TEAM ID - PNT2022TMID04639

1. Download the Dataset

https://www.kaggle.com/code/kredy10/simple-lstm-for-text-classification/data

2. Import the required libraries

```
import os
import re
import pandas as pd
import numpy as np
import nltk
from nltk.corpus import stopwords
from nltk.stem  import  WordNetLemmatizer
from wordcloud import WordCloud
import matplotlib.pyplot as plt
import tensorflow as tf
from  tensorflow.keras.models  import  Sequential
from tensorflow.keras.layers import Dense, LSTM, Dropout, Embedding
from  tensorflow.keras.callbacks  import  EarlyStopping
from  tensorflow.keras.preprocessing.text  import  Tokenizer
import keras
from  sklearn.preprocessing  import  LabelEncoder
from  sklearn.feature_extraction.text  import  TfidfVectorizer
from  sklearn.model_selection  import  train_test_split
from google.colab import drive
```

```
#Mount and access drive
drive.mount('/content/drive',force_remount=True)
os.chdir('/content/drive/My Drive')
print("Change successful.")
```

```
Mounted at /content/drive
Change successful.
```

3.Read the dataset and do pre-processing

```
spam_df  =  pd.read_csv(filepath_or_buffer='Dataset-3_Spam.csv',  delimiter=',',encoding='l
spam_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

```
#List the column names
spam_df.columns
```

```
Index(['v1', 'v2', 'Unnamed: 2', 'Unnamed: 3', 'Unnamed: 4'], dtype='object')
```

```
#Drop the unnamed columns
spam_df.drop(columns=['Unnamed: 2', 'Unnamed: 3', 'Unnamed: 4'], axis=1, inplace=True)
spam_df.columns
```

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

```
#Print the number of rows in the dataset
spam_df.shape
```

```
(5572, 2)
```

```
#Get the summary statistics of the dataset
spam_df.describe()
```

	v1	v2
count	5572	5572
unique	2	5169
top	ham	Sorry, I'll call later
freq	4825	30

```
#Check for null values
spam_df.isna().sum()
```

```
v1    0
v2    0
dtype: int64
```

```
#Check for duplicated rows
spam_df.duplicated().sum()
```

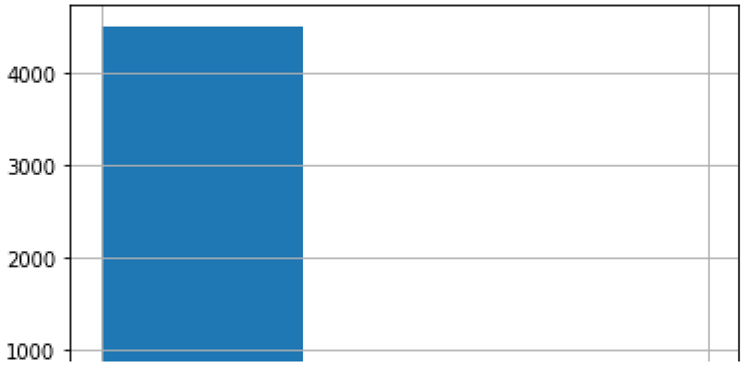
```
403
```

```
#Remove the duplicated rows
spam_df = spam_df.drop_duplicates()
spam_df.duplicated().sum()
```

```
0
```

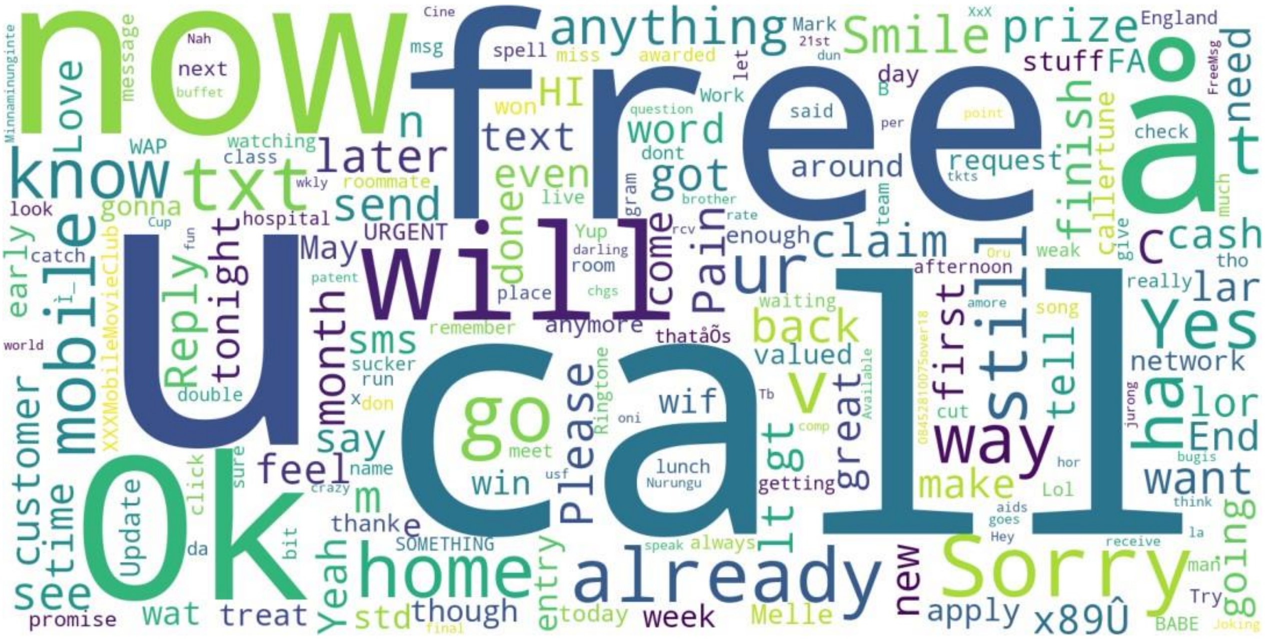
```
#Display the count of spam and ham labels
#Stratified-split is required
spam_df['v1'].hist(bins=3)
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f92aa5f2f90>
```



```
def wordcloud_vis(column):
  mostcommon = nltk.FreqDist(spam_df[column]).most_common(100)
  wordcloud = WordCloud(width=1600, height=800, background_color='white').generate(str(m
  fig = plt.figure(figsize=(30,10), facecolor='white')
  plt.imshow(wordcloud) #, interpolation="bilinear")
  plt.axis('off')
  plt.show()
```

```
#Plot the word-cloud before removing stopwords, performing lemmatization
wordcloud_vis('v2')
```



```
#Retain only the letters and spaces
spam_df['alpha_text'] = spam_df['v2'].apply(lambda x: re.sub(r'[^a-zA-Z ]+', '', x.lower(
spam_df.head()
```

	v1	v2	alpha_text
0	ham	Go until jurong point, crazy.. Available only ...	go until jurong point crazy available only in ...
1	ham	Ok lar... Joking wif u oni...	ok lar joking wif u oni
2	spam	Free entry in 2 a wkly comp to win FA Cup fina...	free entry in a wkly comp to win fa cup final...
3	ham	U dun say so early hor... U c already then say...	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...	nah i dont think he goes to usf he lives aroun...

```
#Remove stop-words
nltk.download('stopwords')
spam_df['imp_text'] = spam_df['alpha_text'].apply(lambda x : ' '.join([word for word in
spam_df.head()
```

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

	v1	v2	alpha_text	imp_text
0	ham	Go until jurong point, crazy.. Available only ...	go until jurong point crazy available only in ...	go jurong point crazy available bugis n great ...
1	ham	Ok lar... Joking wif u oni...	ok lar joking wif u oni	ok lar joking wif u oni
2	spam	Free entry in 2 a wkly comp to win FA Cup fina...	free entry in a wkly comp to win fa cup final...	free entry wkly comp win fa cup final tkts st ...
3	ham	U dun say so early hor... U c already then say...	u dun say so early hor u c already then say	u dun say early hor u c already say
4	ham	Nah I don't think he goes to usf, he lives aro...	nah i dont think he goes to usf he lives aroun...	nah dont think goes usf lives around though

```
#Tokenize the data
def tokenize(data):
  generated_token = list(data.split())
  return generated_token
spam_df['token_text'] = spam_df['imp_text'].apply(lambda x: tokenize(x))
spam_df.head()
```

	v1	v2	alpha_text	imp_text	token_text
0	ham	Go until jurong point, crazy.. Available only ...	go until jurong point crazy available only in ...	go jurong point crazy available bugis n great ...	[go, jurong, point, crazy, available, bugis, n...
1	ham	Ok lar... Joking wif u oni...	ok lar joking wif u oni	ok lar joking wif u oni	[ok, lar, joking, wif, u, oni]
2	spam	Free entry in 2 a wkly comp to win FA Cup fina...	free entry in a wkly comp to win fa cup final...	free entry wkly comp win fa cup final tkts st ...	[free, entry, wkly, comp, win, fa, cup, final,...
3	ham	U dun say so early hor... U c already then say...	u dun say so early hor u c already then say	u dun say early hor u c already say	[u, dun, say, early, hor, u, c, already, say]
4	ham	Nah I don't think he goes to usf, he lives aro...	nah i dont think he goes to usf he lives aroun...	nah dont think goes usf lives around though	[nah, dont, think, goes, usf, lives, around, t...

```
#Perform Lemmatization
nltk.download('wordnet')
nltk.download('omw-1.4')
lemmatizer = WordNetLemmatizer()
def lemmatization(list_of_words):
  lemmatized_list = [lemmatizer.lemmatize(word) for word in list_of_words]
  return lemmatized_list
spam_df['lemmatized_text'] = spam_df['token_text'].apply(lambda x: lemmatization(x))
spam_df.head()
```

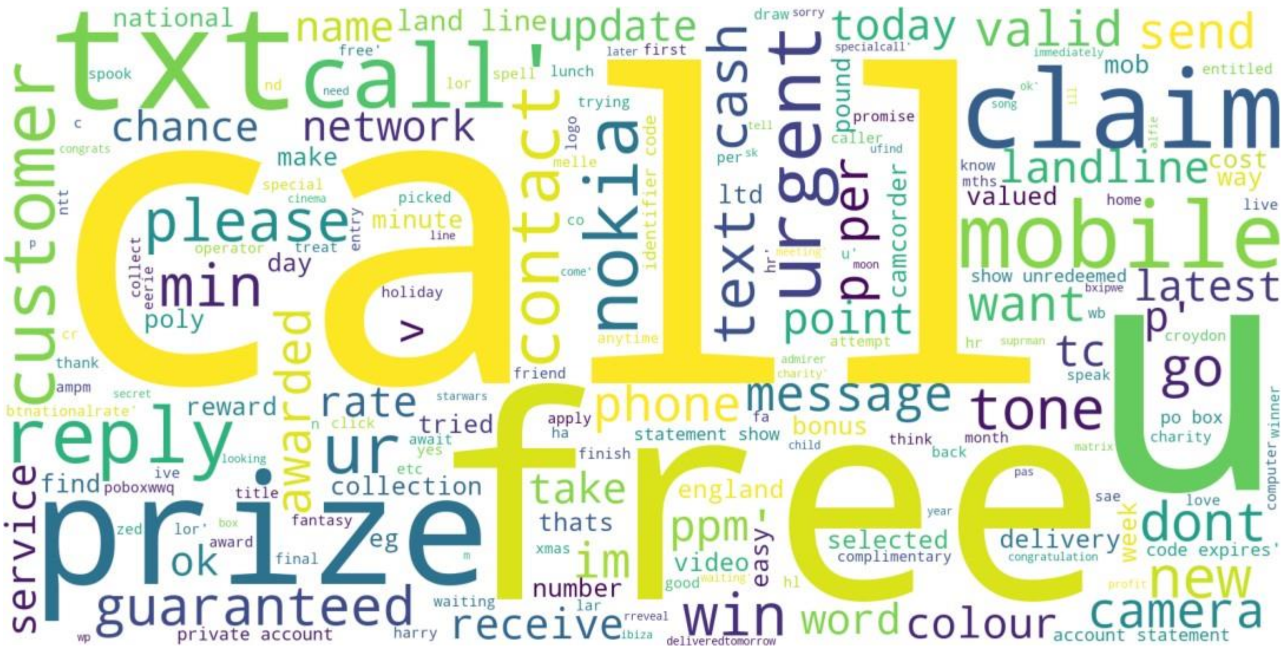
```
[nltk_data] Downloading package wordnet to /root/nltk_data...
[nltk_data]   Package wordnet is already up-to-date!
[nltk_data] Downloading package omw-1.4 to /root/nltk_data...
```

	v1	v2	alpha_text	imp_text	token_text	lemmatized_text
0	ham	Go until jurong point, crazy.. Available only ...	go until jurong point crazy available only in ...	go jurong point crazy available bugis n great ...	[go, jurong, point, crazy, available, bugis, n...	[go, jurong, point, crazy, available, bugis, n...
1	ham	Ok lar... Joking wif u oni...	ok lar joking wif u oni	ok lar joking wif u oni	[ok, lar, joking, wif, u, oni]	[ok, lar, joking, wif, u, oni]
2	spam	Free entry in 2 a wkly comp to win FA Cup fina...	free entry in a wkly comp to win fa cup final...	free entry wkly comp win fa cup final tkts st ...	[free, entry, wkly, comp, win, fa, cup, final,...	[free, entry, wkly, comp, win, fa, cup, final,...
3	ham	U dun say so early hor... U c already then say...	u dun say so early hor u c already then say	u dun say early hor u c already say	[u, dun, say, early, hor, u, c, already, say]	[u, dun, say, early, hor, u, c, already, say]
4	ham	Nah I don't think he goes to usf, he lives aro...	nah i dont think he goes to usf he lives aroun...	nah dont think goes usf lives around though	[nah, dont, think, goes, usf, lives, around, t...	[nah, dont, think, go, usf, life, around, though]

```python
#Combine the tokens (into sentences) to get the final cleansed data
spam_df['clean'] = spam_df['lemmatized_text'].apply(lambda x: ' '.join(x))
spam_df.head()
```

	v1	v2	alpha_text	imp_text	token_text	lemmatized_text	clean
0	ham	Go until jurong point, crazy.. Available only ...	go until jurong point crazy available only in ...	go jurong point crazy available bugis n great ...	[go, jurong, point, crazy, available, bugis, n...	[go, jurong, point, crazy, available, bugis, n...	go jurong point crazy available bugis n great ...
1	ham	Ok lar... Joking wif u oni...	ok lar joking wif u oni	ok lar joking wif u oni	[ok, lar, joking, wif, u, oni]	[ok, lar, joking, wif, u, oni]	ok lar joking wif u oni
2	spam	Free entry in 2 a wkly comp to win FA Cup fina...	free entry in a wkly comp to win fa cup final...	free entry wkly comp win fa cup final tkts st ...	[free, entry, wkly, comp, win, fa, cup, final,...	[free, entry, wkly, comp, win, fa, cup, final,...	free entry wkly comp win fa cup final tkts st ...
3	ham	U dun say so early hor... U c already then say...	u dun say so early hor u c already then say	u dun say early hor u c already say	[u, dun, say, early, hor, u, c, already, say]	[u, dun, say, early, hor, u, c, already, say]	u dun say early hor u c already say
4	ham	Nah I don't think he goes to usf, he lives aro...	nah i dont think he goes to usf he lives aroun...	nah dont think goes usf lives around though	[nah, dont, think, goes, usf, lives, around, t...	[nah, dont, think, go, usf, life, around, though]	nah dont think go usf life around though

```python
#Display the wordcloud after preprocessing
wordcloud_vis('clean')
```



```
#Number of unique words in spam and ham
df1 = spam_df.loc[spam_df['v1'] == 'spam']
df2 = spam_df.loc[spam_df['v1'] == 'ham']

spam = set()
df1['clean'].str.lower().str.split().apply(spam.update)
print("Number of unique words in spam", len(spam))

ham = set()
df2['clean'].str.lower().str.split().apply(ham.update)
print("Number of unique words in ham", len(ham))
```

```
Number of unique words in spam 2037
Number of unique words in ham 6738
```

```
#Find the number of overlapping words between spam and ham labels
print("Number of overlapping words between spam and ham: ", len(spam & ham))
```

```
Number of overlapping words between spam and ham:  895
```

```
#Maximum number of words in a sentence
#Useful for applying padding
spam_df['clean'].apply(lambda  x:len(str(x).split())).max()
```

```
80
```

```
#Prepare the data for training
X = spam_df['clean']
y = spam_df['v1']
```

```
#Convert the class labels into integer values
le = LabelEncoder()
y = le.fit_transform(y)
y
```

```
array([0, 0, 1, ..., 0, 0, 0])
```

```
X.shape
```

```
(5169,)
```

```
y.shape
```

```
(5169,)
```

```
#Split the data into train, test
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.15, random_state=4
```

```
tokenizer  =  Tokenizer(num_words=1000)
tokenizer.fit_on_texts(X_train)
tokenized_train  =  tokenizer.texts_to_sequences(X_train)
X_train  =  tf.keras.utils.pad_sequences(tokenized_train,  maxlen=100)
```

```
tokenized_test  =  tokenizer.texts_to_sequences(X_test)
X_test  =  tf.keras.utils.pad_sequences(tokenized_test,  maxlen=100)
```

4. Create the model

```
#Create a wrapper to add layers to the model
model = Sequential()
```

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

```
model.add(Embedding(1000, output_dim=50, input_length=100))
model.add(LSTM(units=64 , return_sequences = True, dropout = 0.2))
model.add(LSTM(units=32 , dropout = 0.1))
model.add(Dense(units = 64 , activation = 'relu'))
model.add(Dense(units = 32 , activation = 'relu'))
model.add(Dense(1, activation='sigmoid'))
```

```
model.summary()
```

```
Model:  "sequential_12"

 Layer (type)                Output Shape              Param #

 embedding_14  (Embedding)   (None, 100, 50)           50000

 lstm_38 (LSTM)              (None, 100, 64)           29440

 lstm_39 (LSTM)              (None, 32)                12416

 dense_25 (Dense)            (None, 64)                2112

 dense_26 (Dense)            (None, 32)                2080

 dense_27 (Dense)            (None, 1)                 33
```

```
Total params: 96,081
Trainable params: 96,081
Non-trainable params: 0
```

6. Compile the Model

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

7. Fit the Model

```
model.fit(X_train, y_train, batch_size=128,epochs=10,validation_split=0.2,callbacks=[Earl
```

```
Epoch 1/10
28/28 [==============================] - 13s 308ms/step - loss: 0.4777 - accuracy: 0.8603
- val_loss: 0.3748 - val_accuracy: 0.8760
Epoch 2/10
28/28 [==============================] - 8s 272ms/step - loss: 0.3768 - accuracy: 0.8731
- val_loss: 0.3598 - val_accuracy: 0.8760
Epoch 3/10
28/28 [==============================] - 8s 271ms/step - loss: 0.2600 - accuracy: 0.8990
- val_loss: 0.1339 - val_accuracy: 0.9647
Epoch 4/10
28/28 [==============================] - 8s 272ms/step - loss: 0.0874 - accuracy: 0.9772
- val_loss: 0.0870 - val_accuracy: 0.9738
Epoch 5/10
28/28 [==============================] - 8s 271ms/step - loss: 0.0602 - accuracy: 0.9829
- val_loss: 0.0748 - val_accuracy: 0.9761
Epoch 6/10
28/28 [==============================] - 7s 268ms/step - loss: 0.0520 - accuracy: 0.9843
- val_loss: 0.0687 - val_accuracy: 0.9772
Epoch 7/10
28/28 [==============================] - 8s 270ms/step - loss: 0.0350 - accuracy: 0.9898
- val_loss: 0.0646 - val_accuracy: 0.9795
Epoch 8/10
28/28 [==============================] - 8s 269ms/step - loss: 0.0269 - accuracy: 0.9920
- val_loss: 0.0685 - val_accuracy: 0.9761
Epoch 9/10
28/28 [==============================] - 8s 272ms/step - loss: 0.0215 - accuracy: 0.9943
- val_loss: 0.0711 - val_accuracy: 0.9772
<keras.callbacks.History at 0x7f9280f9aa90>
```

8. Save the Model

```
model.save('spam-classifier.h5')
```

9. Test the Model

```
print("Accuracy of the model on Testing Data is - " , model.evaluate(X_test,y_test)[1]*1
```

```
25/25 [==============================] - 1s 26ms/step - loss: 0.0625 - accuracy: 0.9871
```