Handwriting_Recognition

June 20, 2020

[1]:

```
import pandas as pd
import numpy as np
import tensorflow as tf
from tensorflow import keras
import matplotlib.pyplot as plt
```

[2]:

```
digits_mnist = keras.datasets.mnist
(train_images, train_labels), (test_images, test_labels) = digits_mnist.
 ↪load_data()
```

[11]:

```
X_train = train_images / 255.0
X_test = test_images / 255.0
y_train = train_labels
y_test = test_labels
```

[4]:

```
from tensorflow.keras import layers
from tensorflow.keras.models import load_model
```

[5]:

```
model = keras.Sequential([
    layers.Flatten(),
    layers.Dense(512, activation = 'relu'),
    layers.Dense(10, activation = 'softmax')
])
```

[7]:

```
class myCallback(tf.keras.callbacks.Callback):
    def on_epoch_end(self, epoch, logs = {}):
        if logs.get('accuracy') > 0.99:
            print("\nReached 99% accuracy so cancelling training!")
            self.model.stop_training = True
```

[8]:

```
callbacks = myCallback()
```

[9]:

```
model.compile(optimizer = 'adam', loss = 'sparse_categorical_crossentropy',␣
 ↪metrics = ['accuracy'])
```

[12]:

```
history = model.fit(X_train, y_train, epochs = 50, callbacks = [callbacks])
```

```
Epoch 1/50
1875/1875 [==============================] - 9s 5ms/step - loss: 0.2024 -
accuracy: 0.9400
Epoch 2/50
1875/1875 [==============================] - 8s 4ms/step - loss: 0.0806 -
accuracy: 0.9758
Epoch 3/50
1875/1875 [==============================] - 9s 5ms/step - loss: 0.0525 -
accuracy: 0.9835
Epoch 4/50
1875/1875 [==============================] - 8s 4ms/step - loss: 0.0371 -
accuracy: 0.9879
Epoch 5/50
1872/1875 [============================>.] - ETA: 0s - loss: 0.0287 - accuracy:
0.9907
Reached 99% accuracy so cancelling training!
1875/1875 [==============================] - 9s 5ms/step - loss: 0.0287 -
accuracy: 0.9907
```

[13]:
```python
model.save("handwriting_model.h5")
print("Saved Model to Disk")
```

```
Saved Model to Disk
```

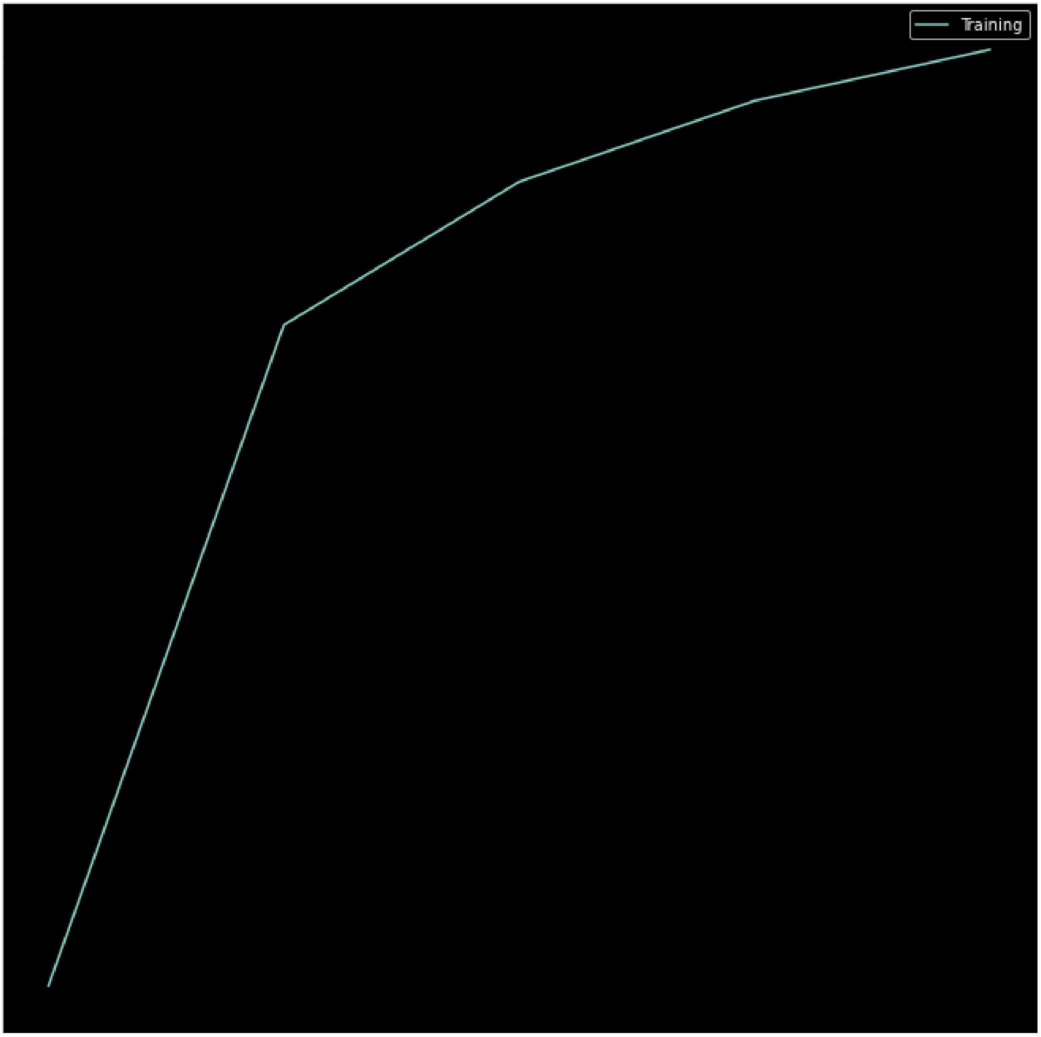
[14]:
```python
model = load_model("handwriting_model.h5")
y_hat = model.predict(test_images)
```

[15]:
```python
model.evaluate(test_images, test_labels)
```

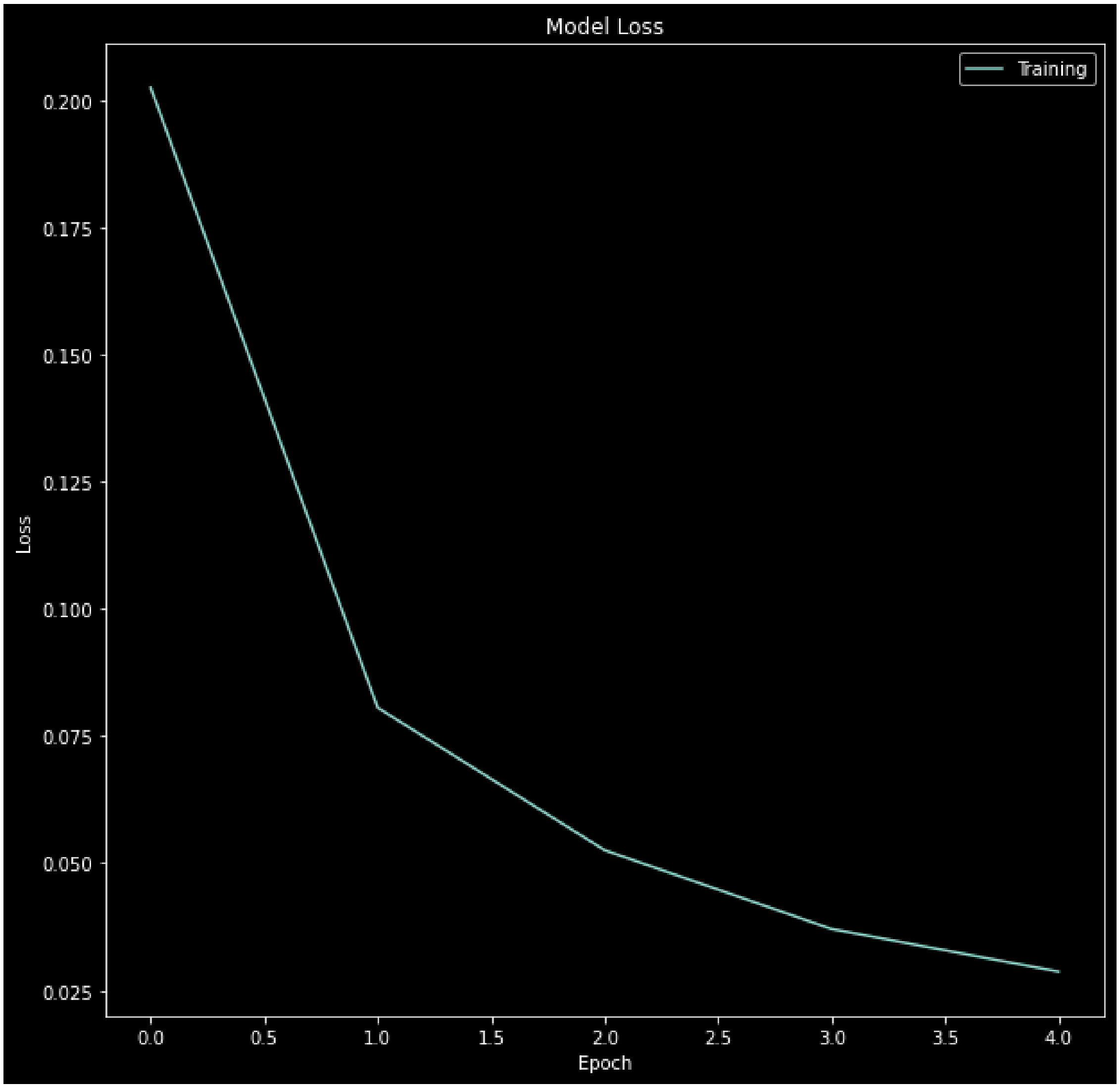
```
313/313 [==============================] - 1s 2ms/step - loss: 14.1302 -
accuracy: 0.9796
```

[15]:
```
[14.130195617675781, 0.9796000123023987]
```

[16]:
```python
plt.figure(figsize=(10,10))
plt.style.use('dark_background')
plt.plot(history.history['accuracy'])
# plt.plot(history.history['val_accuracy'])
plt.title('Model Accuracy')
plt.ylabel('Accuracy')
plt.xlabel('Epoch')
plt.legend(['Training', 'Testing'])
plt.tight_layout()
plt.show()
```



[17]:
```
plt.figure(figsize=(10,10))
plt.style.use('dark_background')
plt.plot(history.history['loss'])
# plt.plot(history.history['val_loss'])
plt.title('Model Loss')
plt.ylabel('Loss')
plt.xlabel('Epoch')
plt.legend(['Training', 'Testing'])
plt.show()
```


Model Loss
Training
Loss
0.200
0.175
0.150
0.125
0.100
0.075
0.050
0.025
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
Epoch

```
[ ]:
```