Assignment -4

Problem Statement:-SMS SPAM Classification

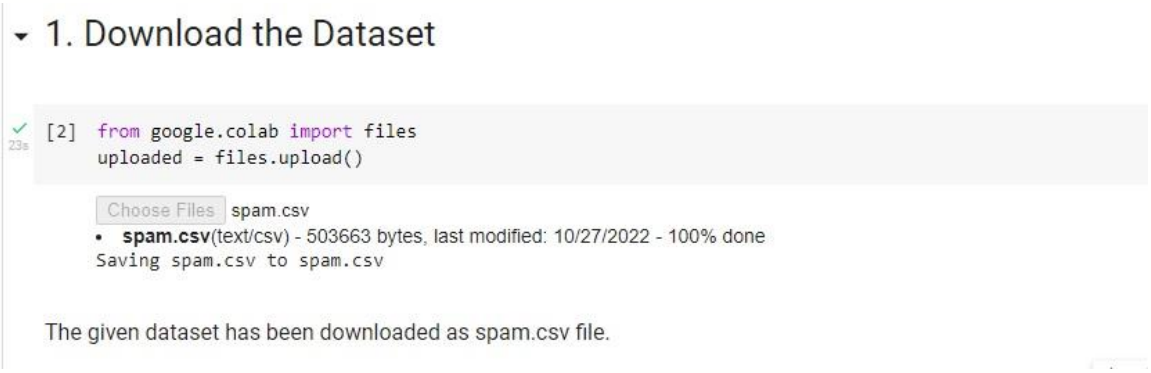
Assignment Date	:	27-10-2022
Student Name	:	S.Nagu
Student Roll Number	:	912419104020
Project	:	Fertilizer Recommendation System for Disease Prediction
Maximum Marks	:	2 Marks

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
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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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```
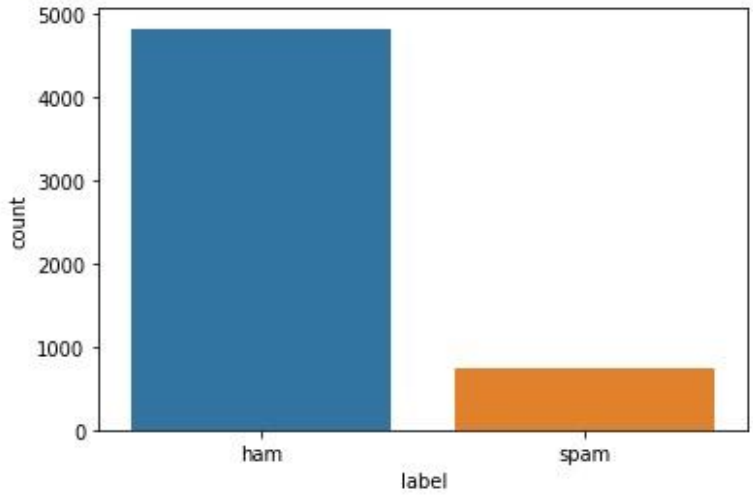

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f71bb051950>
```



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')

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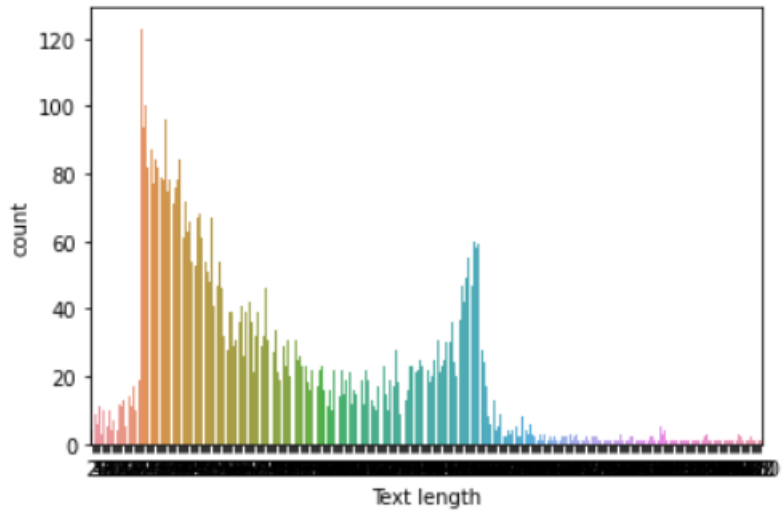
```

```
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_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]

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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)
```

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```
#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
)
```

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    embeddings_initializer='uniform',
    input_length=OUTPUTLEN
)
```

Question-4:

Create Model

Solution:

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

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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)

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

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    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
```

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

```
Epoch 1/5
140/140 [==============================] - 31s 167ms/step - loss: 0.1683 - accuracy: 0.9453 - val_loss: 0.0956 - val_accuracy: 0.9668
Epoch 2/5
140/140 [==============================] - 22s 158ms/step - loss: 0.0286 - accuracy: 0.9930 - val_loss: 0.0566 - val_accuracy: 0.9821
Epoch 3/5
140/140 [==============================] - 23s 163ms/step - loss: 0.0120 - accuracy: 0.9960 - val_loss: 0.0750 - val_accuracy: 0.9821
Epoch 4/5
140/140 [==============================] - 22s 154ms/step - loss: 9.8526e-04 - accuracy: 0.9998 - val_loss: 0.0952 - val_accuracy: 0.9830
Epoch 5/5
140/140 [==============================] - 22s 154ms/step - loss: 6.7317e-05 - accuracy: 1.0000 - val_loss: 0.1042 - val_accuracy: 0.9830
```

```
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
```

```
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    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,
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    return model_results_dict
```

Question-7:

Saving and testing the model

Solution:

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

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

```
WARNING:absl:Found untraced functions such as lstm_cell_1_layer_call_fn, lstm_cell_1_layer_call_and_return_conditional_losses, lstm_cell_2_layer_call_fn
```

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

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

```
35/35 [==============================] - 2s 13ms/step - loss: 0.1042 - accuracy: 0.9830
[0.10417114198207855, 0.9829596281051636]
```

print(evaluate_model(model_2,X_test, y_test))

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

```
35/35 [==========================] - 2s 11ms/step
{'accuracy': 0.9829596412556054, 'precision': 0.9310344827586207, 'recall': 0.9375, 'f1-score': 0.9342560553633218}
```