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2)	Implement a Classifier using an open-source dataset	7/8/2025	7/8/25
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1	1
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Exp-4 BUILD A SIMPLE FEED FORWARD NETWORK TO RECOGNIZE HANDWRITTEN CHARACTER

13/08

AIM:

To implement a simple feedforward neural network for handwritten digit recognition.

OBJECTIVE:

i) To load & preprocess the MNIST Dataset from raw idx format.

ii) To design a feedforward neural network architecture for classification of digits (0-9).

iii) To train the model using backpropagation.

iv) To test the trained model on a custom external image and verify its prediction.

OBSERVATION:

i) The MNIST dataset contains 60,000 training images and 10,000 testing images of handwritten digits (0-9).

ii) The images are grayscale and of size 28×28 pixels.

iii) The pixel values are normalised to the range [0,1] before training.

iv) The model initially achieved a test accuracy of 97% after training on the MNIST dataset.

v) During training, the loss decreased and accuracy increased steadily, showing that the model was learning effectively.

vi) The trained model was tested with an external image "test2.jpg". The model correctly predicted it as 5.

RESULT:-

The model was successfully trained on the MNIST dataset, achieving an intial accuracy of 97% on the test data. The model was able to correctly classify a custom handwritten digit image (test2.jpg) as digit 5.

14/8/25

```
PS C:\Users\aarus> & C:/Users/aarus/AppData/Local/Programs/Python/Python310/python.exe "c:/Users/aarus/OneDrive/Desktop/SRM/DLT/LAB 4/mnist_ffnn.py"
Training set shape: (60000, 784) (60000,)
Test set shape: (10000, 784) (10000,)
2025-08-13 22:27:00.250568: W tensorflow/stream_executor/platform/default/dso_loader.cc:64] Could not load dynamic library 'curand64_10.dll'; dlerror: curand64_10.dll not found
2025-08-13 22:27:00.251392: W tensorflow/stream_executor/platform/default/dso_loader.cc:64] Could not load dynamic library 'cusolver64_11.dll'; dlerror: cusolver64_11.dll not found
2025-08-13 22:27:00.252210: W tensorflow/stream_executor/platform/default/dso_loader.cc:64] Could not load dynamic library 'cusparse64_11.dll'; dlerror: cusparse64_11.dll not found
2025-08-13 22:27:00.252996: W tensorflow/core/common_runtime/gpu/gpu_device.cc:1934] Cannot dlopen some GPU libraries. Please make sure the missing libraries mentioned above are installed properly if y
ou would like to use GPU. Follow the guide at https://www.tensorflow.org/install/gpu for how to download and setup the required libraries for your platform.
Skipping registering GPU devices...
2025-08-13 22:27:00.253258: I tensorflow/core/platform/cpu_feature_guard.cc:193] This TensorFlow binary is optimized with oneAPI Deep Neural Network Library (oneDNN) to use the following CPU instructio
ns in performance-critical operations:  AVX AVX2
To enable them in other operations, rebuild TensorFlow with the appropriate compiler flags.
Epoch 1/10
1688/1688 [==============================] - 2s 1ms/step - loss: 0.2572 - accuracy: 0.9249 - val_loss: 0.1172 - val_accuracy: 0.9650
Epoch 2/10
1688/1688 [==============================] - 2s 1ms/step - loss: 0.1055 - accuracy: 0.9669 - val_loss: 0.0908 - val_accuracy: 0.9730
Epoch 3/10
1688/1688 [==============================] - 2s 1ms/step - loss: 0.0746 - accuracy: 0.9759 - val_loss: 0.0762 - val_accuracy: 0.9773
Epoch 4/10
1688/1688 [==============================] - 2s 1ms/step - loss: 0.0555 - accuracy: 0.9817 - val_loss: 0.0816 - val_accuracy: 0.9780
Epoch 5/10
1688/1688 [==============================] - 2s 1ms/step - loss: 0.0449 - accuracy: 0.9855 - val_loss: 0.0814 - val_accuracy: 0.9773
Epoch 6/10
1688/1688 [==============================] - 2s 1ms/step - loss: 0.0345 - accuracy: 0.9885 - val_loss: 0.0878 - val_accuracy: 0.9770
Epoch 7/10
1688/1688 [==============================] - 2s 1ms/step - loss: 0.0315 - accuracy: 0.9897 - val_loss: 0.0923 - val_accuracy: 0.9795
Epoch 8/10
1688/1688 [==============================] - 2s 1ms/step - loss: 0.0245 - accuracy: 0.9914 - val_loss: 0.0854 - val_accuracy: 0.9787
Epoch 9/10
1688/1688 [==============================] - 2s 1ms/step - loss: 0.0219 - accuracy: 0.9927 - val_loss: 0.0933 - val_accuracy: 0.9782
Epoch 10/10
1688/1688 [==============================] - 2s 1ms/step - loss: 0.0179 - accuracy: 0.9941 - val_loss: 0.1043 - val_accuracy: 0.9762
313/313 [==============================] - 0s 735us/step - loss: 0.0998 - accuracy: 0.9763
Test Accuracy: 97.63%
Model saved as mnist_ffnn_model.h5
PS C:\Users\aarus>
```

```
PS C:\Users\aarus> & C:/Users/aarus/AppData/Local/Programs/Python/Python310/python.exe "c:/Users/aarus/OneDrive/Desktop/SRM/DLT/LAB 4/testing.py"
2025-08-13 22:52:08.174990: W tensorflow/stream_executor/platform/default/dso_loader.cc:64] Could not load dynamic library 'curand64_10.dll'; dlerror: curand64_10.dll not found
2025-08-13 22:52:08.176004: W tensorflow/stream_executor/platform/default/dso_loader.cc:64] Could not load dynamic library 'cusolver64_11.dll'; dlerror: cusolver64_11.dll not found
2025-08-13 22:52:08.176910: W tensorflow/stream_executor/platform/default/dso_loader.cc:64] Could not load dynamic library 'cusparse64_11.dll'; dlerror: cusparse64_11.dll not found
2025-08-13 22:52:08.177635: W tensorflow/core/common_runtime/gpu/gpu_device.cc:1934] Cannot dlopen some GPU libraries. Please make sure the missing libraries mentioned above are installed properly if y
ou would like to use GPU. Follow the guide at https://www.tensorflow.org/install/gpu for how to download and setup the required libraries for your platform.
Skipping registering GPU devices...
2025-08-13 22:52:08.177942: I tensorflow/core/platform/cpu_feature_guard.cc:193] This TensorFlow binary is optimized with oneAPI Deep Neural Network Library (oneDNN) to use the following CPU instructio
ns in performance-critical operations:  AVX AVX2
To enable them in other operations, rebuild TensorFlow with the appropriate compiler flags.
1/1 [==============================] - 0s 49ms/step
Predicted digit: 5
PS C:\Users\aarus>
```