFlow and Keras. By carefully designing and training the model, we achieved a high test accuracy, proving the model’s effectiveness in recognizing and categorizing different fashion items. Future improvements could involve experimenting with Convolutional Neural Networks (CNNs) to potentially achieve even higher accuracy.