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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_NalaiyaThiran/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

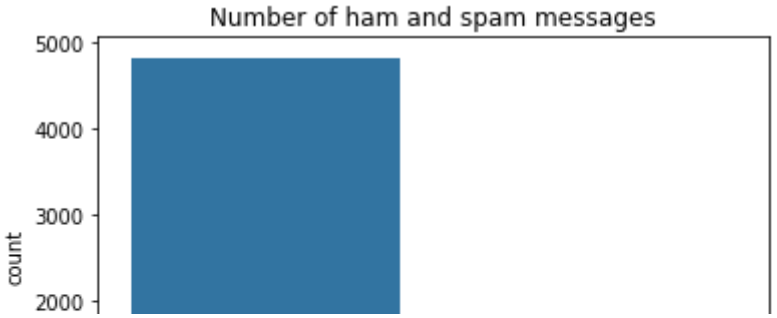
PREPROCESSING

```
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 var
  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
```

```
2
```

```
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 [==============================] - 31s 770ms/step - loss: 0.2919 - accuracy: 0.9029 - val_loss: 0.1052 - val_accuracy: 0.
Epoch 2/7
30/30 [==============================] - 22s 722ms/step - loss: 0.0823 - accuracy: 0.9762 - val_loss: 0.0575 - val_accuracy: 0.
Epoch 3/7
30/30 [==============================] - 23s 751ms/step - loss: 0.0548 - accuracy: 0.9865 - val_loss: 0.0498 - val_accuracy: 0.
Epoch 4/7
30/30 [==============================] - 21s 712ms/step - loss: 0.0438 - accuracy: 0.9889 - val_loss: 0.0465 - val_accuracy: 0.
Epoch 5/7
30/30 [==============================] - 21s 708ms/step - loss: 0.0319 - accuracy: 0.9916 - val_loss: 0.0597 - val_accuracy: 0.
Epoch 6/7
30/30 [==============================] - 21s 706ms/step - loss: 0.0236 - accuracy: 0.9929 - val_loss: 0.0559 - val_accuracy: 0.
Epoch 7/7
30/30 [==============================] - 21s 714ms/step - loss: 0.0201 - accuracy: 0.9952 - val_loss: 0.0586 - val_accuracy: 0.
```

SAVE THE MODEL

```
model.save
```

```
<bound method Model.save of <keras.engine.sequential.Sequential object at 0x7f8d44508750>>
```

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)
```

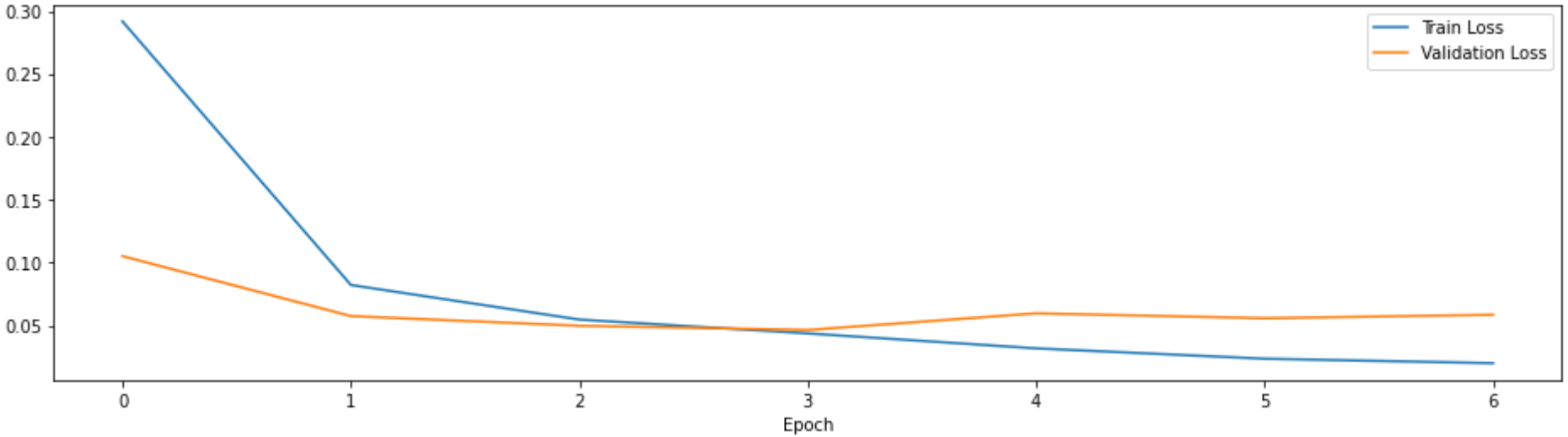
```
27/27 [==============================] - 3s 60ms/step - loss: 0.0962 - accuracy: 0.9749
```

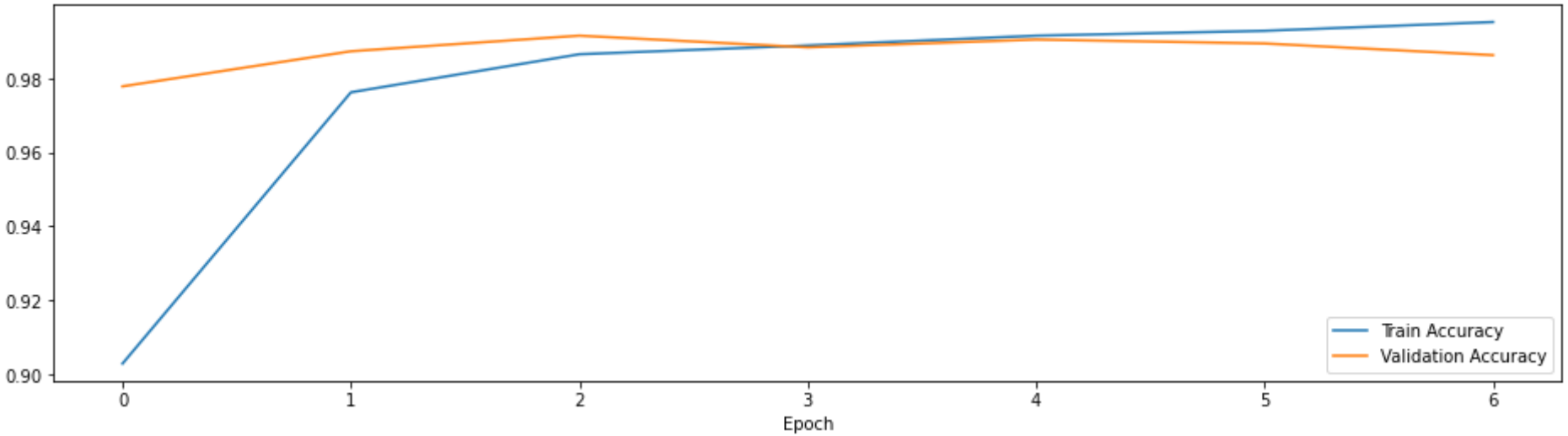
```
l = accr[0]
a =accr[1]
print('Test set\n  Loss: {:0.3f}\n  Accuracy: {:0.3f}'.format(l,a))
```

```
Test set
  Loss: 0.096
  Accuracy: 0.975
```

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()
```


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


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

Colab paid products - Cancel contracts here

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