

**Assignment -4**  
**LSTM for Text Classification**

Assignment Date	31 October 2022
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Student Roll Number	620619106030
Maximum Marks	2 Marks

**#Import necessary libraries**

```
import numpy as np
```

```
import pandas as pd
```

```
import matplotlib.pyplot as plt
```

```
import seaborn as sns
```

```
%matplotlib inline
```

```
from sklearn.model_selection import train_test_split
```

```
from keras.layers import Dense , LSTM , Embedding , Dropout , Activation , Flatten
```

```
from sklearn.preprocessing import LabelEncoder
```

```
from keras.preprocessing.text import Tokenizer
```

```
from keras.models import Sequential
```

```
from tensorflow.keras.preprocessing import sequence
```

```
from tensorflow.keras.utils import to_categorical
```

```
from keras.callbacks import EarlyStopping
```

```
from tensorflow.keras.optimizers import RMSprop
```

```
from keras_preprocessing.sequence import pad_sequences
```

```
In [1]: import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
%matplotlib inline
```

```
In [2]: from sklearn.model_selection import train_test_split
from keras.layers import Dense , LSTM , Embedding , Dropout , Activation , Flatten
from sklearn.preprocessing import LabelEncoder
from keras.preprocessing.text import Tokenizer
from keras.models import Sequential
from tensorflow.keras.preprocessing import sequence
from tensorflow.keras.utils import to_categorical
from keras.callbacks import EarlyStopping
from tensorflow.keras.optimizers import RMSprop
from keras_preprocessing.sequence import pad_sequences
```

### **#Read dataset and do pre-processing**

```
data = pd.read_csv('/content/spam.csv',delimiter=',',encoding='latin-1')
```

```
data
```

```
#Information about dataset
```

```
data.describe().T
```

```
data.shape
```

```
#Check if there is any missing values
```

```
data.isnull().sum()
```

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

```
#Visualize the dataset
```

```
sns.countplot(data.v1)
```

```
#Preprocess using Label Encoding
```

```
X = data.v2
```

```
Y = data.v1
```

```
le = LabelEncoder()
```

```
Y = le.fit_transform(Y)
```

```
Y = Y.reshape(-1,1)
```

```
In [3]: data = pd.read_csv('/content/spam.csv',delimiter=',',encoding='latin-1')
```

```
In [4]: data
```

```
Out[4]:
```

	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
...	...	...	...	...	...
5567	spam	This is the 2nd time we have tried 2 contact u...	NaN	NaN	NaN
5568	ham	Will i_b going to esplanade fr home?	NaN	NaN	NaN
5569	ham	Pity, * was in mood for that. So...any other s...	NaN	NaN	NaN
5570	ham	The guy did some bitching but I acted like i'd...	NaN	NaN	NaN
5571	ham	Rofl. Its true to its name	NaN	NaN	NaN

5572 rows x 5 columns

```
In [5]: data.describe().T
```

```
Out[5]:
```

	count	unique	top	freq
v1	5572	2	ham	4825
v2	5572	5169	Sorry, I'll call later	30
Unnamed: 2	50	43	bt not his girlfrnd... G o o d n i g h t . . @"	3
Unnamed: 3	12	10	MK17 92H. 450Ppw 16"	2
Unnamed: 4	6	5	GNT:-)"	2

```
In [6]: data.shape
```

```
Out[6]: (5572, 5)
```

```
In [7]: data.isnull().sum()
```

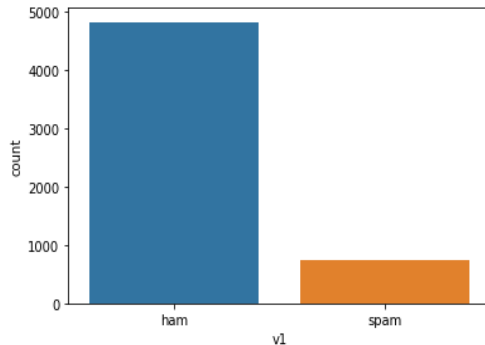
```
Out[7]: v1          0
v2          0
Unnamed: 2    5522
Unnamed: 3    5560
Unnamed: 4    5566
dtype: int64
```

```
In [8]: data.drop(['Unnamed: 2', 'Unnamed: 3', 'Unnamed: 4'],axis=1,inplace=True)
```

```
In [9]: sns.countplot(data.v1)
```

```
/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
```

```
Out[9]: <matplotlib.axes._subplots.AxesSubplot at 0x7f1735223150>
```



```
In [10]: X = data.v2  
Y = data.v1  
le = LabelEncoder()  
Y = le.fit_transform(Y)
```

```
In [11]: Y = Y.reshape(-1,1)
```

**#Create Model and Add Layers (LSTM, Dense-(Hidden Layers), Output)**

**#Splitting into training and testing data**

```
X_train,X_test,Y_train,Y_test = train_test_split(X,Y,test_size = 0.2)
```

```
max_word = 1000
```

```
max_len = 250
```

```
token = Tokenizer(num_words = max_word)
```

```
token.fit_on_texts(X_train)
```

```
sequences = token.texts_to_sequences(X_train)
```

```
seq_matrix = sequence.pad_sequences(sequences , maxlen = max_len)
```

**#Creating the model**

```
model = Sequential()
```

```
model.add(Embedding(max_word , 32 , input_length = max_len))
```

```
model.add(LSTM(64))
```

```
model.add(Flatten())
```

```
model.add(Dense(250, activation='relu'))  
model.add(Dropout(0.5))  
model.add(Dense(120, activation='relu'))  
model.add(Dense(1, activation='sigmoid'))
```

```
In [12]: X_train,X_test,Y_train,Y_test = train_test_split(X,Y,test_size = 0.2)
```

```
In [13]: max_word = 1000  
max_len = 250  
token = Tokenizer(num_words = max_word)  
token.fit_on_texts(X_train)  
sequences = token.texts_to_sequences(X_train)  
seq_matrix = sequence.pad_sequences(sequences , maxlen = max_len)
```

```
In [28]: model = Sequential()  
model.add(Embedding(max_word , 32 , input_length = max_len))  
model.add(LSTM(64))  
model.add(Flatten())  
model.add(Dense(250, activation='relu'))  
model.add(Dropout(0.5))  
model.add(Dense(120, activation='relu'))  
model.add(Dense(1, activation='sigmoid'))
```

### **#compile the model**

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

```
In [15]: model.compile(loss = 'binary_crossentropy' , optimizer = 'RMSprop' , metrics = 'accuracy')
model.summary()
```

Model: "sequential"

Layer (type)	Output Shape	Param #
embedding (Embedding)	(None, 250, 32)	32000
lstm (LSTM)	(None, 64)	24832
flatten (Flatten)	(None, 64)	0
dense (Dense)	(None, 250)	16250
dropout (Dropout)	(None, 250)	0
dense_1 (Dense)	(None, 120)	30120
dense_2 (Dense)	(None, 1)	121

```
=====
Total params: 103,323
Trainable params: 103,323
Non-trainable params: 0
=====
```

## #Fit the model

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

```
test_seq = token.texts_to_sequences(X_test)
```

```
test_seq_matrix = sequence.pad_sequences(test_seq,maxlen=max_len)
```

```
In [18]: model.fit(seq_matrix,Y_train,batch_size=128,epochs=10,validation_split=0.2,callbacks=[EarlyStopping(monitor='val_loss',min_delta=
```

```
Epoch 1/10
28/28 [=====] - 14s 489ms/step - loss: 0.0256 - accuracy: 0.9910 - val_loss: 0.0566 - val_accuracy: 0.9843
Epoch 2/10
28/28 [=====] - 11s 385ms/step - loss: 0.0180 - accuracy: 0.9952 - val_loss: 0.0582 - val_accuracy: 0.9843
```

```
Out[18]: <keras.callbacks.History at 0x7f172ca32b90>
```

```
In [19]: test_seq = token.texts_to_sequences(X_test)
test_seq_matrix = sequence.pad_sequences(test_seq,maxlen=max_len)
```

### #Save the model

```
model.save(r'lstm_model.h5')
```

---

```
In [24]: model.save(r'lstm_model.h5')
```

---

### #Test the model:

```
from tensorflow.keras.models import load_model
```

```
new_model=load_model(r'lstm_model.h5')
```

```
new_model.evaluate(test_seq_matrix,Y_test)
```

```
scores = model.evaluate(test_seq_matrix, Y_test, verbose=0)
```

```
scores
```

```
print("Accuracy: %.2f%%" % (scores[1]*100))
```

---

```
In [25]: from tensorflow.keras.models import load_model  
new_model=load_model(r'lstm_model.h5')
```

---

```
In [27]: new_model.evaluate(test_seq_matrix,Y_test)|  
35/35 [=====] - 2s 36ms/step - loss: 0.0655 - accuracy: 0.9821
```

```
Out[27]: [0.06549865007400513, 0.9820627570152283]
```

---

```
In [20]: scores = model.evaluate(test_seq_matrix, Y_test, verbose=0)  
scores
```

```
Out[20]: [0.06549865007400513, 0.9820627570152283]
```

```
In [21]: print("Accuracy: %.2f%%" % (scores[1]*100))
```

```
Accuracy: 98.21%
```