

## MULTILAYER PERCEPTRON MODEL(ONE HIDDEN LAYER WITH OUTPUT LAYER) :

Downloading data from <https://storage.googleapis.com/tensorflow/tf-keras-datasets/mnist.npz>  
11490434/11490434 [=====] - 0s 0us/step  
Epoch 1/10  
300/300 - 10s - loss: 0.2806 - accuracy: 0.9213 - val\_loss: 0.1561 - val\_accuracy: 0.9519 - 10s/epoch - 32ms/step  
Epoch 2/10  
300/300 - 6s - loss: 0.1095 - accuracy: 0.9683 - val\_loss: 0.0950 - val\_accuracy: 0.9724 - 6s/epoch - 22ms/step  
Epoch 3/10  
300/300 - 4s - loss: 0.0713 - accuracy: 0.9790 - val\_loss: 0.0888 - val\_accuracy: 0.9727 - 4s/epoch - 13ms/step  
Epoch 4/10  
300/300 - 4s - loss: 0.0499 - accuracy: 0.9860 - val\_loss: 0.0717 - val\_accuracy: 0.9785 - 4s/epoch - 13ms/step  
Epoch 5/10  
300/300 - 4s - loss: 0.0366 - accuracy: 0.9896 - val\_loss: 0.0679 - val\_accuracy: 0.9791 - 4s/epoch - 12ms/step  
Epoch 6/10  
300/300 - 4s - loss: 0.0259 - accuracy: 0.9928 - val\_loss: 0.0626 - val\_accuracy: 0.9804 - 4s/epoch - 13ms/step  
Epoch 7/10  
300/300 - 4s - loss: 0.0190 - accuracy: 0.9952 - val\_loss: 0.0604 - val\_accuracy: 0.9815 - 4s/epoch - 13ms/step  
Epoch 8/10  
300/300 - 4s - loss: 0.0146 - accuracy: 0.9963 - val\_loss: 0.0642 - val\_accuracy: 0.9806 - 4s/epoch - 13ms/step  
Epoch 9/10  
300/300 - 4s - loss: 0.0106 - accuracy: 0.9978 - val\_loss: 0.0570 - val\_accuracy: 0.9833 - 4s/epoch - 13ms/step  
Epoch 10/10  
300/300 - 4s - loss: 0.0082 - accuracy: 0.9984 - val\_loss: 0.0632 - val\_accuracy: 0.9814 - 4s/epoch - 13ms/step  
Baseline Error: 1.86%

## SINGLE LAYER CNN MODEL(ONE CONVOLUTION, POOLING AND FULLY CONNECTED LAYER) :

Epoch 1/10  
300/300 [=====] - 33s 109ms/step - loss: 0.2599 - accuracy: 0.9241 - val\_loss: 0.0868 - val\_accuracy: 0.9749  
Epoch 2/10  
300/300 [=====] - 33s 108ms/step - loss: 0.0791 - accuracy: 0.9761 - val\_loss: 0.0544 - val\_accuracy: 0.9815  
Epoch 3/10  
300/300 [=====] - 33s 109ms/step - loss: 0.0549 - accuracy: 0.9835 - val\_loss: 0.0462 - val\_accuracy: 0.9851  
Epoch 4/10  
300/300 [=====] - 32s 107ms/step - loss: 0.0345 - accuracy: 0.9892 - val\_loss: 0.0409 - val\_accuracy: 0.9854  
Epoch 5/10  
300/300 [=====] - 32s 107ms/step - loss: 0.0290 - accuracy: 0.9907 - val\_loss: 0.0402 - val\_accuracy: 0.9864  
Epoch 6/10  
300/300 [=====] - 32s 107ms/step - loss: 0.0236 - accuracy: 0.9926 - val\_loss: 0.0331 - val\_accuracy: 0.9892  
Epoch 7/10  
300/300 [=====] - 32s 107ms/step - loss: 0.0206 - accuracy: 0.9937 - val\_loss: 0.0346 - val\_accuracy: 0.9895  
Epoch 8/10  
300/300 [=====] - 32s 106ms/step - loss: 0.0165 - accuracy: 0.9944 - val\_loss: 0.0348 - val\_accuracy: 0.9889  
Epoch 9/10  
300/300 [=====] - 32s 105ms/step - loss: 0.0148 - accuracy: 0.9951 - val\_loss: 0.0331 - val\_accuracy: 0.9905  
CNN Error: 0.95%

## MULTI LAYER CNN MODEL(ONE CONVOLUTION, POOLING AND FULLY CONNECTED LAYER) :

Epoch 1/10  
300/300 [=====] - 39s 128ms/step - loss: 0.3992 - accuracy: 0.8744 - val\_loss: 0.0781 - val\_accuracy: 0.9765  
Epoch 2/10  
300/300 [=====] - 38s 127ms/step - loss: 0.0951 - accuracy: 0.9714 - val\_loss: 0.0530 - val\_accuracy: 0.9834  
Epoch 3/10  
300/300 [=====] - 38s 126ms/step - loss: 0.0714 - accuracy: 0.9774 - val\_loss: 0.0410 - val\_accuracy: 0.9877  
Epoch 4/10  
300/300 [=====] - 38s 126ms/step - loss: 0.0569 - accuracy: 0.9821 - val\_loss: 0.0367 - val\_accuracy: 0.9870  
Epoch 5/10  
300/300 [=====] - 38s 126ms/step - loss: 0.0476 - accuracy: 0.9851 - val\_loss: 0.0283 - val\_accuracy: 0.9909  
Epoch 6/10  
300/300 [=====] - 38s 126ms/step - loss: 0.0423 - accuracy: 0.9869 - val\_loss: 0.0298 - val\_accuracy: 0.9901  
Epoch 7/10  
300/300 [=====] - 38s 126ms/step - loss: 0.0369 - accuracy: 0.9884 - val\_loss: 0.0248 - val\_accuracy: 0.9921  
Epoch 8/10  
300/300 [=====] - 38s 126ms/step - loss: 0.0341 - accuracy: 0.9891 - val\_loss: 0.0258 - val\_accuracy: 0.9918  
Epoch 9/10  
300/300 [=====] - 38s 127ms/step - loss: 0.0314 - accuracy: 0.9898 - val\_loss: 0.0275 - val\_accuracy: 0.9910  
Epoch 10/10  
300/300 [=====] - 38s 127ms/step - loss: 0.0295 - accuracy: 0.9905 - val\_loss: 0.0237 - val\_accuracy: 0.9923  
Large CNN Error: 0.77%