# Assignment -4

Problem Statement:-SMS SPAM Classification

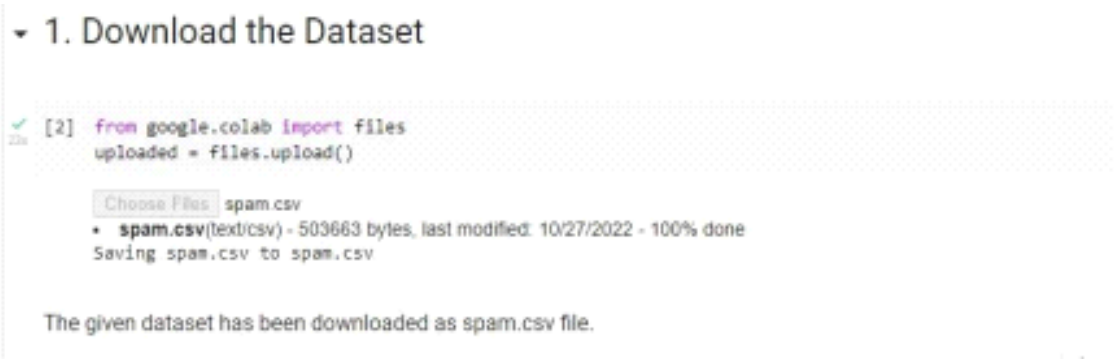
| | |
|---|---|
| Assignment Date : | 27-10-2022 |
| Student Name : | L.Bhuvaneswari |
| Student Roll Number : | 912419106002 |
| Project : | Real time communication system powered by AI for specially abled |
| Maximum Marks : | 2 Marks |

**Question-1:**

**Download the Dataset**

**Solution:**

```
from google.colab import files
uploaded = files.upload()
```




**Question-2:**

**Import required library**

**Solution:**

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
```

import seaborn as sns
import tensorflow as tf
from tensorflow import keras
from tensorflow.keras import layers

## 2. Import required libraries

```
[ ]  import numpy as np
     import pandas as pd
     import matplotlib.pyplot as plt
     import seaborn as sns
     import tensorflow as tf
     from tensorflow import keras
     from tensorflow.keras import layers
```

**Question-3:**

**Read dataset and do pre-processing**

**Solution:**

df = pd.read_csv(r"/content/spam.csv", encoding="latin-1")

## 3. Read dataset and do pre-processing

```
[ ]  df = pd.read_csv(r"/content/spam.csv", encoding="latin-1")
```

df.head() # an overview

```
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```

| | 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 |

**Since the given dataset has three Unnamed columns that we don't need, we will drop them and also our label is in string form -> spam and ham, we will map them in numerical form.**

df = df.drop(['Unnamed: 2', 'Unnamed: 3', 'Unnamed: 4'], axis=1) df = df.rename(columns={'v1':'label', 'v2':'Text'}) df['label_in_num'] = df['label'].map({'ham':0,'spam':1}) df.head()

```
[ ] df = df.drop(['Unnamed: 2', 'Unnamed: 3', 'Unnamed: 4'], axis=1)
    df = df.rename(columns={'v1':'label', 'v2':'Text'})
    df['label_in_num'] = df['label'].map({'ham':0,'spam':1})
    df.head()
```

| | label | Text | label_in_num |
|---|---|---|---|
| 0 | ham | Go until jurong point, crazy.. Available only ... | 0 |
| 1 | ham | Ok lar... Joking wif u oni... | 0 |
| 2 | spam | Free entry in 2 a wkly comp to win FA Cup fina... | 1 |
| 3 | ham | U dun say so early hor... U c already then say... | 0 |
| 4 | ham | Nah I don't think he goes to usf, he lives aro... | 0 |

sns.countplot(x=df['label']) # countplot for label

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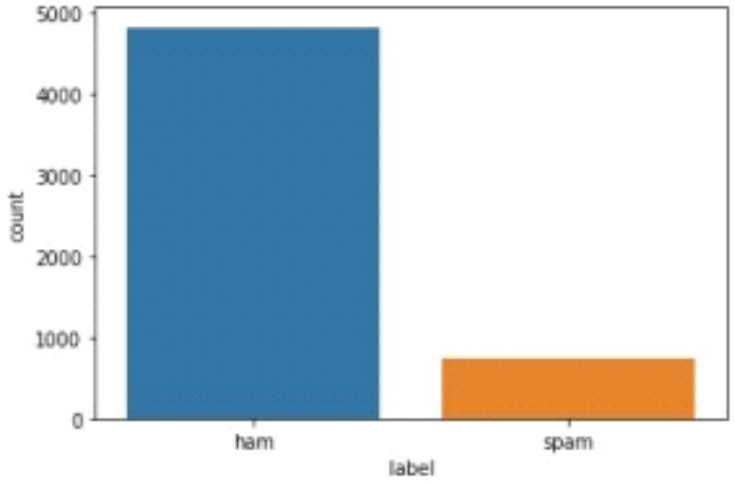
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f71bb051950>
```




df['label'].value_counts()

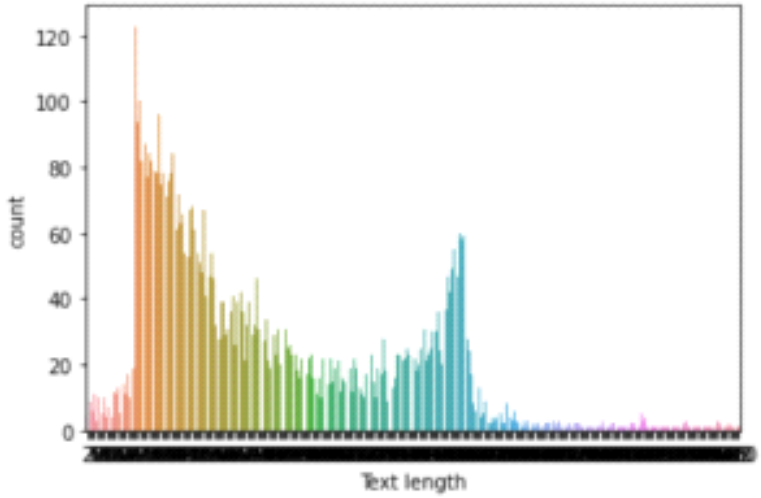
```
[ ] df['label'].value_counts()
```

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

sns.countplot(x=[len(df.loc[i]['Text']) for i in range(len(df))]) plt.xlabel('Text length')

```
sns.countplot(x=[len(df.loc[i]['Text']) for i in range(len(df))])
plt.xlabel('Text length')
```

```
Text(0.5, 0, 'Text length')
```



text_words_lengths = [len(df.loc[i]['Text'].split()) for i in range(0, len(df))] total_length = np.sum(text_words_lengths)
text_words_mean = int(np.mean(text_words_lengths))
print('we have ' + str(total_length) + ' words in our Dataframe') print('the average word count in every scentence is ' + str(text_words_mean))
text_words_lengths[:5], total_length, text_words_mean

```
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text_words_mean = int(np.mean(text_words_lengths))
print('we have ' + str(total_length) + ' words in our Dataframe')
print('the average word count in every scentence is ' + str(text_words_mean))
text_words_lengths[:5], total_length, text_words_mean
```

```
we have 86335 words in our Dataframe
the average word count in every scentence is 15
([20, 6, 28, 11, 13], 86335, 15)
```

## Train & Test Split

from sklearn.model_selection import train_test_split
X, y = np.asanyarray(df['Text']), np.asanyarray(df['label_in_num'])
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, rando m_state=24)
len(X_train), len(X_test), X_train[:2], y_train[:2]

Train & Test Split

```
from sklearn.model_selection import train_test_split
X, y = np.asanyarray(df['Text']), np.asanyarray(df['label_in_num'])
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=24)
len(X_train), len(X_test), X_train[:2], y_train[:2]
```

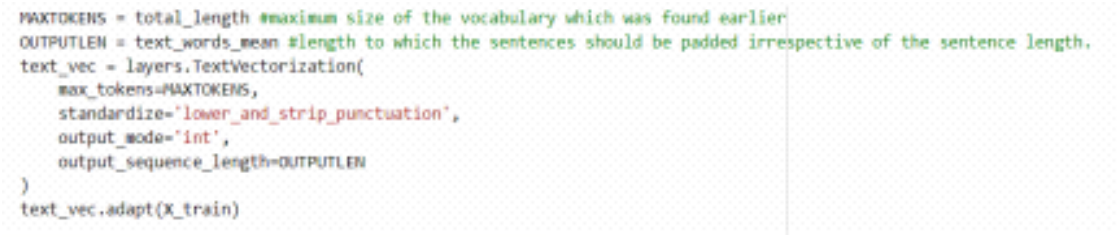
```
(4457, 1115, array(['Kallis wont bat in 2nd innings.',
       'Ringtone Club: Get the UK singles chart on your mobile each week and choose any top quality ringtone! This
message is free of charge.'],
      dtype=object), array([0, 1]))
```

### Helper Functions

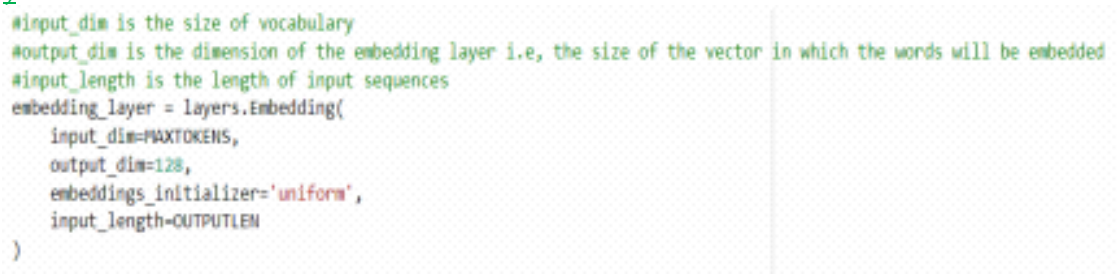
**Text vectorization is the process of converting text into a numerical representation. Example: Bag of words frequency, Binary Term frequency, etc.; A word embedding is a learned representation of text in which words with related meanings have similar representations. Each word is assigned to a single vector, and the vector values are learned like that of a neural network.Now, we'll create a custom text vectorization layer using TensorFlow.**

MAXTOKENS = total_length #maximum size of the vocabulary which was found earlier
OUTPUTLEN = text_words_mean #length to which the sentences should be padded irrespective of the sentence length.
text_vec = layers.TextVectorization(

```
    max_tokens=MAXTOKENS,
    standardize='lower_and_strip_punctuation',
    output_mode='int',
    output_sequence_length=OUTPUTLEN
)
text_vec.adapt(X_train)
```




```
#input_dim is the size of vocabulary
#output_dim is the dimension of the embedding layer i.e, the size of the vect or in which the words will be embedded
#input_length is the length of input sequences
embedding_layer = layers.Embedding(
    input_dim=MAXTOKENS,
    output_dim=128,
    embeddings_initializer='uniform',
    input_length=OUTPUTLEN
)
```




**Question-4:**

**Create Model**

**Solution:**

```
input_layer = layers.Input(shape=(1,), dtype=tf.string) # Input layer, string t ype(text)
```

vec_layer = text_vec(input_layer) # text vectorization layer(built previous li nes)
embedding_layer_model = embedding_layer(vec_layer) # word embedding layer
bi_lstm = layers.Bidirectional(layers.LSTM(64, activation='tanh', return_seq uences=True))(embedding_layer_model) # Bidirectional-LSTM, 64 units lstm = layers.Bidirectional(layers.LSTM(64))(bi_lstm)
flatten = layers.Flatten()(lstm) # Flatten layer for enering in dense layers dropout = layers.Dropout(.1)(flatten) # drop out layer
x = layers.Dense(32, activation='relu')(dropout) # Dense layer
output_layer = layers.Dense(1, activation='sigmoid')(x) # output layer model_2 = keras.Model(input_layer, output_layer) # final model

```
input_layer = layers.Input(shape=(1,), dtype=tf.string) # Input layer, string type(text)
vec_layer = text_vec(input_layer) # text vectorization layer(built previous lines)
embedding_layer_model = embedding_layer(vec_layer) # word embedding layer
bi_lstm = layers.Bidirectional(layers.LSTM(64, activation='tanh', return_sequences=True))(embedding_layer_model) # Bidirectional-LSTM, 64 units
lstm = layers.Bidirectional(layers.LSTM(64))(bi_lstm)
flatten = layers.Flatten()(lstm) # Flatten layer for enering in dense layers
dropout = layers.Dropout(.1)(flatten) # drop out layer
x = layers.Dense(32, activation='relu')(dropout) # Dense layer
output_layer = layers.Dense(1, activation='sigmoid')(x) # output layer
model_2 = keras.Model(input_layer, output_layer) # final model
```

**Question-5:**

**Add Layers (LSTM, Dense-(Hidden Layers), Output)**

**Solution:**

# Input layer
input_layer = layers.Input(shape=(1,), dtype=tf.string) # Text Vectorizatino layer
vec_layer = text_vec(input_layer)
# Embedding layer
embedding_layer_model = embedding_layer(vec_layer) # Global Average Pooling layer

x =
layers.GlobalAveragePooling1D()(embedding_layer_model) #
Flatten layer for Dense layers
x = layers.Flatten()(x)
# 32 units dense layer
x = layers.Dense(32, activation='relu')(x)
# output layer with sigmoid activation function
output_layer = layers.Dense(1,
activation='sigmoid')(x) # final model
model_1 = keras.Model(input_layer, output_layer)

```
# Input layer
input_layer = layers.Input(shape=(1,), dtype=tf.string)
# Text Vectorizatino layer
vec_layer = text_vec(input_layer)
# Embedding layer
embedding_layer_model = embedding_layer(vec_layer)
# Global Average Pooling layer
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x = layers.Dense(32, activation='relu')(x)
# output layer with sigmoid activation function
output_layer = layers.Dense(1, activation='sigmoid')(x)
# final model
model_1 = keras.Model(input_layer, output_layer)
```

**Question-6:**

**Compile the Model, Fit the Model**

**Solution:**

```
def compile_model(model):
    model.compile(optimizer=keras.optimizers.Adam(),
                  loss=keras.losses.BinaryCrossentropy(),
                  metrics=['accuracy'])
def fit_model(model, epochs, X_train=X_train, y_train=y_train,
X_test=X_t est, y_test=y_test):
    history = model.fit(X_train,
              y_train,
```

```
        epochs=epochs,
        validation_data=(X_test, y_test),
        validation_steps=int(0.2*len(X_test)))
  return history
```

```
def compile_model(model):
    model.compile(optimizer=keras.optimizers.Adam(),
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def fit_model(model, epochs, X_train=X_train, y_train=y_train, X_test=X_test, y_test=y_test):
    history = model.fit(X_train,
              y_train,
             epochs=epochs,
             validation_data=(X_test, y_test),
             validation_steps=int(0.2*len(X_test)))
    return history
```

```
compile_model(model_2) # compile the model
history_2 = fit_model(model_2, epochs=5) # fit the model
```

```
from sklearn.metrics import precision_score, recall_score, f1_score,
accurac y_score
def evaluate_model(model, X, y):
    y_preds = np.round(model.predict(X))
    accuracy = accuracy_score(y, y_preds)
    precision = precision_score(y, y_preds)
    recall = recall_score(y, y_preds)
    f1 = f1_score(y, y_preds)
    model_results_dict = {'accuracy':accuracy,
                          'precision':precision,
                          'recall':recall,
                          'f1-score':f1}
  return model_results_dict
```

**Question-7:**

**Saving and testing the model**

**Solution:**

```
model_2.save('spam')
```

```
model_2.evaluate(X_test, y_test)
```

```
print(evaluate_model(model_2,X_test, y_test))
```