

## Assignment -4

|                     |                 |
|---------------------|-----------------|
| Assignment Date     | 12 October 2022 |
| Student Name        | Hariharan K     |
| Student Roll Number | 6213191060306   |
| Maximum Marks       | 2 Marks         |

## Importing Required Libraries

```
In [1]: import pandas as pd
import numpy as np
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
from keras.callbacks import EarlyStopping
from keras.utils import pad_sequences
%matplotlib inline
```

## Read Dataset and Preprocessing

```
In [2]: df = pd.read_csv('spam.csv', delimiter=',', encoding='latin-1')
df.head()
```

```
Out[2]:
```

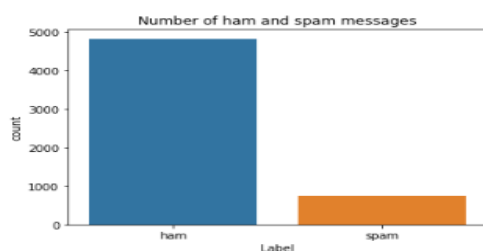
|   | v1   | v2  | Unnamed: 2 | Unnamed: 3 | Unnamed: 4 |
|---|------|---|------------|------------|------------|
| 0 | ham  | Go until jurong point, crazy.. Available only ... | NaN        | NaN        | NaN        |
| 1 | ham  | Ok lar... Joking wif u oni...                     | NaN        | NaN        | 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        |

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

```
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
```

```
In [4]: sns.countplot(df.v1)
plt.xlabel('Label')
plt.title('Number of ham and spam messages')
X = df.v2
Y = df.v1
le = LabelEncoder()
Y = le.fit_transform(Y)
Y = Y.reshape(-1,1)
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43: FutureWarning: Pass the following variable as a keyword arg: x. From version 0.12, the only valid positional argument will be `data`, and passing other arguments without an explicit keyword will result in an error or misinterpretation.
FutureWarning
```



```
In [5]: X_train, X_test, Y_train, Y_test = train_test_split(X, Y, test_size=0.15)
```

```
In [6]: max_words = 1000
max_len = 150
tok = Tokenizer(num_words=max_words)
tok.fit_on_texts(X_train)
sequences = tok.texts_to_sequences(X_train)
sequences_matrix = pad_sequences(sequences, maxlen=max_len)
```

## Create Model

```
In [7]: def RNN():
        inputs = Input(name='inputs', shape=[max_len])
        layer = Embedding(max_words, 50, input_length=max_len)(inputs)
        layer = LSTM(64)(layer)
        layer = Dense(256, name='FC1')(layer)
        layer = Activation('relu')(layer)
        layer = Dropout(0.5)(layer)
        layer = Dense(1, name='out_layer')(layer)
        layer = Activation('sigmoid')(layer)
        model = Model(inputs=inputs, outputs=layer)
        return model
```

## Adding LSTM Layers

```
In [8]: model = RNN()
        model.summary()
```

Model: "model"

| Layer (type)              | Output Shape    | Param # |
|---------------------------|-----------------|---------|
| inputs (InputLayer)       | [(None, 150)]   | 0       |
| embedding (Embedding)     | (None, 150, 50) | 50000   |
| lstm (LSTM)               | (None, 64)      | 29440   |
| FC1 (Dense)               | (None, 256)     | 16640   |
| activation (Activation)   | (None, 256)     | 0       |
| dropout (Dropout)         | (None, 256)     | 0       |
| out_layer (Dense)         | (None, 1)       | 257     |
| activation_1 (Activation) | (None, 1)       | 0       |
| Total params: 96,337      |                 |         |
| Trainable params: 96,337  |                 |         |
| Non-trainable params: 0   |                 |         |

## Compile The Model

```
In [9]: model.compile(loss='binary_crossentropy', optimizer=RMSprop(), metrics=['accuracy'])
```

## Fit The Model

```
In [10]: model.fit(sequences_matrix, Y_train, batch_size=128, epochs=10,
                 validation_split=0.2, callbacks=[EarlyStopping(monitor='val_loss', min_delta=0.0001)])

Epoch 1/10
30/30 [=====] - 20s 564ms/step - loss: 0.3216 - accuracy: 0.8825 - val_loss: 0.1561 - val_accuracy: 0.9462
Epoch 2/10
30/30 [=====] - 15s 488ms/step - loss: 0.0779 - accuracy: 0.9823 - val_loss: 0.0673 - val_accuracy: 0.9768

Out[10]:
```

## Save The Model

```
In [11]: model.save('Spam.h5')
```

## Test The Model

```
In [12]: test_sequences = tok.texts_to_sequences(X_test)
test_sequences_matrix = pad_sequences(test_sequences,maxlen=max_len)
test_sequences_matrix
```

```
Out[12]: array([[ 0,  0,  0, ..., 17, 143, 196],
 [ 0,  0,  0, ..., 13, 108, 876],
 [ 0,  0,  0, ..., 29, 16, 10],
 ...,
 [ 0,  0,  0, ..., 17, 55, 455],
 [ 0,  0,  0, ..., 505, 57, 40],
 [ 0,  0,  0, ..., 53, 255, 207]], dtype=int32)
```

## Accuracy Of The Model

```
In [13]: accr = model.evaluate(test_sequences_matrix,Y_test)
print('Accuracy:',accr[1])
print('Loss:',accr[0])
```

```
27/27 [=====] - 1s 23ms/step - loss: 0.0640 - accuracy: 0.9809
Accuracy: 0.980861246585846
Loss: 0.06395354866981506
```