Assignment -4

Assignment Date	15 November 2022
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SMS SPAM Classification

In [132]:

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

```
Drive already mounted at /content/drive; to attempt to forcibly remount, call drive.mou
nt("/content/drive", force_remount=True).
```

Import Libraries

In [133]:

```
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
import tensorflow
%matplotlib inline
```

In [ ]:

```
!pip install tensorflow
```

In [135]:

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

Read the Dataset

In [136]:

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

Out[136]:

	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

Pre-processing the Dataset

In [137]:

```
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
```

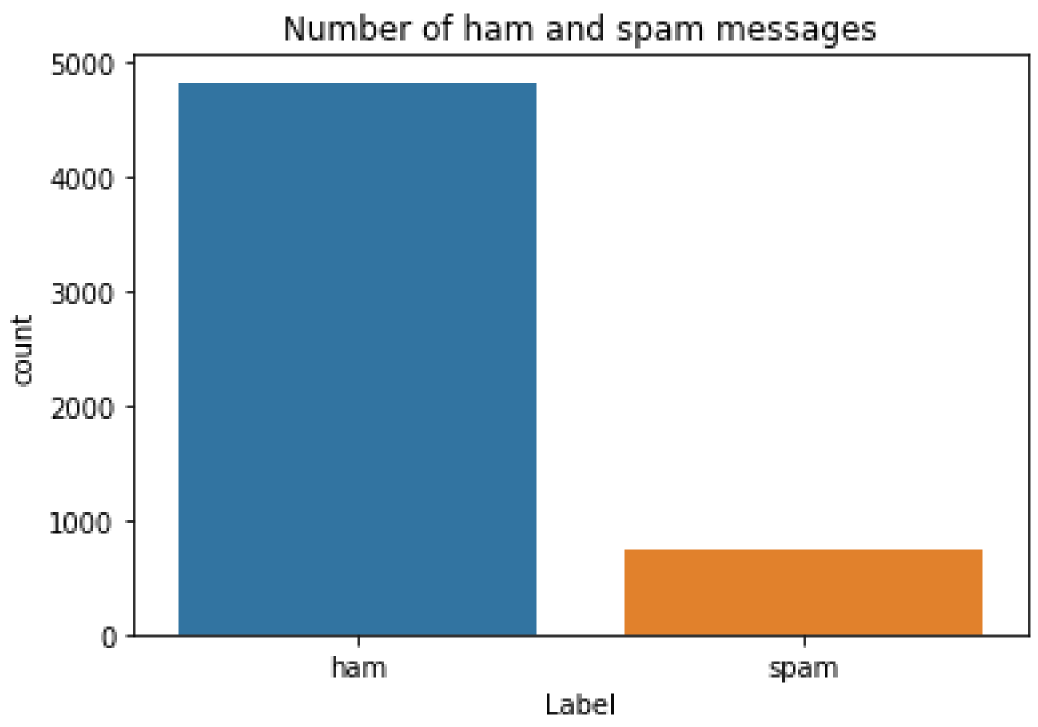
In [138]:

```
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 t
he 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 r
esult in an error or misinterpretation.
  FutureWarning
```

Out[138]:

```
Text(0.5, 1.0, 'Number of ham and spam messages')
```



In [139]:

```
x= df.v2
y= df.v1
le= LabelEncoder()
y= le.fit_transform(y)
y= y.reshape(-1,1)
```

In [140]:

```
x_train,x_test,y_train,y_test = train_test_split(x,y,test_size=0.15)
```

In [141]:

```
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)
```

Create Model & Add Layers

In [142]:

```
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)
 moddel = Model(inputs=inputs,outputs=layer)
 return model
```

Compile the Model

In [143]:

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

```
Model: "model_4"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 inputs (InputLayer)         [(None, 150)]             0

 embedding_4 (Embedding)     (None, 150, 50)           50000

 lstm_4 (LSTM)               (None, 64)                29440

 FC1 (Dense)                 (None, 256)               16640

 activation_8 (Activation)   (None, 256)               0

 dropout_4 (Dropout)         (None, 256)               0

 out_layer (Dense)           (None, 1)                 257

 activation_9 (Activation)   (None, 1)                 0

=================================================================
Total params: 96,337
Trainable params: 96,337
Non-trainable params: 0
_________________________________________________________________
```

In [144]:

```
df.columns
```

Out[144]:

```
Index(['v1', 'v2'], dtype='object')
```

In [145]:

```
data=df.rename(
    {
        "v1":"Category",
        "v2":"Message"
    },

    axis=1
)
```

In [146]:

```
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
```

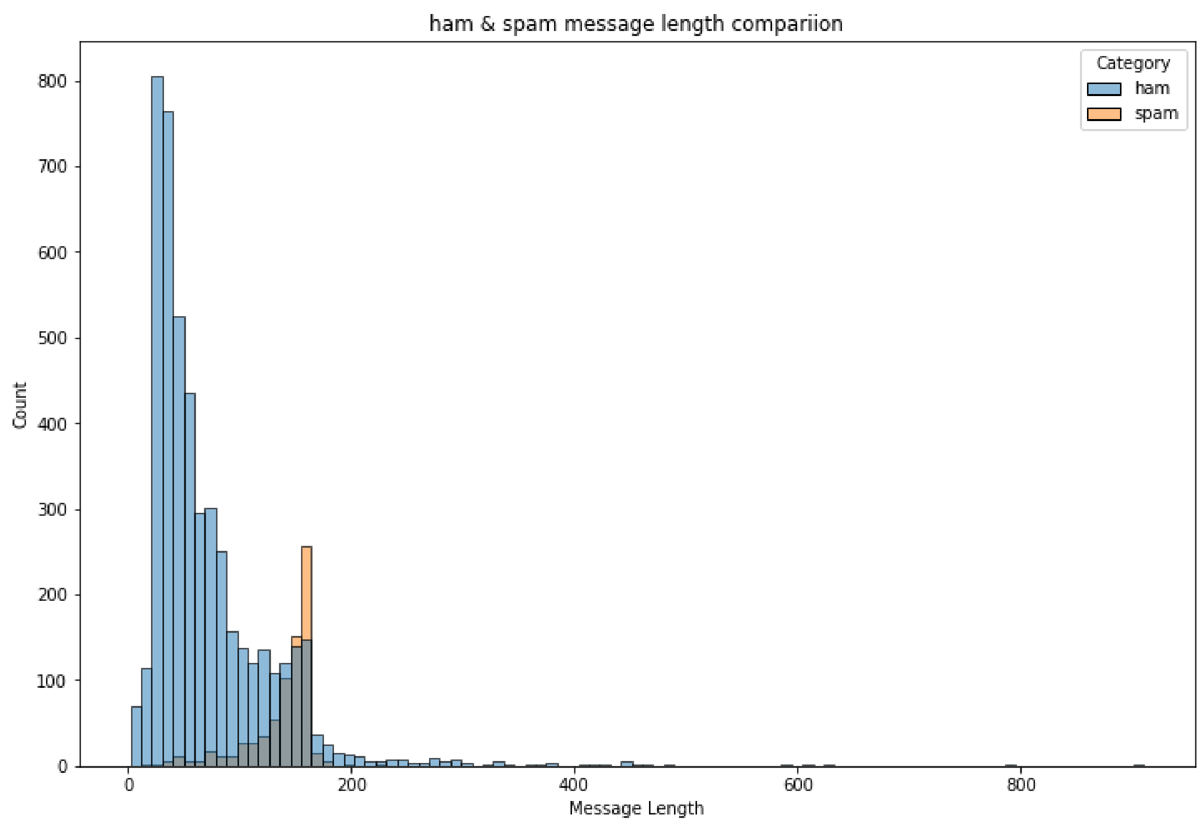
In [147]:

```
data["Message Length"]=data["Message"].apply(len)
```

In [148]:

```
fig=plt.figure(figsize=(12,8))
sns.histplot(
    x=data["Message Length"],
    hue=data["Category"]
)
plt.title("ham & spam message length compariion")
plt.show
```

Out[148]:



In [149]:

```
ham_desc=data[data["Category"]=="ham"]["Message Length"].describe()
spam_desc=data[data["Category"]=="spam"]["Message Length"].describe()

print("Ham Message Length Description:\n",ham_desc)
print("****************************")
print("spam Message Length Description:\n",spam_desc)
```

```
Ham Message Length Description:
 count    4825.000000
mean       71.023627
std        58.016023
min         2.000000
25%        33.000000
50%        52.000000
75%        92.000000
max       910.000000
Name: Message Length, dtype: float64
****************************
spam Message Length Description:
 count    747.000000
mean     138.866131
std       29.183082
min       13.000000
25%      132.500000
50%      149.000000
75%      157.000000
max      224.000000
Name: Message Length, dtype: float64
```

In [150]:

```
data.describe(include="all")
```

Out[150]:

	Category	Message	Message Length
count	5572	5572	5572.000000
unique	2	5169	NaN
top	ham	Sorry, I'll call later	NaN
freq	4825	30	NaN
mean	NaN	NaN	80.118808
std	NaN	NaN	59.690841
min	NaN	NaN	2.000000
25%	NaN	NaN	36.000000
50%	NaN	NaN	61.000000
75%	NaN	NaN	121.000000
max	NaN	NaN	910.000000

In [151]:

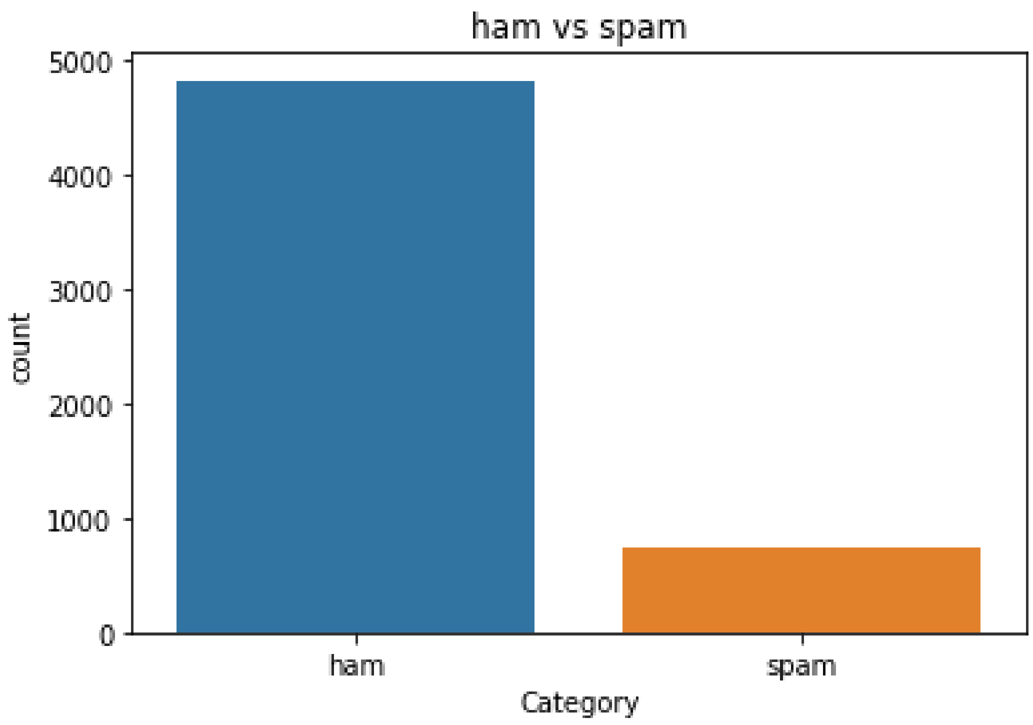
```
data["Category"].value_counts()
```

Out[151]:

```
ham     4825
spam     747
Name: Category, dtype: int64
```

In [152]:

```
sns.countplot(
    data=data,
    x="Category"
)
plt.title("ham vs spam")
plt.show()
```



In [153]:

```
ham_count=data["Category"].value_counts()[0]
spam_count=data["Category"].value_counts()[1]
total_count=data.shape[0]

print("Ham Contains:{:2f}% of total data.".format(ham_count/total_count*100))
print("Spam Contains:{:2f}% of total data.".format(spam_count/total_count*100))
```

```
Ham Contains:86.593683% of total data.
Spam Contains:13.406317% of total data.
```

In [154]:

```
minority_len=len(data[data["Category"]=="spam"])
majority_len=len(data[data["Category"]=="ham"])
minority_indices=data[data["Category"]=="spam"].index
majority_indices=data[data["Category"]=="ham"].index
random_majority_indices=np.random.choice(
    majority_indices,
    size=minority_len,
    replace=False
)
undersampled_indices=np.concatenate([minority_indices,random_majority_indices])
df=data.loc[undersampled_indices]
df=df.sample(frac=1)

df=df.reset_index()
df=df.drop(
    columns=["index"],
)
```

In [155]:

```
df.shape
```

Out[155]:

```
(1494, 3)
```

In [156]:

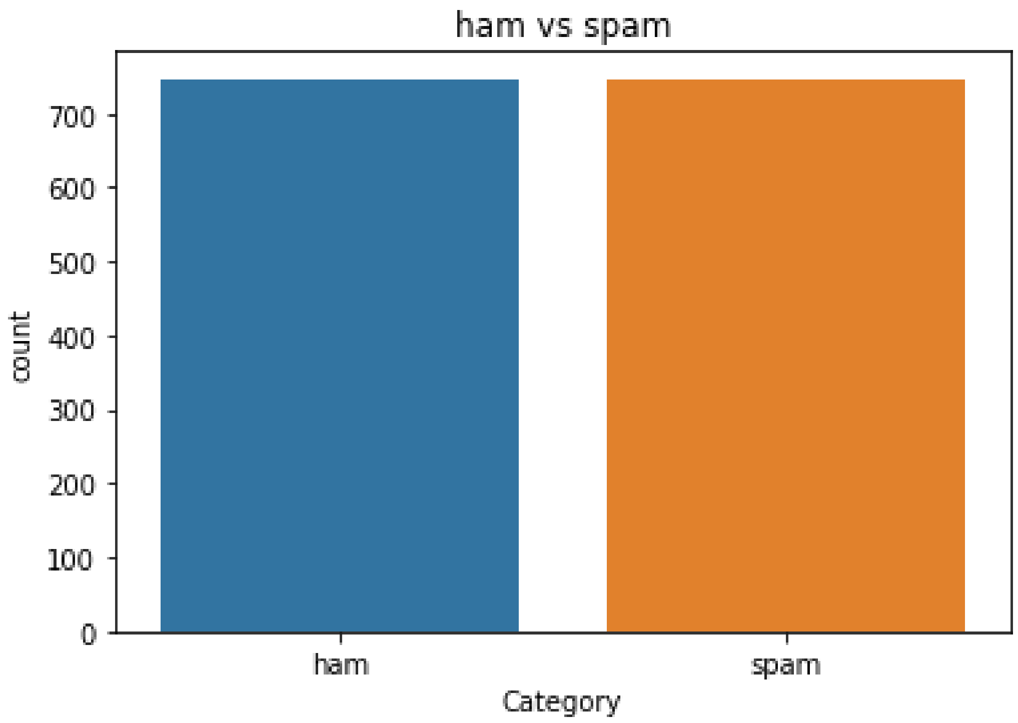
```
df["Category"].value_counts()
```

Out[156]:

```
ham     747
spam    747
Name: Category, dtype: int64
```

In [157]:

```
sns.countplot(
    data=df,
    x="Category"
)
plt.title("ham vs spam")
plt.show()
```



In [158]:

```
df.head()
```

Out[158]:

	Category	Message	Message Length
0	ham	Sorry completely forgot * will pop em round th...	73
1	ham	Are you this much buzy	22
2	ham	sure, but make sure he knows we ain't smokin yet	48
3	ham	S:-)if we have one good partnership going we w...	61
4	spam	REMINDER FROM O2: To get 2.50 pounds free call...	147

In [159]:

```
df["label"]=df["Category"].map(
    {
        "ham":0,
        "spam":1
    }
)
```

In [160]:

```
df.head()
```

Out[160]:

	Category	Message	Message Length	label
0	ham	Sorry completely forgot * will pop em round th...	73	0
1	ham	Are you this much buzy	22	0
2	ham	sure, but make sure he knows we ain't smokin yet	48	0
3	ham	S:-)if we have one good partnership going we w...	61	0
4	spam	REMINDER FROM O2: To get 2.50 pounds free call...	147	1

In [161]:

```
import re
import nltk
from nltk.corpus import stopwords
from nltk.stem import PorterStemmer

stemmer=PorterStemmer
```

In [162]:

```
corpus=[]
for message in df["Message"]:
  message=re.sub("[^a-zA-Z]","",message)
  message=message.lower()
  message=message.split()
```

In [ ]:

```
!pip install tensorflow
```

In [163]:

```
from tensorflow.keras.preprocessing.text import one_hot
vocab_size=10000

oneHot_doc=[one_hot(words,n=vocab_size)
for words in corpus
]
```

In [164]:

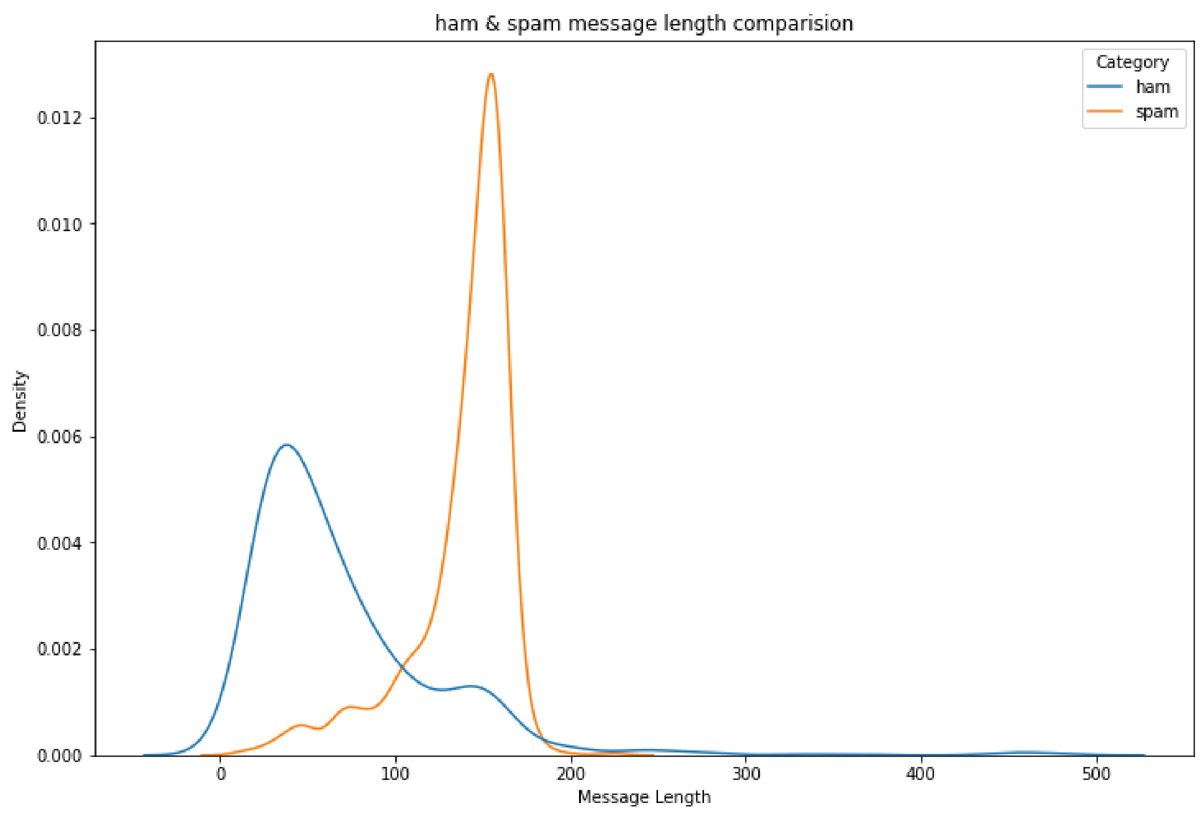
```
df["Message Length"].describe()
```

Out[164]:

```
count    1494.000000
mean      104.647256
std        56.391151
min         2.000000
25%        51.000000
50%       115.000000
75%       153.000000
max       482.000000
Name: Message Length, dtype: float64
```

In [165]:

```
fig=plt.figure(figsize=(12,8))
sns.kdeplot(
    x=df["Message Length"],
    hue=df["Category"]
)
plt.title("ham & spam message length comparision")
plt.show()
```



In [166]:

```
from tensorflow.keras.preprocessing.sequence import pad_sequences
sentence_len=100
embedded_doc=pad_sequences(
    oneHot_doc,
    maxlen=sentence_len,
    padding="pre"
)
```

In [167]:

```
extract_features=pd.DataFrame(
    data=embedded_doc
)
target=df["label"]
```

In [168]:

```
df_final=pd.concat([extract_features,target],axis=1)
```

In [169]:

```
df_final.head()
```

Out[169]:

	0	1	2	3	4	5	6	7	8	9	...	91	92	93	94	95	96	97	98	99	label
0	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	0
1	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	0
2	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	0

	0	1	2	3	4	5	6	7	8	9	...	91	92	93	94	95	96	97	98	99	label
3	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	0
4	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	1

5 rows × 101 columns

In [170]:

```
x=df_final.drop("label",axis=1)
y=df_final["label"]
```

In [171]:

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

In [172]:

```
x_trainval,x_test,y_trainval,y_test=train_test_split(
    x,
    y,
    random_state=37,
    test_size=0.2
)
```

In [173]:

```
x_trainval,x_val,y_trainval,y_test=train_test_split(
    x_trainval,
    y_trainval,
    random_state=37,
    test_size=0.2
)
```

In [174]:

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

```
Model: "model_4"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 inputs (InputLayer)         [(None, 150)]             0

 embedding_4 (Embedding)     (None, 150, 50)           50000

 lstm_4 (LSTM)               (None, 64)                29440

 FC1 (Dense)                 (None, 256)               16640

 activation_8 (Activation)   (None, 256)               0

 dropout_4 (Dropout)         (None, 256)               0

 out_layer (Dense)           (None, 1)                 257

 activation_9 (Activation)   (None, 1)                 0

=================================================================
Total params: 96,337
Trainable params: 96,337
Non-trainable params: 0
```