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Artificial Intelligence Lab 10 Report:

This code is for building, training, and evaluating various neural network models for image classification tasks using the MNIST and Fashion MNIST datasets. Let's break down the key components and provide a detailed explanation:

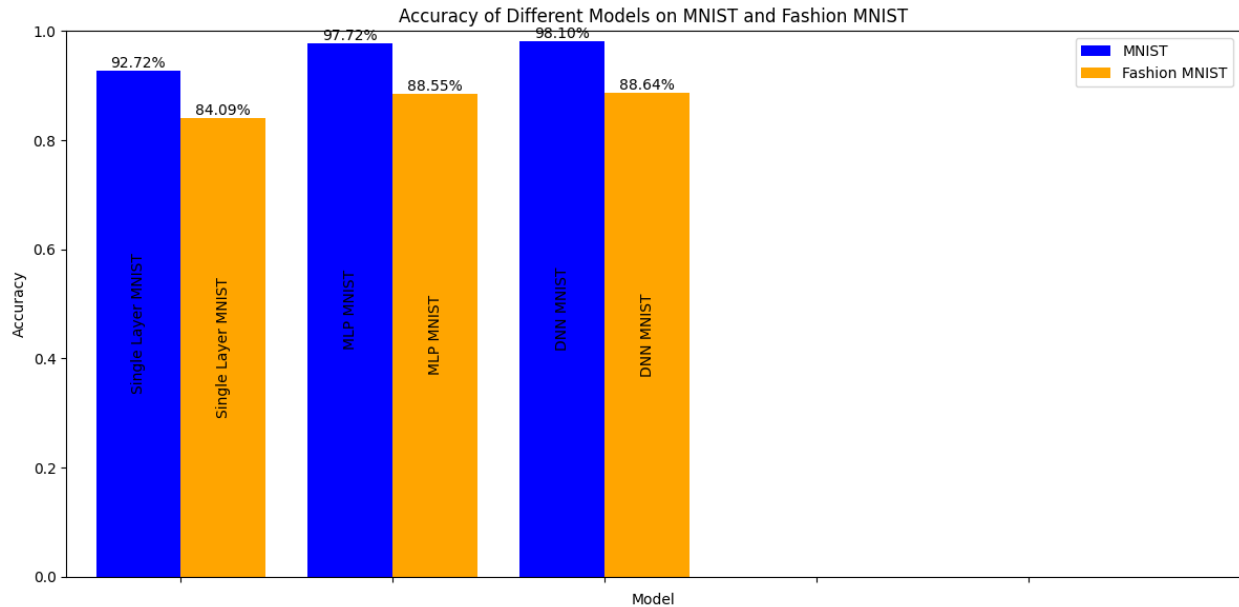
1. **Importing Libraries:** The code imports necessary libraries such as NumPy, TensorFlow, Matplotlib, and components from TensorFlow.keras for building neural network models.
2. **Loading Datasets:** The MNIST and Fashion MNIST datasets are loaded using `mnist.load_data()` and `fashion_mnist.load_data()` functions, respectively. These datasets contain grayscale images of handwritten digits (MNIST) and clothing items (Fashion MNIST).
3. **Describing Datasets:** Basic information about the datasets is printed, including the number of training and testing samples, image shape, data type, pixel value range, and the number of classes.
4. **Preprocessing:** Before training the models, the images are preprocessed. This includes normalization (scaling pixel values to the range $[0, 1]$) and flattening the images to convert them from 2D arrays to 1D arrays.

Model Definitions: Three types of neural network models are defined:

1. **Single Layer Perceptron:** This model consists of a single layer of neurons with a softmax activation function.
2. **Multi-Layer Perceptron (MLP):** This model has multiple layers, including a hidden layer with ReLU activation and an output layer with softmax activation.
3. **Fully Connected Deep Neural Network (DNN):** This model is deeper than MLP, containing multiple hidden layers with ReLU activation and an output layer with softmax activation.
4. **Training Models:** A function `train_model()` is defined to compile, train, and evaluate each model. The models are compiled with the Adam optimizer and sparse categorical crossentropy loss. They are then trained using the training data and evaluated on the testing data.

Model Training and Evaluation:

The Single Layer Perceptron, MLP, and Fully Connected DNN models are trained and evaluated for both MNIST and Fashion MNIST datasets.

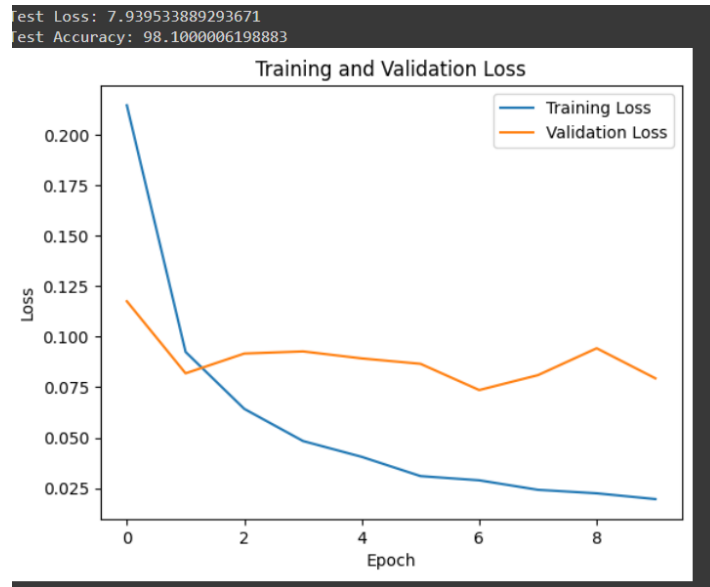


For each model, training loss, training accuracy, validation loss, validation accuracy, and test accuracy are printed.

For both the data set MNIST and Fashion-MNIST **fully connected DNN** has the most accuracy of **98.1%** and **87.98%** respectively.

Output and Visualization: The results of model training and evaluation are printed, showing the test loss and test accuracy for each model.

The loss visuals for DNN of MNIST and FMNIST are:



For DNN FMNIST:

