Sprint2

Team ID	PNT2022TMID46416
Project Name	Project – A novel method for handwritten digitrecognition
Date	22 October 2022

```
import numpy #for numerical analysis
import tensorflow #open source ml tool by google



from tensorflow.keras.datasets import mnist #mnist dataset
from tensorflow.keras.models import Sequential
from tensorflow.keras import layers


from tensorflow.keras.layers import Dense,Flatten
from tensorflow.keras.layers import Conv2D
from tensorflow import keras


from tensorflow.keras.optimizers import Adam
from keras.utils import np_utils
```

LOADING DATASET

```
(x_train,y_train),(x_test,y_test)=mnist.load_data()


print(x_train.shape)
print(y_train.shape)
```

```
(60000, 28, 28)
(60000,)
```

```
print(x_test.shape)
print(y_test.shape)
```

```
(10000, 28, 28)
(10000,)
```

ANALYZE THE DATA

```
x_train[3]
```

```
          0,   0],
       [  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
          0,   0,  60, 228, 251, 251,  94,   0,   0,   0,   0,   0,   0,
          0,   0],
       [  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
          0,   0, 155, 253, 253, 189,   0,   0,   0,   0,   0,   0,   0,
          0,   0],
       [  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
          0,  20, 253, 251, 235,  66,   0,   0,   0,   0,   0,   0,   0,
          0,   0],
       [  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
```

```
  32, 205, 253, 251, 126,   0,   0,   0,   0,   0,   0,   0,   0,
   0,   0],
[  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
 104, 251, 253, 184,  15,   0,   0,   0,   0,   0,   0,   0,   0,
   0,   0],
[  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,  80,
 240, 251, 193,  23,   0,   0,   0,   0,   0,   0,   0,   0,   0,
   0,   0],
[  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,  32, 253,
 253, 253, 159,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
   0,   0],
[  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0, 151, 251,
 251, 251,  39,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
   0,   0],
[  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,  48, 221, 251,
 251, 172,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
   0,   0],
[  0,   0,   0,   0,   0,   0,   0,   0,   0,   0, 234, 251, 251,
 196,  12,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
   0,   0],
[  0,   0,   0,   0,   0,   0,   0,   0,   0,   0, 253, 251, 251,
  89,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
   0,   0],
[  0,   0,   0,   0,   0,   0,   0,   0,   0, 159, 255, 253, 253,
  31,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
   0,   0],
[  0,   0,   0,   0,   0,   0,   0,   0,  48, 228, 253, 247, 140,
   8,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
   0,   0],
[  0,   0,   0,   0,   0,   0,   0,   0,  64, 251, 253, 220,   0,
   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
   0,   0],
[  0,   0,   0,   0,   0,   0,   0,   0,  64, 251, 253, 220,   0,
   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
   0,   0],
[  0,   0,   0,   0,   0,   0,   0,   0,  24, 193, 253, 220,   0,
   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
   0,   0],
[  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
   0,   0],
[  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
   0,   0],
[  0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,   0,
   0,   0]], dtype=uint8)
```

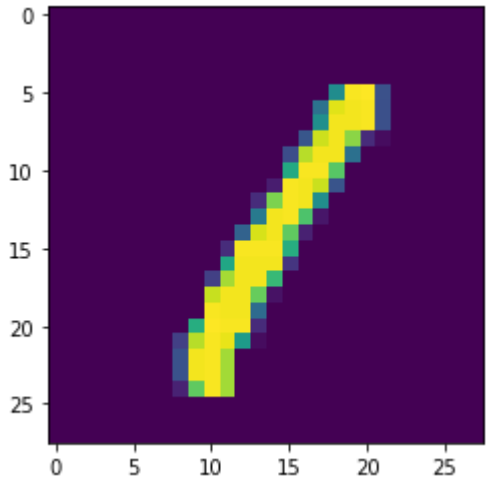
```
y_train[3]
```

```
1
```

```
import matplotlib.pyplot as plt
```

```
plt.imshow(x_train[3])
```

```
<matplotlib.image.AxesImage at 0x7efc78d14b10>
```



RESHAPING THE DATA.

```
x_train=x_train.reshape(60000,28,28,1).astype('float32')
x_test=x_test.reshape(10000,28,28,1).astype('float32')
```

APPLY ONE HOT ENCODING

```
no_of_classes=10
y_train=np_utils.to_categorical(y_train,no_of_classes)
y_test=np_utils.to_categorical(y_test,no_of_classes)
```

```
y_test[3]
```

```
array([1., 0., 0., 0., 0., 0., 0., 0., 0., 0.], dtype=float32)
```

CREATE THE MODEL

```
model=Sequential()

model.add(Conv2D(64,(3,3),input_shape=(28,28,1),activation='relu'))
model.add(Conv2D(32,(3,3),activation='relu'))

model.add(Flatten())
model.add(Dense(no_of_classes,activation='softmax'))
```

COMPILING THE MODEL

```
model.compile(loss='categorical_crossentropy',optimizer='Adam',metrics=['accuracy'])
```

TRAIN THE MODEL

```
model.fit(x_train,y_train,validation_data=(x_test,y_test),epochs=5,batch_size=32)
```

```
Epoch 1/5
1875/1875 [==============================] - 128s 68ms/step - loss: 0.2302 - accurac
Epoch 2/5
1875/1875 [==============================] - 127s 68ms/step - loss: 0.0649 - accurac
Epoch 3/5
1875/1875 [==============================] - 123s 66ms/step - loss: 0.0454 - accurac
Epoch 4/5
1875/1875 [==============================] - 126s 67ms/step - loss: 0.0364 - accurac
Epoch 5/5
1875/1875 [==============================] - 124s 66ms/step - loss: 0.0271 - accurac
<keras.callbacks.History at 0x7efc7452f890>
```

METRICS ARE NOTED

```
metrics=model.evaluate(x_test,y_test,verbose=0)
print("metrics-score=>test loss & accuracy")
print(metrics)
```

```
metrics-score=>test loss & accuracy
[0.11036540567874908, 0.9764000177383423]
```

TEST THE MODEL

```
prediction=model.predict(x_test[:5])
print(prediction)
```

```
1/1 [==============================] - 0s 84ms/step
[[6.25657795e-15 1.05156142e-18 1.22086008e-09 2.45196552e-09
  1.33981165e-17 9.07641993e-17 4.98111414e-19 1.00000000e+00
  2.75971468e-11 2.33391622e-11]
 [1.02854422e-12 5.58150123e-11 1.00000000e+00 9.26562091e-11
  2.58257417e-17 1.22140988e-20 3.76503646e-12 2.03179154e-18
  2.17259214e-11 2.70688090e-21]
 [2.85233637e-09 9.99993920e-01 5.40673739e-07 3.44808820e-10
  2.74280274e-06 1.12679146e-07 4.11499196e-10 7.90978660e-09
  2.64735422e-06 2.92728147e-10]
 [9.99999881e-01 5.13201010e-16 9.24923071e-08 8.89283981e-13
  1.56655305e-14 1.21902911e-12 6.39609754e-11 1.28959387e-12
  8.11355072e-09 2.94187679e-08]
 [8.81784663e-12 1.38155817e-13 5.78738706e-12 1.68293005e-10
  9.99999285e-01 4.03126352e-16 3.91080943e-18 3.06052591e-15
  4.98500893e-11 7.03791216e-07]]
```

```
import numpy as np
```

```
print(np.argmax(prediction,axis=1))
```

```
[7 2 1 0 4]
```

```
print(y_test[:5])
```

```
[[0. 0. 0. 0. 0. 0. 0. 1. 0. 0.]
 [0. 0. 1. 0. 0. 0. 0. 0. 0. 0.]
 [0. 1. 0. 0. 0. 0. 0. 0. 0. 0.]
 [1. 0. 0. 0. 0. 0. 0. 0. 0. 0.]
 [0. 0. 0. 0. 1. 0. 0. 0. 0. 0.]]
```

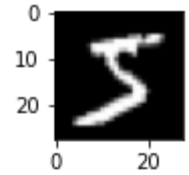
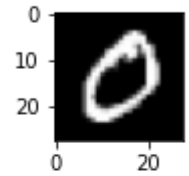
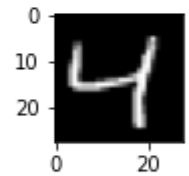
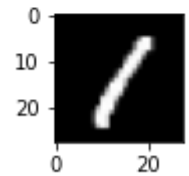
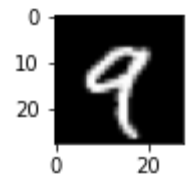
SAVING THE MODEL

```
model.save('models/mnistcnn.h5')
```

TEST THE SAVED MODEL

```
print('x_train:' +str(x_train.shape))
print('y_train:' +str(y_train.shape))
print('x_test:' +str(x_test.shape))
print('y_test:' +str(y_test.shape))
from matplotlib import pyplot
for i in range(9):
  pyplot.subplot(330+1+i)
  pyplot.imshow(x_train[i],cmap=pyplot.get_cmap('gray'))
  pyplot.show()
```

```
x_train:(60000, 28, 28)
y_train:(60000,)
x_test:(10000, 28, 28)
y_test:(10000,)
```


```
from tensorflow.keras.models import load_model
model=load_model('models/mnistcnn.h5')
from PIL import Image
for index in range(9):
  img=x_train[index].reshape((28,28))
  imgarray=np.array(img)
  imgarray=imgarray.reshape(1,28,28,1)
  y_pred=model.predict(imgarray)
  print(np.argmax(y_pred))
```

```
1/1 [==============================] - 0s 58ms/step
5
1/1 [==============================] - 0s 19ms/step
0
1/1 [==============================] - 0s 20ms/step
4
1/1 [==============================] - 0s 16ms/step
1
1/1 [==============================] - 0s 21ms/step
9
1/1 [==============================] - 0s 22ms/step
2
```

```
1/1 [==============================] - 0s 19ms/step
1
1/1 [==============================] - 0s 17ms/step
3
1/1 [==============================] - 0s 18ms/step
1
```

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