In [ ]:

```
from keras.models import load_model
import tensorflow as tf
```

Load the MNIST Model -1

In [ ]:

```
import tarfile
my_tar = tarfile.open('mnist.tar.gz')
my_tar.extractall()
my_tar.close()
```

Load MNIST MODEL -2

In [ ]:

```
import tarfile
my_tar = tarfile.open('mnist_v1.tar.gz')
my_tar.extractall()
my_tar.close()
```

In [ ]:

```
!ls saved_model/my_model
```

```
assets  saved_model.pb  variables
```

In [ ]:

```
model_v1 = tf.keras.models.load_model('saved_model/my_model')
```

```
WARNING:tensorflow:SavedModel saved prior to TF 2.5 detected when loading Keras model. Please ensure
that you are saving the model with model.save() or tf.keras.models.save_model(), *NOT* tf.saved_mode
l.save(). To confirm, there should be a file named "keras_metadata.pb" in the SavedModel directory.
```

In [ ]:

```
model_v1.summary()
```

```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 conv2d (Conv2D)             (None, 28, 28, 32)        832

 conv2d_1 (Conv2D)           (None, 28, 28, 32)        25632

 max_pooling2d (MaxPooling2D  (None, 14, 14, 32)       0
 )

 dropout (Dropout)           (None, 14, 14, 32)        0

 conv2d_2 (Conv2D)           (None, 14, 14, 64)        51264

 conv2d_3 (Conv2D)           (None, 14, 14, 64)        102464

 max_pooling2d_1 (MaxPooling  (None, 7, 7, 64)         0
 2D)

 dropout_1 (Dropout)         (None, 7, 7, 64)          0

 flatten (Flatten)           (None, 3136)              0

 dense (Dense)               (None, 512)               1606144

 dropout_2 (Dropout)         (None, 512)               0

 dense_1 (Dense)             (None, 10)                5130

=================================================================
Total params: 1,791,466
Trainable params: 1,791,466
Non-trainable params: 0
_________________________________________________________________
```

In [ ]:

```
!ls saved_model_v2/
```

```
my_model_v2
```

In [ ]:

```
!ls saved_model_v2/my_model_v2/
```

```
assets  saved_model.pb  variables
```

In [ ]:

```
import warnings
warnings.filterwarnings("ignore")
model_v2 = tf.keras.models.load_model('saved_model_v2/my_model_v2')
```

```
WARNING:tensorflow:SavedModel saved prior to TF 2.5 detected when loading Keras model. Please ensure
that you are saving the model with model.save() or tf.keras.models.save_model(), *NOT* tf.saved_mode
l.save(). To confirm, there should be a file named "keras_metadata.pb" in the SavedModel directory.
```

In [ ]:

```
model_v2.summary()
```

```
Model: "sequential_2"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 conv2d_9 (Conv2D)           (None, 28, 28, 64)        1664

 batch_normalization (BatchN  (None, 28, 28, 64)       112
 ormalization)

 conv2d_10 (Conv2D)          (None, 28, 28, 64)        102464

 batch_normalization_1 (Batc  (None, 28, 28, 64)       112
 hNormalization)

 max_pooling2d_5 (MaxPooling  (None, 14, 14, 64)       0
 2D)

 batch_normalization_2 (Batc  (None, 14, 14, 64)       56
 hNormalization)

 conv2d_11 (Conv2D)          (None, 14, 14, 64)        102464

 batch_normalization_3 (Batc  (None, 14, 14, 64)       56
 hNormalization)

 conv2d_12 (Conv2D)          (None, 14, 14, 64)        102464

 batch_normalization_4 (Batc  (None, 14, 14, 64)       56
 hNormalization)

 max_pooling2d_6 (MaxPooling  (None, 7, 7, 64)         0
 2D)

 flatten_3 (Flatten)         (None, 3136)              0

 batch_normalization_5 (Batc  (None, 3136)             12544
 hNormalization)

 dense_7 (Dense)             (None, 512)               1606144

 batch_normalization_6 (Batc  (None, 512)              2048
 hNormalization)

 dense_8 (Dense)             (None, 10)                5130

=================================================================
Total params: 1,935,314
Trainable params: 1,927,822
Non-trainable params: 7,492
_________________________________________________________________
```

In [ ]:

```
!pip install -q streamlit
```

In [ ]:

```
!pip install -q pyngrok
```

In [ ]:

```
!pip install -q streamlit_ace
```

REFERENCE: https://www.analyticsvidhya.com/blog/2020/12/deploying-machine-learning-models-using-streamlit-an-introductory-guide-to-model-deployment/ (https://www.analyticsvidhya.com/blog/2020/12/deploying-machine-learning-models-using-streamlit-an-introductory-guide-to-model-deployment/)

In [ ]:

```
import pandas as pd
import streamlit as st
```

In [ ]:

```
test_data = pd.read_csv("test.csv")
```

In [ ]:

```
test_data.head()
```

Out[ ]:

	pixel0	pixel1	pixel2	pixel3	pixel4	pixel5	pixel6	pixel7	pixel8	pixel9	...	pixel774	pixel775	pixel776	pixel777	pixel778
0	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	...	0	0	0	0	0

5 rows x 784 columns

In [ ]:

```
test_data.shape
```

Out[ ]:

```
(28000, 784)
```

In [ ]:

```
test_data['pixel1'].value_counts()
```

Out[ ]:

```
0    28000
Name: pixel1, dtype: int64
```

In [ ]:

```
import matplotlib.pyplot as plt
import numpy as np
```

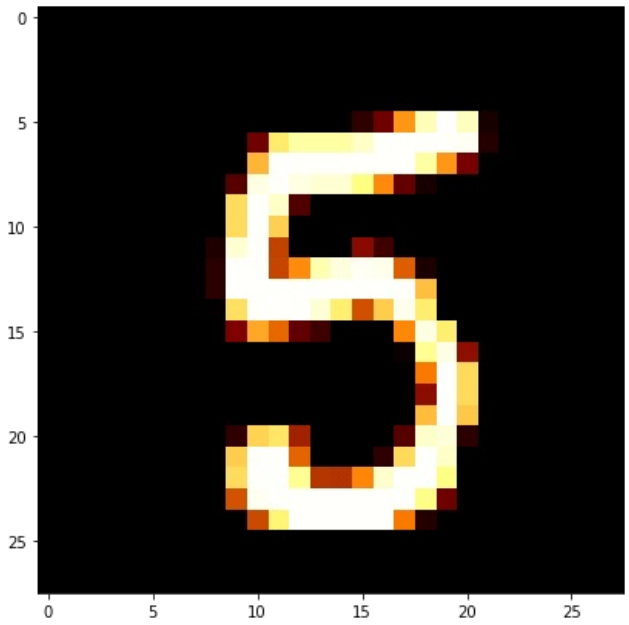
In [ ]:

```
def image_show(X,idx):
  plt.figure(figsize=(7,7))
  grid_data = X.iloc[idx].to_numpy().reshape(28,28)
  plt.imshow(grid_data,interpolation=None,cmap='afmhot')
  plt.show()
```

In [ ]:

```
test_data = test_data/255.0

image_show(test_data,10)
```



In [ ]:

```
def prediction(idx):
  plt.figure(figsize=(7,7))
  image= test_data.iloc[idx].to_numpy().reshape(1,28,28)
  p = model_v1.predict(image)
  return p
```

In [ ]:

```
p = prediction(9)
print("prediction {}".format(np.argmax(p)))
```

```
prediction 3
```

```
<Figure size 504x504 with 0 Axes>
```

Model Deployment of MNIST DATA set using streamlit library

In [ ]:

```
%%writefile app.py
import streamlit as st
import matplotlib.pyplot as plt
from keras.models import load_model
import tensorflow as tf
import numpy as np
import pandas as pd
model_v1 = tf.keras.models.load_model('saved_model/my_model')
test_data = pd.read_csv("test.csv")
def prediction(idx):
  idx = int(idx)
  plt.figure(figsize=(7,7))
  image= test_data.iloc[idx].to_numpy().reshape(1,28,28)
  p = model_v1.predict(image)
  return p
# this is main function which defines the web pages
def main():
   #front end element on web pages
   html_temp = """
   <div style ="background-color:yellow;padding:13px">
   <h1 style ="color:black;text-align:center;">Digit Recogintion</h1>
   </div>
   """
   # display the front end aspect
   st.markdown(html_temp, unsafe_allow_html = True)
   idx = st.number_input("Enter the MNIST image index")
   result= " "
   if st.button("Predict"):
     result = prediction(idx)
     st.success("MNIST digit Recogintion based on entered image's index =  {}".format(np.argmax(result)))
if __name__=='__main__':
    main()
```

```
Overwriting app.py
```

In [ ]:

```
!streamlit run app.py &>/dev/null&
```

In [ ]:

```
!ngrok authtoken 24QK9tsxhgVhAIssPQhPrFNQSWg_3j6PtXWiKHCUnCtXn6BbG
```

```
Authtoken saved to configuration file: /root/.ngrok2/ngrok.yml
```

In [ ]:

```
from pyngrok import ngrok
public_url = ngrok.connect('8501')
public_url
```

```
INFO:pyngrok.ngrok:Opening tunnel named: http-8501-6a1477c9-ea55-4714-b1d7-68b961dd0ea7
2022-09-12 19:03:11.716 INFO    pyngrok.ngrok: Opening tunnel named: http-8501-6a1477c9-ea55-4714-b1
d7-68b961dd0ea7
INFO:pyngrok.process.ngrok:t=2022-09-12T19:03:11+0000 lvl=info msg="no configuration paths supplied"
2022-09-12 19:03:11.860 INFO    pyngrok.process.ngrok: t=2022-09-12T19:03:11+0000 lvl=info msg="no c
onfiguration paths supplied"
INFO:pyngrok.process.ngrok:t=2022-09-12T19:03:11+0000 lvl=info msg="using configuration at default c
onfig path" path=/root/.ngrok2/ngrok.yml
2022-09-12 19:03:11.868 INFO    pyngrok.process.ngrok: t=2022-09-12T19:03:11+0000 lvl=info msg="usin
g configuration at default config path" path=/root/.ngrok2/ngrok.yml
INFO:pyngrok.process.ngrok:t=2022-09-12T19:03:11+0000 lvl=info msg="open config file" path=/root/.ng
rok2/ngrok.yml err=nil
2022-09-12 19:03:11.876 INFO    pyngrok.process.ngrok: t=2022-09-12T19:03:11+0000 lvl=info msg="open
config file" path=/root/.ngrok2/ngrok.yml err=nil
INFO:pyngrok.process.ngrok:t=2022-09-12T19:03:11+0000 lvl=info msg="starting web service" obj=web ad
dr=127.0.0.1:4040
2022-09-12 19:03:11.884 INFO    pyngrok.process.ngrok: t=2022-09-12T19:03:11+0000 lvl=info msg="star
ting web service" obj=web addr=127.0.0.1:4040
INFO:pyngrok.process.ngrok:t=2022-09-12T19:03:12+0000 lvl=info msg="tunnel session started" obj=tunn
els.session
2022-09-12 19:03:12.031 INFO    pyngrok.process.ngrok: t=2022-09-12T19:03:12+0000 lvl=info msg="tunn
el session started" obj=tunnels.session
INFO:pyngrok.process.ngrok:t=2022-09-12T19:03:12+0000 lvl=info msg="client session established" obj=
csess id=ba6443affdb0
2022-09-12 19:03:12.041 INFO    pyngrok.process.ngrok: t=2022-09-12T19:03:12+0000 lvl=info msg="clie
nt session established" obj=csess id=ba6443affdb0
INFO:pyngrok.process.ngrok:t=2022-09-12T19:03:12+0000 lvl=info msg=start pg=/api/tunnels id=25da1acf
266fdeae
2022-09-12 19:03:12.069 INFO    pyngrok.process.ngrok: t=2022-09-12T19:03:12+0000 lvl=info msg=start
pg=/api/tunnels id=25da1acf266fdeae
INFO:pyngrok.process.ngrok:t=2022-09-12T19:03:12+0000 lvl=info msg=end pg=/api/tunnels id=25da1acf26
6fdeae status=200 dur=460.431µs
2022-09-12 19:03:12.082 INFO    pyngrok.process.ngrok: t=2022-09-12T19:03:12+0000 lvl=info msg=end p
g=/api/tunnels id=25da1acf266fdeae status=200 dur=460.431µs
INFO:pyngrok.process.ngrok:t=2022-09-12T19:03:12+0000 lvl=info msg=start pg=/api/tunnels id=8c31481f
2f4089b1
2022-09-12 19:03:12.097 INFO    pyngrok.process.ngrok: t=2022-09-12T19:03:12+0000 lvl=info msg=start
pg=/api/tunnels id=8c31481f2f4089b1
INFO:pyngrok.process.ngrok:t=2022-09-12T19:03:12+0000 lvl=info msg=end pg=/api/tunnels id=8c31481f2f
4089b1 status=200 dur=132.412µs
2022-09-12 19:03:12.103 INFO    pyngrok.process.ngrok: t=2022-09-12T19:03:12+0000 lvl=info msg=end p
g=/api/tunnels id=8c31481f2f4089b1 status=200 dur=132.412µs
INFO:pyngrok.process.ngrok:t=2022-09-12T19:03:12+0000 lvl=info msg=start pg=/api/tunnels id=c4977021
6db854d3
2022-09-12 19:03:12.109 INFO    pyngrok.process.ngrok: t=2022-09-12T19:03:12+0000 lvl=info msg=start
pg=/api/tunnels id=c49770216db854d3
INFO:pyngrok.process.ngrok:t=2022-09-12T19:03:12+0000 lvl=info msg="started tunnel" obj=tunnels name
="http-8501-6a1477c9-ea55-4714-b1d7-68b961dd0ea7 (http)" addr=http://localhost:8501 url=http://58b0-
34-138-217-149.ngrok.io
2022-09-12 19:03:12.160 INFO    pyngrok.process.ngrok: t=2022-09-12T19:03:12+0000 lvl=info msg="star
ted tunnel" obj=tunnels name="http-8501-6a1477c9-ea55-4714-b1d7-68b961dd0ea7 (http)" addr=http://loc
alhost:8501 url=http://58b0-34-138-217-149.ngrok.io
```

Out[ ]:

```
<NgrokTunnel: "http://58b0-34-138-217-149.ngrok.io" -> "http://localhost:8501">
```

```
INFO:pyngrok.process.ngrok:t=2022-09-12T19:03:12+0000 lvl=info msg="started tunnel" obj=tunnels name
=http-8501-6a1477c9-ea55-4714-b1d7-68b961dd0ea7 addr=http://localhost:8501 url=https://58b0-34-138-2
17-149.ngrok.io
2022-09-12 19:03:12.167 INFO    pyngrok.process.ngrok: t=2022-09-12T19:03:12+0000 lvl=info msg="star
ted tunnel" obj=tunnels name=http-8501-6a1477c9-ea55-4714-b1d7-68b961dd0ea7 addr=http://localhost:85
01 url=https://58b0-34-138-217-149.ngrok.io
INFO:pyngrok.process.ngrok:t=2022-09-12T19:03:12+0000 lvl=info msg=end pg=/api/tunnels id=c49770216d
b854d3 status=201 dur=90.402484ms
2022-09-12 19:03:12.176 INFO    pyngrok.process.ngrok: t=2022-09-12T19:03:12+0000 lvl=info msg=end p
g=/api/tunnels id=c49770216db854d3 status=201 dur=90.402484ms
```