MNIST_project

March 24, 2023

importing libraries

[1]:
```
from keras.datasets import mnist
import numpy as np
from keras.utils import to_categorical
import tensorflow as tf
from keras.models import Sequential #arranging the latyer in sequential order
from keras .layers import Conv2D, MaxPool2D, Flatten, Dense
import matplotlib.pyplot as plt
from keras.callbacks import EarlyStopping
from keras.layers import BatchNormalization
from sklearn.model_selection import KFold
```

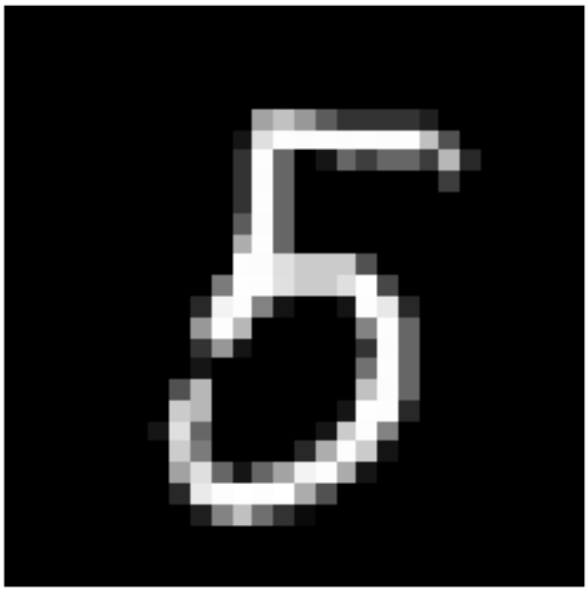
[2]:
```
# Define early stopping callback
early_stop = EarlyStopping(monitor='val_loss',min_delta=0.
 ↪001,restore_best_weights=True, patience=10, verbose=1, mode='auto')
```

[3]:
```
(X_train, y_train), (X_test, y_test) = mnist.load_data()
```

[4]:
```
X_train = X_train.reshape((X_train.shape[0], X_train.shape[1],X_train.
 ↪shape[2],1))# reshaping the data into single channel
```

[5]:
```
X_test=X_test.reshape((X_test.shape[0],X_test.shape[1],X_test.shape[2],1))
```

[6]:
```
plt.axis('off')
plt.imshow(X_test[45], cmap='gray')
plt.show()
```



[7]:
```
X_train = X_train / 255
X_test = X_test/ 255  #normalization of pixel value pixel value is in range 0␣
 ↪to 255 by deving max range
X_train = np.expand_dims(X_train, axis=-1)
X_test = np.expand_dims(X_test, axis=-1)
```

[8]:
```
#One hot encoding target values
y_train=to_categorical(y_train)
y_test=to_categorical(y_test)
```

[10]:
```
model=Sequential()
model.add(Conv2D(32,(3,3), activation ='relu', input_shape=(28,28,1)))    # ,␣
 ↪32 is face ,3,3 is kernal size or filter, 1 for greyscale
model.add(MaxPool2D(2,2))
model.add(Flatten())
model.add(Dense(100, activation='relu'))
model.add(Dense(10, activation='softmax')) #output layer as multiclass␣
 ↪classification softmax is used , output 0 to 9= 10'''
```

[12]:
```
#compile model
model.compile(loss='categorical_crossentropy',optimizer='adam',metrics=['acc'])
```

[13]:
```
history=model.fit(X_train , y_train ,validation_data =␣
 ↪(X_test,y_test),epochs=5,batch_size=32, callbacks=[early_stop])
```

```
Epoch 1/5
1875/1875 [==============================] - 27s 13ms/step - loss: 0.1622 - acc:
```

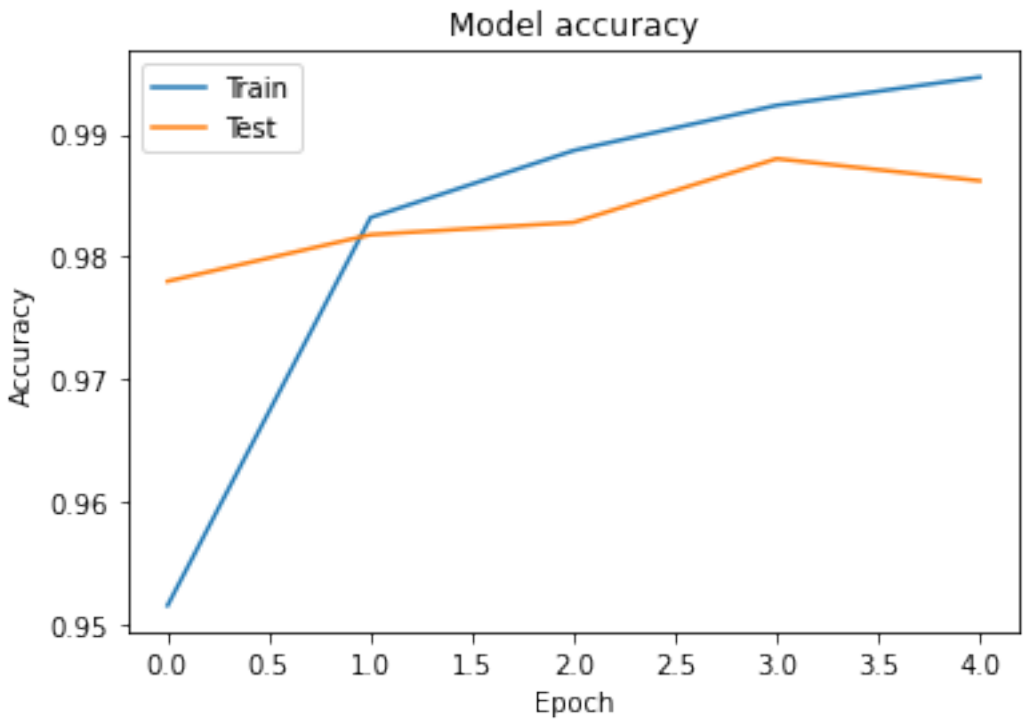
```
0.9516 - val_loss: 0.0659 - val_acc: 0.9780
Epoch 2/5
1875/1875 [==============================] - 25s 13ms/step - loss: 0.0551 - acc:
0.9832 - val_loss: 0.0544 - val_acc: 0.9818
Epoch 3/5
1875/1875 [==============================] - 26s 14ms/step - loss: 0.0363 - acc:
0.9887 - val_loss: 0.0512 - val_acc: 0.9828
Epoch 4/5
1875/1875 [==============================] - 26s 14ms/step - loss: 0.0257 - acc:
0.9923 - val_loss: 0.0412 - val_acc: 0.9880
Epoch 5/5
1875/1875 [==============================] - 26s 14ms/step - loss: 0.0168 - acc:
0.9947 - val_loss: 0.0457 - val_acc: 0.9862
```

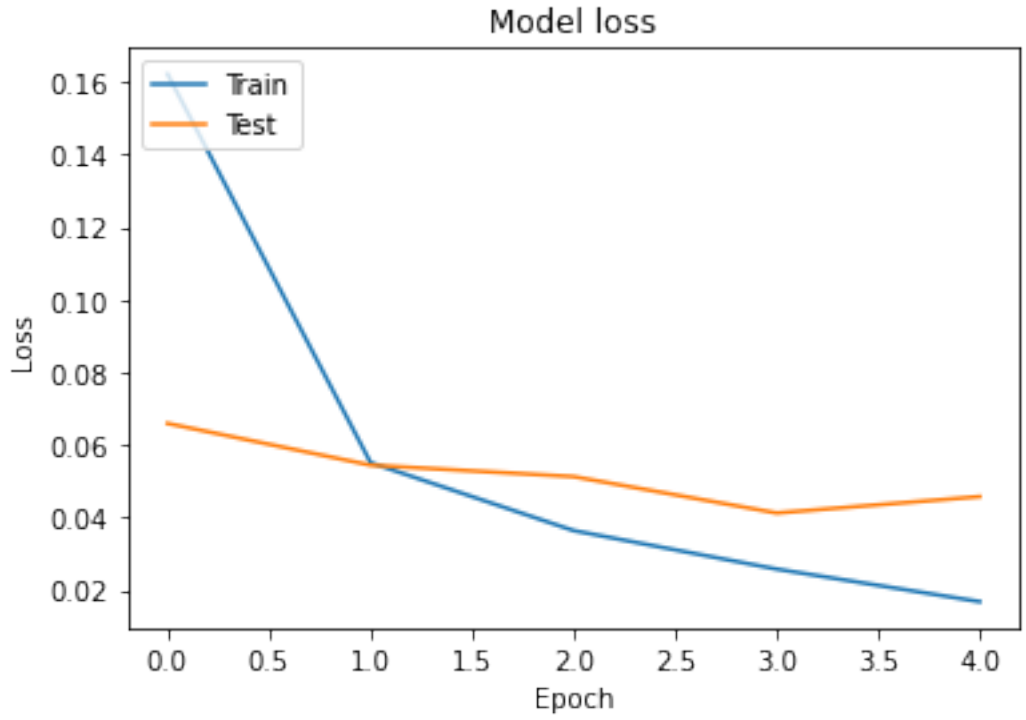
[14]:
```
#Evaluate the Model
_, accuracy = model.evaluate(X_test, y_test)
print('Accuracy: %.2f' % (accuracy*100))
```

```
313/313 [==============================] - 2s 7ms/step - loss: 0.0457 - acc:
0.9862
Accuracy: 98.62
```

[15]:
```
#Graphical Representation of Accuracy & Loss Graph
plt.plot(history.history['acc'])
plt.plot(history.history['val_acc'])
plt.title('Model accuracy')
plt.ylabel('Accuracy')
plt.xlabel('Epoch')
plt.legend(['Train', 'Test'], loc='upper left')
plt.show()

plt.plot(history.history['loss'])
plt.plot(history.history['val_loss'])
plt.title('Model loss')
plt.ylabel('Loss')
plt.xlabel('Epoch')
plt.legend(['Train', 'Test'], loc='upper left')
plt.show()
```


Model accuracy
Train
Test
Accuracy
0.99
0.98
0.97
0.96
0.95
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
Epoch


Model loss
Train
Test
Loss
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
Epoch

[16]:
```
#Save Model
''''model_json = model.to_json()
with open("model.json", "w") as json_file:
    json_file.write(model_json)
model.save_weights("model.h5")
print("Saved model to disk")'''
```

```
Saved model to disk
```

[ ]:
```

```