PRML_ex6

April 16, 2022

[ ]:
```
## Mounting Google drive at colab
from google.colab import drive
drive.mount('/content/drive')

## Path where
path1='/content/drive/MyDrive/Colab Notebooks/GTSRB_subset_2/class1'
path2='/content/drive/MyDrive/Colab Notebooks/GTSRB_subset_2/class2'
```

```
Mounted at /content/drive
```

[ ]:
```
import glob
import cv2
# glob returns the path of each image file.
files1 = glob.glob("/content/drive/MyDrive/Colab Notebooks/GTSRB_subset_2/
 ↪class1/*.jpg")
files1 = sorted(files1)


files2 = glob.glob("/content/drive/MyDrive/Colab Notebooks/GTSRB_subset_2/
 ↪class2/*.jpg")
files2 = sorted(files2)

# Image will be stored at cv_img
# Image has been transformed to greyscale.
class1 = []
class2 = []

for img in files1:
    n= cv2.imread(img)
    class1.append(n)
    #class1.append(cv2.cvtColor(n, cv2.COLOR_BGR2GRAY))

for img in files2:
    n= cv2.imread(img)
    class2.append(n)
    #class2.append(cv2.cvtColor(n, cv2.COLOR_BGR2GRAY))
```

[ ]:
```
import sklearn
from sklearn.model_selection import train_test_split
import tensorflow as tf
import numpy as np
from tensorflow import keras
from tensorflow.keras import layers
import keras.optimizers
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense
import matplotlib.pyplot as plt


y1 = np.zeros(len(class1), dtype= np.int8)
y2 = np.ones(len(class2), dtype= np.int8)
y3 = np.concatenate([y1, y2])
x3 = np.concatenate([class1, class2])

train_len = int(len(x3) * 0.8)
train_x, test_x, train_y, test_y  = train_test_split(x3, y3,␣
 ↪train_size=train_len, shuffle=True, stratify=y3)
train_y = np.asarray(train_y).astype('float32').reshape((-1,1))
test_y = np.asarray(test_y).astype('float32').reshape((-1,1))

print(len(x3), len(x3),len(y1) ,len(y2))
print('train and test set',len(train_x), len(train_y),len(test_x), len(test_y),␣
 ↪train_y.shape, test_y.shape)
```

```
660 660 450 210
train and test set 528 528 132 132 (528, 1) (132, 1)
```

[ ]:
```
# https://pyimagesearch.com/2018/12/31/keras-conv2d-and-convolutional-layers/

model = Sequential()
model.add(keras.Input(shape=(64, 64, 3) ))

model.add(layers.Conv2D(10, (3,3), strides=2, activation="relu"))
model.add(layers.MaxPooling2D(pool_size=(2, 2), strides=None, padding="valid",␣
 ↪input_shape=( 31, 31, 10) ))

model.add(layers.Conv2D(10, (3,3), strides=2, activation="relu"))
model.add(layers.MaxPooling2D(pool_size=(2, 2), strides=None, padding="valid",␣
 ↪input_shape=(7, 7, 10)) )

model.add(layers.Flatten())

model.add(Dense(1, activation='sigmoid'))
model.summary()
```

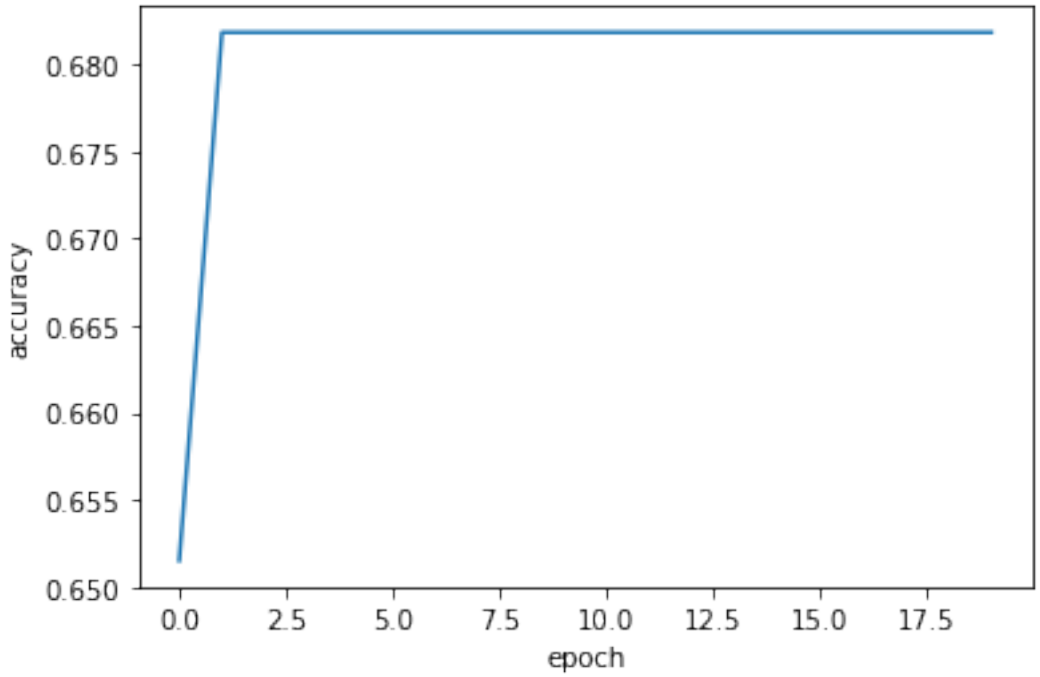
```
Model: "sequential_8"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 conv2d_16 (Conv2D)          (None, 31, 31, 10)        280

 max_pooling2d_16 (MaxPoolin  (None, 15, 15, 10)       0
 g2D)

 conv2d_17 (Conv2D)          (None, 7, 7, 10)          910

 max_pooling2d_17 (MaxPoolin  (None, 3, 3, 10)         0
 g2D)

 flatten_8 (Flatten)         (None, 90)                0

 dense_8 (Dense)             (None, 1)                 91

=================================================================
Total params: 1,281
Trainable params: 1,281
Non-trainable params: 0
_________________________________________________________________
```

[ ]:
```
opt = tf.keras.optimizers.SGD(learning_rate=0.05)
model.compile(optimizer=opt, loss=tf.keras.losses.BinaryCrossentropy(),␣
 ↪metrics=['mse','accuracy'])
num_of_epochs = 20

tr_hist = model.fit(train_x, train_y, epochs=num_of_epochs,␣
 ↪verbose=1,batch_size=32)

plt.plot(tr_hist.history['accuracy'])
plt.ylabel('accuracy')
plt.xlabel('epoch')
#plt.legend(['opetus'], loc='upper right')
plt.show()
```

```
Epoch 1/20
17/17 [==============================] - 1s 16ms/step - loss: 576553.5625 - mse:
0.3068 - accuracy: 0.6515
Epoch 2/20
17/17 [==============================] - 0s 16ms/step - loss: 0.6654 - mse:
0.2362 - accuracy: 0.6818
Epoch 3/20
17/17 [==============================] - 0s 17ms/step - loss: 0.6519 - mse:
0.2295 - accuracy: 0.6818
Epoch 4/20
```

```
17/17 [==============================] - 0s 16ms/step - loss: 0.6434 - mse:
0.2254 - accuracy: 0.6818
Epoch 5/20
17/17 [==============================] - 0s 16ms/step - loss: 0.6376 - mse:
0.2226 - accuracy: 0.6818
Epoch 6/20
17/17 [==============================] - 0s 15ms/step - loss: 0.6335 - mse:
0.2206 - accuracy: 0.6818
Epoch 7/20
17/17 [==============================] - 0s 17ms/step - loss: 0.6310 - mse:
0.2195 - accuracy: 0.6818
Epoch 8/20
17/17 [==============================] - 0s 15ms/step - loss: 0.6292 - mse:
0.2186 - accuracy: 0.6818
Epoch 9/20
17/17 [==============================] - 0s 16ms/step - loss: 0.6280 - mse:
0.2181 - accuracy: 0.6818
Epoch 10/20
17/17 [==============================] - 0s 16ms/step - loss: 0.6272 - mse:
0.2177 - accuracy: 0.6818
Epoch 11/20
17/17 [==============================] - 0s 17ms/step - loss: 0.6267 - mse:
0.2175 - accuracy: 0.6818
Epoch 12/20
17/17 [==============================] - 0s 16ms/step - loss: 0.6264 - mse:
0.2173 - accuracy: 0.6818
Epoch 13/20
17/17 [==============================] - 0s 16ms/step - loss: 0.6261 - mse:
0.2172 - accuracy: 0.6818
Epoch 14/20
17/17 [==============================] - 0s 15ms/step - loss: 0.6260 - mse:
0.2172 - accuracy: 0.6818
Epoch 15/20
17/17 [==============================] - 0s 16ms/step - loss: 0.6258 - mse:
0.2171 - accuracy: 0.6818
Epoch 16/20
17/17 [==============================] - 0s 16ms/step - loss: 0.6258 - mse:
0.2171 - accuracy: 0.6818
Epoch 17/20
17/17 [==============================] - 0s 16ms/step - loss: 0.6257 - mse:
0.2171 - accuracy: 0.6818
Epoch 18/20
17/17 [==============================] - 0s 16ms/step - loss: 0.6257 - mse:
0.2170 - accuracy: 0.6818
Epoch 19/20
17/17 [==============================] - 0s 15ms/step - loss: 0.6257 - mse:
0.2170 - accuracy: 0.6818
Epoch 20/20
```

```
17/17 [==============================] - 0s 15ms/step - loss: 0.6257 - mse:
0.2170 - accuracy: 0.6818
```

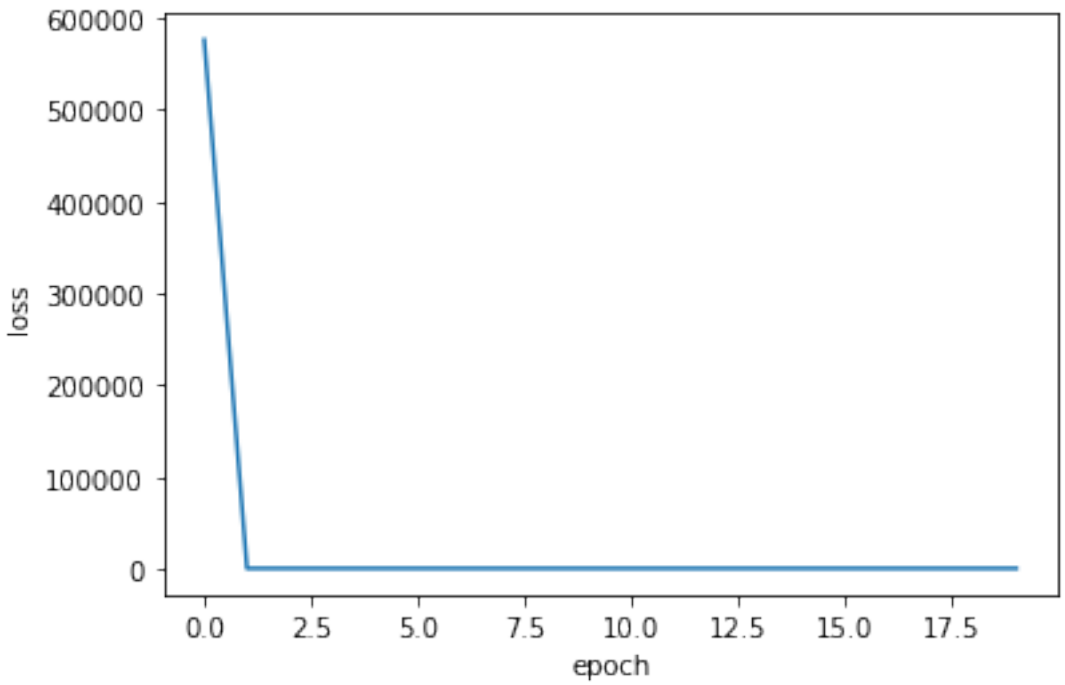


[ ]:
```
prediction = model.predict(test_x)
model.evaluate(test_x, y = test_y,verbose=1)
# Training set accuracy is 0.6818
# Test set accuracy is 0.6818
```

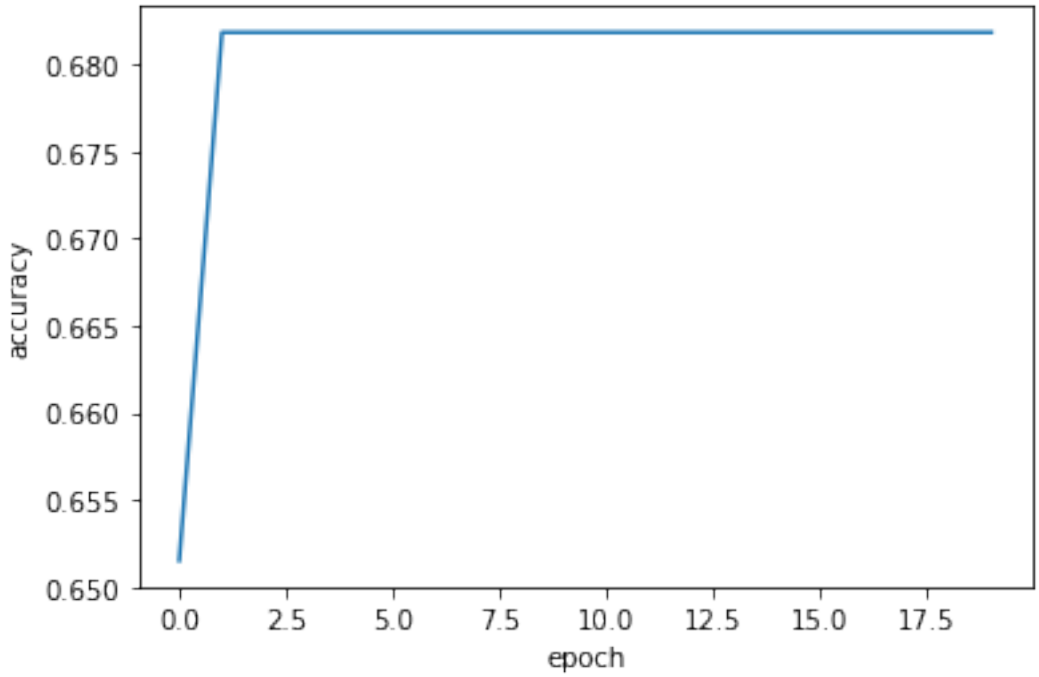
```
5/5 [==============================] - 0s 7ms/step - loss: 0.6256 - mse: 0.2170
- accuracy: 0.6818
```

[ ]:
```
[0.6255534887313843, 0.21696925163269043, 0.6818181872367859]
```

[ ]:
```
plt.plot(tr_hist.history['loss'])
plt.ylabel('loss')
plt.xlabel('epoch')
#plt.legend(['opetus'], loc='upper right')
plt.show()
```



[ ]:
```
plt.plot(tr_hist.history['accuracy'])
plt.ylabel('accuracy')
plt.xlabel('epoch')
#plt.legend(['opetus'], loc='upper right')
plt.show()
```


0.680
0.675
0.670
0.665
0.660
0.655
0.650
accuracy
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
epoch