ASSIGNMENT -4

SMS Spam classification

ASSIGNMENT DATE	31 OCTOBER 2022
STUDENT NAME	S.KIRUTHIKA
ROLL NUMBER	922119106043
MAXIMUM MARKS	2 MARKS

Task 1:

1. Download the Dataset : Dataset

Solution:

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

SMS SPAM Classification

1. Download The Dataset : Dataset

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

    Mounted at /content/drive
```

Task 2:

2. Importing necessary libraries

Solution:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from keras_preprocessing.sequence import pad_sequences
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.sequence import pad_sequences
```

```
from keras.utils import to_categorical
from keras.callbacks import EarlyStopping
import nltk
from nltk.corpus import stopwords
from nltk.stem.porter import PorterStemmer
from nltk.stem import WordNetLemmatizer
import re
%matplotlib inline
```

2. Importing necessary libraries

```
[2] import pandas as pd
    import numpy as np
    import matplotlib.pyplot as plt
    import seaborn as sns
    from keras_preprocessing.sequence import pad_sequences
    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.sequence import pad_sequences
    from keras.utils import to_categorical
    from keras.callbacks import EarlyStopping
    import nltk
    from nltk.corpus import stopwords
    from nltk.stem.porter import PorterStemmer
    from nltk.stem import WordNetLemmatizer
    import re
    %matplotlib inline
```

Task 3:

3.1 Read the Dataset

Solution:

```
data = pd.read_csv("/content/drive/MyDrive/Colab Notebooks/muthamizhan/spam.csv", encoding="ISO-8859-1")
data.info()

data.head()

data.tail()
```

3.1 Read the Dataset

```
[33] data = pd.read_csv("/content/drive/MyDrive/Colab Notebooks/muthamizhan/spam.csv", encoding="ISO-8859-1")
     data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 5572 entries, 0 to 5571
Data columns (total 5 columns):
 #   Column      Non-Null Count  Dtype 
---  ------      --------------  ----- 
 0   v1          5572 non-null   object
 1   v2          5572 non-null   object
 2   Unnamed: 2  50 non-null     object
 3   Unnamed: 3  12 non-null     object
 4   Unnamed: 4  6 non-null      object
dtypes: object(5)
memory usage: 217.8+ KB
```

3.1 Read the Dataset

```
[3] data = pd.read_csv("/content/drive/MyDrive/Colab Notebooks/Vignesh/spam.csv", encoding="ISO-8859-1")
    data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 5572 entries, 0 to 5571
Data columns (total 5 columns):
 #   Column      Non-Null Count  Dtype 
---  ------      --------------  ----- 
 0   v1          5572 non-null   object
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 2   Unnamed: 2  50 non-null     object
 3   Unnamed: 3  12 non-null     object
 4   Unnamed: 4  6 non-null      object
dtypes: object(5)
memory usage: 217.8+ KB
```

```
[4] data.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

```
[5] data.tail()
```

	v1	v2	Unnamed: 2	Unnamed: 3	Unnamed: 4
5567	spam	This is the 2nd time we have tried 2 contact u...	NaN	NaN	NaN
5568	ham	Will ì_ 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

3.2 Preprocessing the Dataset

Solution:

```
df = data.drop(data[["Unnamed: 2","Unnamed: 3","Unnamed: 4"]], axis=1)

df.rename(columns = {"v1":"Target", "v2":"Text"}, inplace = True)
df

plt.figure(figsize=(6,4))
```

```
fg = sns.countplot(x= df["Target"], palette= ["red", "blue"] )
fg.set_title("Count Plot of Classes", color="#58508d")
fg.set_xlabel("Classes", color="#58508d")
fg.set_ylabel("Number of Data points", color="#58508d")

nltk.download('punkt')

df["No_of_Characters"] = df["Text"].apply(len)
df["No_of_Words"]=df.apply(lambda row: nltk.word_tokenize(row["Text"]),
axis=1).apply(len)
df["No_of_sentence"]=df.apply(lambda row: nltk.sent_tokenize(row["Text"]),
axis=1).apply(len)
df.describe().T

df.head()

plt.figure(figsize=(18,12))
fg = sns.pairplot(data=df, hue="Target",palette=["green","blue"])
plt.show(fg)

def Clean(Text):
    sms = re.sub('[^a-zA-Z]', ' ', Text) #Replacing all non-alphabetic characters with a
space
    sms = sms.lower() #converting to lowecase
    sms = sms.split()
    sms = ' '.join(sms)
    return sms
df["Clean_Text"] = df["Text"].apply(Clean)

df["Tokenize_Text"]=df.apply(lambda row: nltk.word_tokenize(row["Clean_Text"]),
axis=1)

nltk.download('stopwords')
def remove_stopwords(text):
    stop_words = set(stopwords.words("english"))
    filtered_text = [word for word in text if word not in stop_words]
    return filtered_text

df["Nostopword_Text"] = df["Tokenize_Text"].apply(remove_stopwords)

nltk.download('wordnet')
nltk.download('omw-1.4')
```

```
lemmatizer = WordNetLemmatizer()
def lemmatize_word(text):
    lemmas = [lemmatizer.lemmatize(word, pos ='v') for word in text]
    return lemmas
df["Lemmatized_Text"] = df["Nostopword_Text"].apply(lemmatize_word)


corpus= []
for i in df["Lemmatized_Text"]:
    msg = ' '.join([row for row in i])
    corpus.append(msg)
corpus[:5]

df.tail()
```

3.2 Preprocessing the Dataset

```
[6]  df = data.drop(data[["Unnamed: 2","Unnamed: 3","Unnamed: 4"]], axis=1)
```

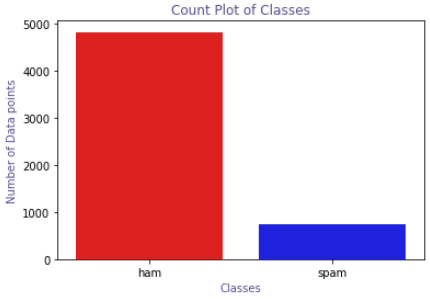
```
[8]  df.rename(columns = {"v1":"Target", "v2":"Text"}, inplace = True)
     df
```

	Target	Text
0	ham	Go until jurong point, crazy.. Available only ...
1	ham	Ok lar... Joking wif u oni...
2	spam	Free entry in 2 a wkly comp to win FA Cup fina...
3	ham	U dun say so early hor... U c already then say...
4	ham	Nah I don't think he goes to usf, he lives aro...
...	...	...
5567	spam	This is the 2nd time we have tried 2 contact u...
5568	ham	Will Ì_ b going to esplanade fr home?
5569	ham	Pity, * was in mood for that. So...any other s...
5570	ham	The guy did some bitching but I acted like i'd...
5571	ham	Rofl. Its true to its name

5572 rows × 2 columns

```
[9] plt.figure(figsize=(6,4))
    fg = sns.countplot(x= df["Target"], palette= ["red", "blue"] )
    fg.set_title("Count Plot of Classes", color="#58508d")
    fg.set_xlabel("Classes", color="#58508d")
    fg.set_ylabel("Number of Data points", color="#58508d")
```

```
Text(0, 0.5, 'Number of Data points')
```




```
[ ] nltk.download('punkt')
```

```
[nltk_data] Downloading package punkt to /root/nltk_data...
[nltk_data]   Unzipping tokenizers/punkt.zip.
True
```

```
df["No_of_Characters"] = df["Text"].apply(len)
df["No_of_Words"]=df.apply(lambda row: nltk.word_tokenize(row["Text"]), axis=1).apply(len)
df["No_of_sentence"]=df.apply(lambda row: nltk.sent_tokenize(row["Text"]), axis=1).apply(len)
df.describe().T
```

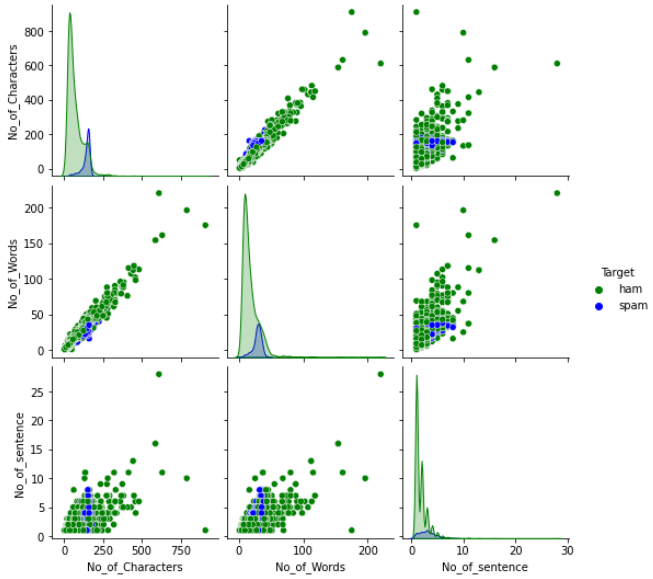
	count	mean	std	min	25%	50%	75%	max
No_of_Characters	5572.0	80.118808	59.690841	2.0	36.0	61.0	121.0	910.0
No_of_Words	5572.0	18.695621	13.742587	1.0	9.0	15.0	27.0	220.0
No_of_sentence	5572.0	1.970747	1.417778	1.0	1.0	1.0	2.0	28.0

```
[ ] df.head()
```

	Target	Text	No_of_Characters	No_of_Words	No_of_sentence
0	ham	Go until jurong point, crazy.. Available only ...	111	24	2
1	ham	Ok lar... Joking wif u oni...	29	8	2
2	spam	Free entry in 2 a wkly comp to win FA Cup fina...	155	37	2
3	ham	U dun say so early hor... U c already then say...	49	13	1
4	ham	Nah I don't think he goes to usf, he lives aro...	61	15	1

```
[ ]  plt.figure(figsize=(18,12))
     fg = sns.pairplot(data=df, hue="Target",palette=["green","blue"])
     plt.show(fg)
```

```
<Figure size 1296x864 with 0 Axes>
```




```
[ ]  def Clean(Text):
         sms = re.sub('[^a-zA-Z]', ' ', Text) #Replacing all non-alphabetic characters with a space
         sms = sms.lower() #converting to lowecase
         sms = sms.split()
         sms = ' '.join(sms)
         return sms
     df["Clean_Text"] = df["Text"].apply(Clean)
```

```
[ ]  df["Tokenize_Text"]=df.apply(lambda row: nltk.word_tokenize(row["Clean_Text"]), axis=1)
```

```
[ ]  nltk.download('stopwords')
     def remove_stopwords(text):
         stop_words = set(stopwords.words("english"))
         filtered_text = [word for word in text if word not in stop_words]
         return filtered_text

     df["Nostopword_Text"] = df["Tokenize_Text"].apply(remove_stopwords)
```

```
[nltk_data] Downloading package stopwords to /root/nltk_data...
[nltk_data]   Unzipping corpora/stopwords.zip.
```

```
[ ]  nltk.download('wordnet')
     nltk.download('omw-1.4')
```

```
[nltk_data] Downloading package wordnet to /root/nltk_data...
[nltk_data] Downloading package omw-1.4 to /root/nltk_data...
True
```

```
[ ]  lemmatizer = WordNetLemmatizer()

     def lemmatize_word(text):
         lemmas = [lemmatizer.lemmatize(word, pos ='v') for word in text]
         return lemmas
     df["Lemmatized_Text"] = df["Nostopword_Text"].apply(lemmatize_word)
```

```
[ ]
     corpus= []
     for i in df["Lemmatized_Text"]:
         msg = ' '.join([row for row in i])
         corpus.append(msg)
     corpus[:5]
```

```
['go jurong point crazy available bugis n great world la e buffet cine get amore wat',
 'ok lar joke wif u oni',
 'free entry wkly comp win fa cup final tkts st may text fa receive entry question std txt rate c apply',
 'u dun say early hor u c already say',
 'nah think go usf live around though']
```

```
[ ] df.tail()
```

	Target	Text	No_of_Characters	No_of_Words	No_of_sentence	Clean_Text	Tokenize_Text	Nostopword_Text	Lemmatized_Text
5567	spam	This is the 2nd time we have tried 2 contact u...	161	35	4	this is the nd time we have tried contact u u ...	[this, is, the, nd, time, we, have, tried, con...	[nd, time, tried, contact, u, u, pound, prize,...	[nd, time, try, contact, u, u, pound, prize, c...
5568	ham	Will ì_ b going to esplanade fr home?	37	9	1	will b going to esplanade fr home	[will, b, going, to, esplanade, fr, home]	[b, going, esplanade, fr, home]	[b, go, esplanade, fr, home]
5569	ham	Pity, * was in mood for that. So...any other s...	57	15	2	pity was in mood for that so any other suggest...	[pity, was, in, mood, for, that, so, any, othe...	[pity, mood, suggestions]	[pity, mood, suggestions]
5570	ham	The guy did some bitching but I acted like i'd...	125	27	1	the guy did some bitching but i acted like i d...	[the, guy, did, some, bitching, but, i, acted,...	[guy, bitching, acted, like, interested, buyin...	[guy, bitch, act, like, interest, buy, somethi...
5571	ham	Rofl. Its true to its name	26	7	2	rofl its true to its name	[rofl, its, true, to, its, name]	[rofl, true, name]	[rofl, true, name]

Task 4:

4. Create Model

Solution:

```
X = df.Clean_Text
Y = df.Target
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 = 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)
```

4. Create Model

```
[21] X = df.Clean_Text
     Y = df.Target
     le = LabelEncoder()
     Y = le.fit_transform(Y)
     Y = Y.reshape(-1,1)
```

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

```
[23] 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)
```

Task 5:

5. Add Layers (LSTM, Dense-(Hidden Layers), Output)

Solution:

```
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
```

5. Add Layers (LSTM, Dense-(Hidden Layers), Output)

```
[24] 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
```

Task 6:

6. Compiling the Model

Solution:

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

6. Compiling the Model

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

```
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
_________________________________________________________________
```

Task 7:

7. Fit the Model

Solution:

```
model.fit(sequences_matrix,Y_train,batch_size=128,epochs=10,

validation_split=0.2,callbacks=[EarlyStopping(monitor='val_loss',min_delta=0.0001)
])
```

7. Fit the Model

```
[26] 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 [==============================] - 8s 31ms/step - loss: 0.3269 - accuracy: 0.8751 - val_loss: 0.1242 - val_accuracy: 0.9652
Epoch 2/10
30/30 [==============================] - 0s 13ms/step - loss: 0.0808 - accuracy: 0.9797 - val_loss: 0.0480 - val_accuracy: 0.9863
<keras.callbacks.History at 0x7fb860f6b790>
```

Task 8:

8. Save The Model

Solution:

```
model.save('sms_classifier.h5')
```

8. Save The Model

```
[27] model.save('sms_classifier.h5')
```

Task 9:

9. Test The Model

Solution:

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

accr = model.evaluate(test_sequences_matrix,Y_test)

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

9. Test The Model

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

```
[29] accr = model.evaluate(test_sequences_matrix,Y_test)

     27/27 [==============================] - 0s 6ms/step - loss: 0.0710 - accuracy: 0.9761
```

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

     Test set
       Loss: 0.071
       Accuracy: 0.976
```