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```
import pandas as pd
import numpy as np
from keras import utils
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import LabelEncoder
from keras.models import Model
from keras.layers import LSTM, Activation, Dense, Dropout, Input, Embedding
from keras.optimizers import RMSprop
from keras.preprocessing.text import Tokenizer
from keras.preprocessing import sequence
from keras.utils import to_categorical
%matplotlib inline
```

```
from google.colab import drive
drive.mount('/content/drive')
```

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

```
ls
```

```
drive/ sample_data/
```

READ DATASET

```
df = pd.read_csv('/content/drive/MyDrive/IBM/spam.csv',delimiter=',',encoding='latin-1')
df.head()
```

	v1	v2	Unnamed: 2	Unnamed: 3	Unnamed: 4
0	ham	Go until jurong point, crazy.. Available only ...	NaN	NaN	NaN
1	ham	Ok lar... Joking wif u oni...	NaN	NaN	NaN
2	spam	Free entry in 2 a wkly comp to win FA Cup fina...	NaN	NaN	NaN
3	ham	U dun say so early hor... U c already then say...	NaN	NaN	NaN
4	ham	Nah I don't think he goes to usf, he lives aro...	NaN	NaN	NaN

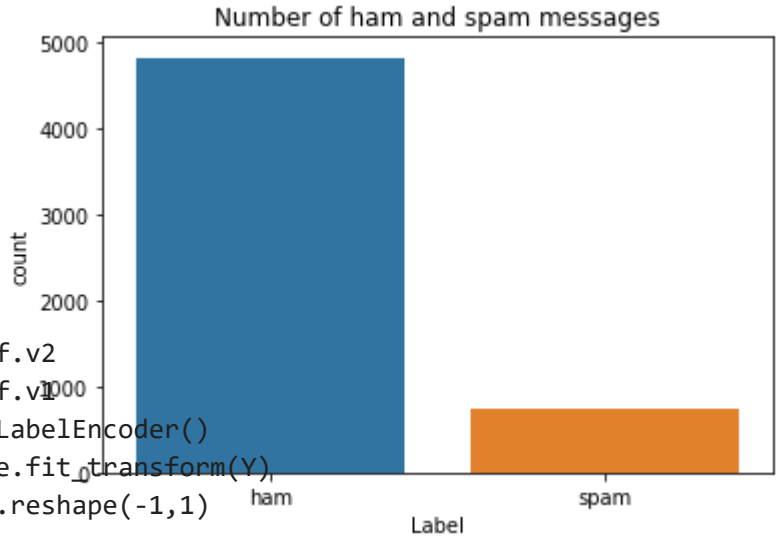
PREPROCESSING

```
df.drop(['Unnamed: 2', 'Unnamed: 3', 'Unnamed: 4'],axis=1,inplace=True)
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 5572 entries, 0 to 5571
Data columns (total 2 columns):
# Column Non-Null Count Dtype
--- ------ -------------- -----
0 v1 5572 non-null object
1 v2 5572 non-null object
dtypes: object(2)
memory usage: 87.2+ KB
```

```
sns.countplot(df.v1)
plt.xlabel('Label')
plt.title('Number of ham and spam messages')
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43: FutureWarning: Pass the following variable as a keyword arg:
        FutureWarning
        Text(0.5, 1.0, 'Number of ham and spam messages')
```




```
X = df.v2
Y = df.v1
le = LabelEncoder()
Y = le.fit_transform(Y)
Y = Y.reshape(-1,1)
```

```
X_train,X_test,Y_train,Y_test = train_test_split(X,Y,test_size=0.15)
```

```
max_words = 1000
max_len = 100
tok = Tokenizer(num_words=max_words)
tok.fit_on_texts(X_train)
sequences = tok.texts_to_sequences(X_train)
sequences_matrix = utils.pad_sequences(sequences,maxlen=max_len)
```

```
sequences_matrix.shape
```

```
(4736, 100)
```

```
sequences_matrix.ndim
```

```
3
```

```
sequences_matrix = np.reshape(sequences_matrix,(4736,100,1))
```

```
sequences_matrix.ndim #3d shape verification to proceed to RNN LSTM
```

```
3
```

```
from keras.models import Sequential
from keras.layers import Dense
from keras.layers import LSTM
from keras.layers import Embedding
```

```
model = Sequential()
model.add(Embedding(max_words,50,input_length=max_len))
```

```
model.add(LSTM(units=64,input_shape = (sequences_matrix.shape[1],1),return_sequences=True))
model.add(LSTM(units=64,return_sequences=True))
model.add(LSTM(units=64,return_sequences=True))
model.add(LSTM(units=64))
model.add(Dense(units = 256,activation = 'relu'))
model.add(Dense(units = 1,activation = 'sigmoid'))
```

```
model.summary()
model.compile(loss='binary_crossentropy',optimizer=RMSprop(),metrics=['accuracy'])
```

```
Model: "sequential"
_________________________________________________________________
Layer (type) Output Shape Param #
=================================================================
embedding (Embedding) (None, 100, 50) 50000

lstm (LSTM) (None, 100, 64) 29440

lstm_1 (LSTM) (None, 100, 64) 33024
```

```
lstm_2 (LSTM) (None, 100, 64) 33024

lstm_3 (LSTM) (None, 64) 33024

dense (Dense) (None, 256) 16640

dense_1 (Dense) (None, 1) 257

=================================================================
Total params: 195,409
Trainable params: 195,409
Non-trainable params: 0
_________________________________________________________________
```

FIT THE MODEL

```
M = model.fit(sequences_matrix,Y_train,batch_size=128,epochs=7,validation_split=0.2)
```

```
Epoch 1/7
30/30 [==============================] - 32s 797ms/step - loss: 0.3160 - accuracy: 0.8928 - val_loss: 0.1125 - val_accuracy: 0.
Epoch 2/7
30/30 [==============================] - 24s 806ms/step - loss: 0.0881 - accuracy: 0.9754 - val_loss: 0.0733 - val_accuracy: 0.
Epoch 3/7
30/30 [==============================] - 22s 730ms/step - loss: 0.0571 - accuracy: 0.9834 - val_loss: 0.0648 - val_accuracy: 0.
Epoch 4/7
30/30 [==============================] - 22s 731ms/step - loss: 0.0412 - accuracy: 0.9863 - val_loss: 0.0627 - val_accuracy: 0.
Epoch 5/7
30/30 [==============================] - 22s 726ms/step - loss: 0.0344 - accuracy: 0.9913 - val_loss: 0.0703 - val_accuracy: 0.
Epoch 6/7
30/30 [==============================] - 22s 743ms/step - loss: 0.0282 - accuracy: 0.9926 - val_loss: 0.0588 - val_accuracy: 0.
Epoch 7/7
30/30 [==============================] - 22s 743ms/step - loss: 0.0211 - accuracy: 0.9937 - val_loss: 0.0731 - val_accuracy: 0.
```

SAVE THE MODEL

```
model.save
```

```
<bound method Model.save of <keras.engine.sequential.Sequential object at 0x7f5e8d09ed50>>
```

TEST THE MODEL

```
test_sequences = tok.texts_to_sequences(X_test)
test_sequences_matrix = utils.pad_sequences(test_sequences,maxlen=max_len)
```

```
accr = model.evaluate(test_sequences_matrix,Y_test)
```

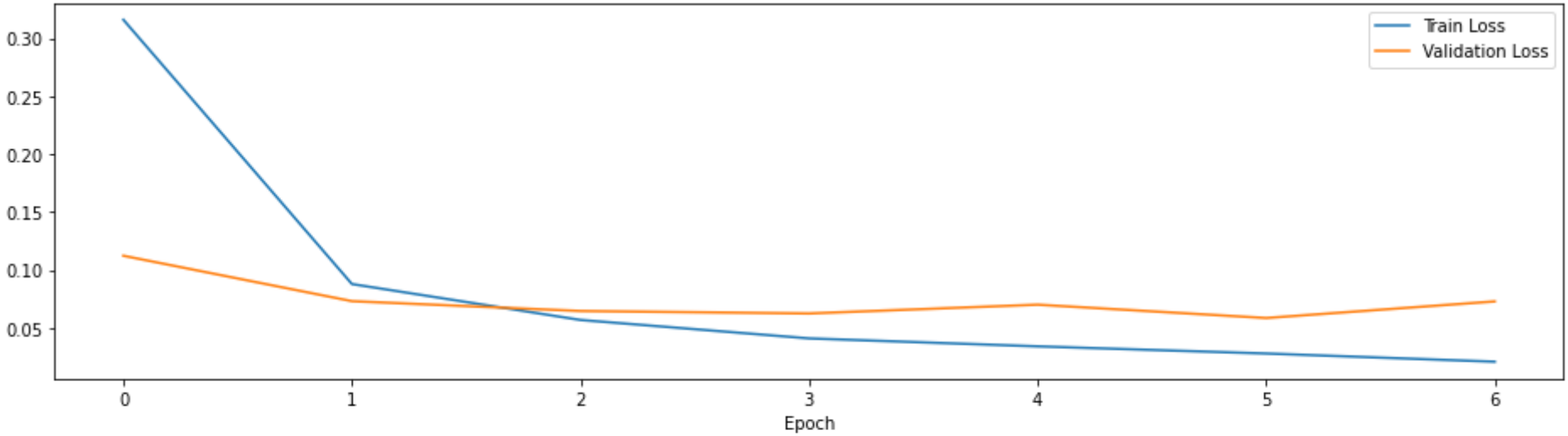
```
27/27 [==============================] - 3s 66ms/step - loss: 0.0587 - accuracy: 0.9880
```

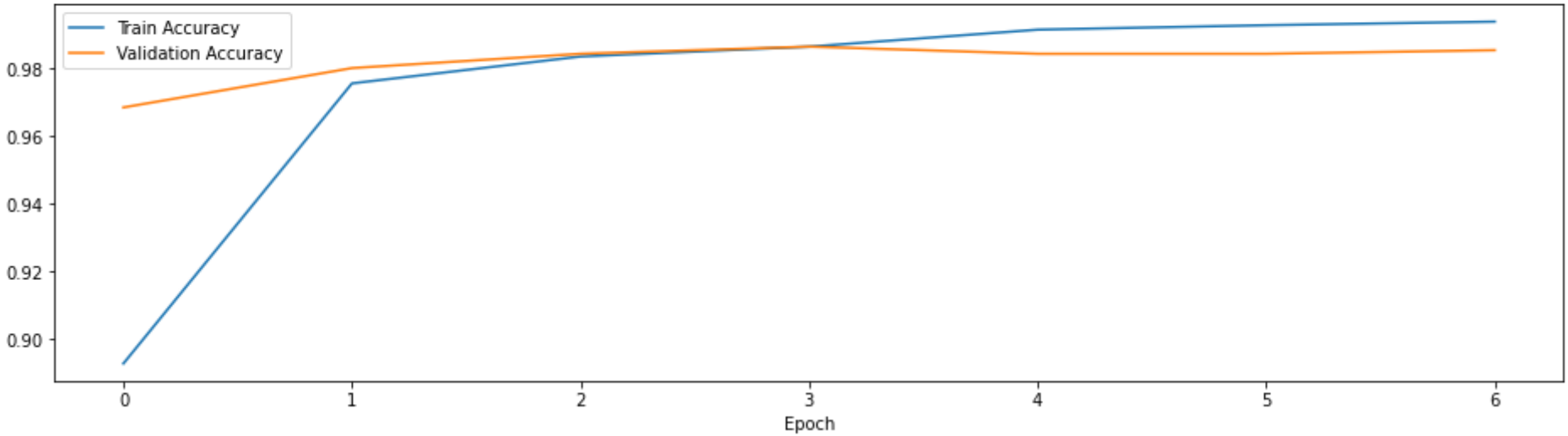
```
l = accr[0]
a =accr[1]
print('Test set\n Loss: {:0.3f}\n Accuracy: {:0.3f}'.format(l,a))
```

```
Test set
Loss: 0.059
Accuracy: 0.988
```

ACCURACY AND LOSS GRAPH

```
results = pd.DataFrame({"Train Loss": M.history['loss'], "Validation Loss": M.history['val_loss'],"Train Accuracy": M.history['accura
fig, ax = plt.subplots(nrows=2, figsize=(16, 9))
results[["Train Loss", "Validation Loss"]].plot(ax=ax[0])
results[["Train Accuracy", "Validation Accuracy"]].plot(ax=ax[1])
ax[0].set_xlabel("Epoch")
ax[1].set_xlabel("Epoch")
plt.show()
```


Train Loss
Validation Loss
0.30
0.25
0.20
0.15
0.10
0.05
0
1
2
3
4
5
6
Epoch


Train Accuracy
Validation Accuracy
0.98
0.96
0.94
0.92
0.90
0
1
2
3
4
5
6
Epoch

Colab paid products - Cancel contracts here

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