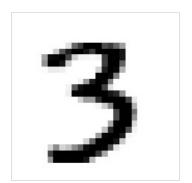
```
In [1]: import numpy as np
           import matplotlib.pyplot as plt
           import pandas as pd
           import os
           import tensorflow as tf
           import seaborn as sns
In [2]: mnist=tf.keras.datasets.mnist
In [3]: mnist
           <module 'keras.api._v2.keras.datasets.mnist' from '/usr/local/lib/python3.8/dist-packages/keras/api/_v2/keras/d</pre>
           atasets/mnist/_init__.py'>
In [5]: (X_train_full,y_train_full),(X_test,y_test)=mnist.load_data()
In [6]: X_train_full
Out[6]: array([[[0, 0, 0, ..., 0, 0, 0],
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In [7]: X train full.shape
           (60000, 28, 28)
Out[7]:
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In [8]: X train full[5000]

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In [15]: plt.figure(figsize=(20,20))
sns.heatmap(X_train_full[9000],annot=True,cmap="binary")
```

Out[15]: <matplotlib.axes._subplots.AxesSubplot at 0x7f6b077d62b0>

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```
In [16]: # Scale the data between 0 to 1 by dividing it by 255. as its an unsigned data between 0-255 range
    X_valid, X_train = X_train_full[:5000] / 255., X_train_full[5000:] / 255.
    y_valid, y_train = y_train_full[:5000], y_train_full[5000:]
```

```
In [17]: # scale the test set as well
X_test = X_test / 255.
```

In [18]: print(X_valid.shape)
 print(X_train.shape)

```
print(y_valid.shape)
            print(y_train.shape)
            (5000, 28, 28)
            (55000, 28, 28)
            (5000,)
            (55000,)
            plt.figure(figsize=(15,15))
In [20]:
            sns.heatmap(X_train[1000],annot=True,cmap="binary")
            <matplotlib.axes._subplots.AxesSubplot at 0x7f6b01eaefd0>
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In [21]:
            LAYERS=[tf.keras.layers.Flatten(input_shape=[28,28],name="inputlayer"),
                      tf.keras.layers.Dense(300,activation='relu',name="hiddenlayer1"),
                       tf.keras.layers.Dense(100,activation='relu',name="hiddenlayer2"),
                       tf.keras.layers.Dense(10,activation='softmax',name="outputlayer")]
 In [ ]: # you need to build a best to best model with hyperpparameter tuning
            # for the hyperparameter tuning you need to use keras tuner
            model clf=tf.keras.models.Sequential(LAYERS)
            model clf.summary()
In [23]:
```

In [44]: pd.DataFrame(history.history)

	- Laura (tura)	Outrot Chan	Da #	
	Layer (type)	Output Shape	Param # 	
	inputlayer (Flatten)	(None, 784)	0	
	hiddenlayer1 (Dense)	(None, 300)	235500	
	hiddenlayer2 (Dense)	(None, 100)	30100	
	outputlayer (Dense)	(None, 10)	1010	
	Total params: 266,610 Trainable params: 266,610 Non-trainable params: 0			
In [25]:	LOSS_FUNCTION="sparse_categ OPTIMIZER="ADAM" METRICS=["accuracy"]	orical_crossentropy"		
In [26]:	<pre>model_clf.compile(loss=LOSS_FUNCTION,optimizer=OPTIMIZER,metrics=METRICS)</pre>			
In [29]:	model_clf.layers[1].name			
Out[29]:	'hiddenlayer1'			
	hidden1=model clf.layers[1]			
	-			
In [33]:	<pre># you can get the wrights of the layers weights,biases=hidden1.get_weights()</pre>			
In [35]:	55000/32			
Out[35]:	1718.75			
In [34]:	<pre>EPOCHS=5 VALIDATION_SET=(X_valid,y_valid) history=model_clf.fit(X_train,y_train,epochs=EPOCHS,validation_data=VALIDATION_SET)</pre>			
	<pre>val_accuracy: 0.9660 Epoch 2/5 1719/1719 [====================================</pre>	=====] - 5s 3	Bms/step - loss: 0	0.2192 - accuracy: 0.9339 - val_loss: 0.1158 - 0.0860 - accuracy: 0.9740 - val_loss: 0.0844 -
	<pre>val_accuracy: 0.9774 Epoch 4/5 1719/1719 [====================================</pre>	=====] - 5s 3	Bms/step - loss: 0	0.0417 - accuracy: 0.9867 - val_loss: 0.0884 - 0.0333 - accuracy: 0.9894 - val_loss: 0.0711 -
In [40]:	<pre>import time import os def saveModel_path(model_dir="/content/SAVED_MODELS/"): os.makedirs(model_dir, exist_ok=True) fileName = time.strftime("Model_%Y_%m_%d_%H_%M_%Sh5") model_path = os.path.join(model_dir, fileName) print(f"your model will be saved at the following location\n{model_path}") return model_path</pre>			
In [41]:	model clf.save(saveModel pa	th())		
T. [41]:	your model will be saved at the following location /content/SAVED MODELS/Model 2023 01 22 10 59 59 .h5			
In [42]:	history.params			
	{'verbose': 1, 'epochs': 5,	'steps': 1719}		
Out[42]:	(_ 1000 . 1/10]		

```
        Out[44]:
        loss
        accuracy
        val_loss
        val_accuracy

        0
        0.219157
        0.933945
        0.115808
        0.9660

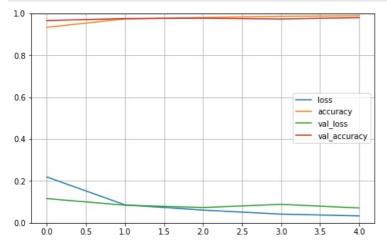
        1
        0.086042
        0.974018
        0.084393
        0.9758

        2
        0.060955
        0.980291
        0.073213
        0.9774

        3
        0.041691
        0.986709
        0.088411
        0.9738

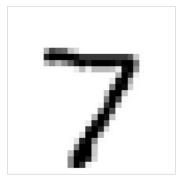
        4
        0.033321
        0.989382
        0.071145
        0.9800
```

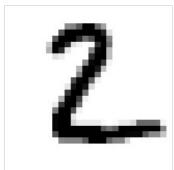
```
In [45]: pd.DataFrame(history.history).plot(figsize=(8, 5))
plt.grid(True)
plt.gca().set_ylim(0, 1)
plt.show()
```

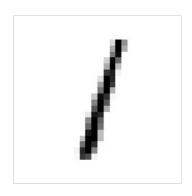


Out[66]: [0.08301505446434021, 0.9767000079154968]

```
for i in range(0,3):
    #print(i)
    plt.imshow(X_test[i],cmap='binary')
    plt.axis("off")
    plt.show()
```







```
In [55]: prediction=model_clf.predict(X_test[:3])
                       1/1 [=======] - 0s 15ms/step
In [56]: prediction
Out[56]: array([[1.5712156e-11, 3.2250725e-07, 1.3399878e-07, 5.9835878e-07,
                                           1.9119368e-09, 1.1688328e-09, 7.6079727e-14, 9.9999857e-01,
                                           7.3059079e-09, 3.4830333e-07],
                                         [4.2223512e-14,\ 4.2435655e-08,\ 1.00000000e+00,\ 1.3242778e-10,
                                           2.0914447e-13, 3.4231471e-15, 8.9540014e-15, 8.6065085e-16,
                                         5.4733568e-11, 3.4164059e-13],
[1.3237576e-06, 9.9926108e-01, 1.2414756e-06, 2.4600706e-06,
                                           2.4581130e-04, 7.8345156e-06, 1.9230753e-04, 2.0784133e-05,
                                           2.6632249e-04, 8.1482580e-07]], dtype=float32)
In [59]: y_prob=prediction[0]
In [62]: np.argmax(y_prob.round(5))
Out[62]:
In [63]: y_prob=prediction[1]
In [64]:
                       np.argmax(y_prob)
Out[64]: 2
  In [ ]: model_clf.predict(X_test)
  In []: from tf.keras.models import load model
                       model=load model("/content/SAVED MODELS/Model 2023 01 22 10 59 59 .h5")
                       #tensorboard
In [69]:
                       import time
                        def get_log_path(log_dir="/content/logs/fit"):
                                  fileName = time.strftime("log_%Y_%m_%d_%H_%M_%S")
log_path = os.path.join(log_dir, fileName)
                                  print(f"saving logs at:\n{log_path}")
                                  return log path
                       log_dir = get_log_path()
                       saving logs at:
                       /content/logs/fit/log 2023 01 22 11 42 44
In [70]: tensorboard_callback =tf.keras.callbacks.TensorBoard(log_dir=log_dir, histogram_freq=1)
In [71]:
                       EP0CHS=5
                        VALIDATION SET=(X_valid,y_valid)
                       history = model\_clf.fit(X\_train, y\_train, epochs = EPOCHS, validation\_data = VALIDATION\_SET, callbacks = [tensorboard\_callbacks = [tensorboard\_c
```

```
Epoch 1/5
           1719/1719 [=====
   val_accuracy: 0.9722
   Epoch 2/5
   val_accuracy: 0.9716
   Epoch 3/5
   val_accuracy: 0.9796
   Epoch 4/5
   val_accuracy: 0.9822
   Epoch 5/5
   val_accuracy: 0.9788
In [72]: %load_ext tensorboard
In [73]: %reload_ext tensorboard
In [74]: %tensorboard --logdir logs/fit
```

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In []: