Deep Learning Task 02

- Custom MNIST dataset
- Train model on Custom dataset and MNIST dataset
- Cross Validation

Custom Dataset:

For this task a Dataset has been Collection on a High-Resolution Camera. Each digit is handwritten on a plane A4 page. A python script is attached which take images automatically after 0.2 secs. A balanced dataset is created which has about 350 images in each class from 0 to 9.

Model Training:

A simple deep learning model is created containing 2 convolution layers and 2 dense layers with trainable parameters of 225034 and trained for 20 epochs on both the custom and MNIST dataset.

```
Model: "sequential_3"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 conv2d_7 (Conv2D)           (None, 26, 26, 32)        320

 max_pooling2d_7 (MaxPoolin  (None, 13, 13, 32)        0
 g2D)

 conv2d_8 (Conv2D)           (None, 11, 11, 64)        18496

 max_pooling2d_8 (MaxPoolin  (None, 5, 5, 64)          0
 g2D)

 flatten_3 (Flatten)         (None, 1600)              0

 dense_6 (Dense)             (None, 128)               204928

 dense_7 (Dense)             (None, 10)                1290

=================================================================
Total params: 225034 (879.04 KB)
Trainable params: 225034 (879.04 KB)
Non-trainable params: 0 (0.00 Byte)
_________________________________________________________________
```

Figure 1: Model Summery

```
Epoch 19/20
89/89 [==============================] - 2s 24ms/step - loss: 0.0046 - accuracy: 0.9986 - val_loss: 0.2814 - val_accuracy: 0.9339
Epoch 20/20
89/89 [==============================] - 2s 24ms/step - loss: 0.0039 - accuracy: 0.9986 - val_loss: 0.2916 - val_accuracy: 0.9367
```

Figure 2: Performance on Custom Dataset

```
Epoch 19/20
1875/1875 [==============================] - 15s 8ms/step - loss: 0.0040 - accuracy: 0.9987 - val_loss: 0.0532 - val_accuracy: 0.9912
Epoch 20/20
1875/1875 [==============================] - 15s 8ms/step - loss: 0.0025 - accuracy: 0.9993 - val_loss: 0.0873 - val_accuracy: 0.9861
```

Figure 3: Model performance on MNIST dataset

Cross Validation:

The model looks well generalized on the MNIST dataset because it is a large dataset while it showed little over fitness on the custom dataset.
On the other hand, cross validation on the MNIST dataset the model showed very poor performance, due to the **DATA DRIFT**. I mean the distribution of the MNIST dataset is much different from the custom dataset created.

```
from tensorflow.keras.models import load_model

# Load the custom MNIST model
custom_mnist_model = load_model('custom_mnist_model.h5')

# Load the MNIST model
mnist_model = load_model('mnist_model.h5')
```

```
[17] ✓ 0.2s
```

```
loss, accuracy = custom_mnist_model.evaluate(test_images, test_labels)
```

```
[18] ✓ 0.8s
313/313 [==============================] - 1s 2ms/step - loss: 2.3729 - accuracy: 0.1114
```

```
loss, accuracy = mnist_model.evaluate(validation_dataset)
```

```
[19] ✓ 0.5s
23/23 [==============================] - 0s 10ms/step - loss: 1132.9048 - accuracy: 0.1125
```

Figure 4:Cross Validation