Assignment -4
SMS SPAM CLASSIFICATION

Assignment Date	21 October 2022
Student Name	THULASI G
Team ID	PNT2022TMID36519
Maximum Marks	2 Marks

Import the Dataset

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

```
Saving spam.csv to spam.csv
```

Import required libraries

```
import csv
import tensorflow as tf
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from tensorflow.keras.preprocessing.text import Tokenizer
from tensorflow.keras.preprocessing.sequence import pad_sequences
import nltk
nltk.download('stopwords')
from nltk.corpus import stopwords
STOPWORDS = set(stopwords.words('english'))
```

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

[nltk_data]   Unzipping corpora/stopwords.zip.
```

Import dataset

```
import io
dataset = pd.read_csv(io.BytesIO(uploaded['spam.csv']), encoding = "ISO-
8859-1")
```

```
dataset
```

```
        v1                                                  v2 Unnamed: 2
\
0      ham  Go until jurong point, crazy.. Available only ...        NaN
1      ham                      Ok lar... Joking wif u oni...        NaN
2     spam  Free entry in 2 a wkly comp to win FA Cup fina...        NaN
3      ham  U dun say so early hor... U c already then say...        NaN
4      ham  Nah I don't think he goes to usf, he lives aro...        NaN
...    ...                                                ...        ...
5567  spam  This is the 2nd time we have tried 2 contact u...        NaN
5568   ham              Will Ì_ b going to esplanade fr home?        NaN
5569   ham  Pity, * was in mood for that. So...any other s...        NaN
5570   ham  The guy did some bitching but I acted like i'd...        NaN
```

```
5571   ham                          Rofl. Its true to its name        NaN

     Unnamed: 3 Unnamed: 4
0           NaN         NaN
1           NaN         NaN
2           NaN         NaN
3           NaN         NaN
4           NaN         NaN
...         ...         ...
5567        NaN         NaN
5568        NaN         NaN
5569        NaN         NaN
5570        NaN         NaN
5571        NaN         NaN

[5572 rows x 5 columns]
```

```
vocab_size = 5000
embedding_dim = 64
max_length = 200
trunc_type = 'post'
padding_type = 'post'
oov_tok = ''
training_portion = .8
```

Read the dataset and do pre-processing.

To remove the stop words.

```
articles = []
labels = []

with open("spam.csv", 'r', encoding = "ISO-8859-1") as dataset:
    reader = csv.reader(dataset, delimiter=',')
    next(reader)
    for row in reader:
        labels.append(row[0])
        article = row[1]
        for word in STOPWORDS:
            token = ' ' + word + ' '
            article = article.replace(token, ' ')
            article = article.replace(' ', ' ')
        articles.append(article)
print(len(labels))
print(len(articles))
```

```
5572
5572
```

Train the model

```
train_size = int(len(articles) * training_portion)
train_articles = articles[0: train_size]
train_labels = labels[0: train_size]
validation_articles = articles[train_size:]
```

```
validation_labels = labels[train_size:]
print(train_size)
print(len(train_articles))
print(len(train_labels))
print(len(validation_articles))
print(len(validation_labels))
```

```
4457
4457
4457
1115
1115
```

```
tokenizer = Tokenizer(num_words = vocab_size, oov_token=oov_tok)
tokenizer.fit_on_texts(train_articles)
word_index = tokenizer.word_index
dict(list(word_index.items())[0:10])
```

```
{'': 1,
 'i': 2,
 'u': 3,
 'call': 4,
 'you': 5,
 '2': 6,
 'get': 7,
 "i'm": 8,
 'ur': 9,
 'now': 10}
```

Training data to Sequences

```
train_sequences = tokenizer.texts_to_sequences(train_articles)
print(train_sequences[10])
```

```
[8, 190, 37, 201, 30, 260, 293, 991, 222, 53, 153, 3815, 423, 46]
```

Train neural network for NLP

```
train_padded = pad_sequences(train_sequences, maxlen=max_length,
padding=padding_type, truncating=trunc_type)
print(len(train_sequences[0]))
print(len(train_padded[0]))

print(len(train_sequences[1]))
print(len(train_padded[1]))

print(len(train_sequences[10]))
print(len(train_padded[10]))
```

```
16
200
6
200
14
200
```

```
print(train_padded[10])
```

```
[   8  190   37  201   30  260  293  991  222   53  153 3815  423   46
    0    0    0    0    0    0    0    0    0    0    0    0    0    0
    0    0    0    0    0    0    0    0    0    0    0    0    0    0
    0    0    0    0    0    0    0    0    0    0    0    0    0    0
    0    0    0    0    0    0    0    0    0    0    0    0    0    0
    0    0    0    0    0    0    0    0    0    0    0    0    0    0
    0    0    0    0    0    0    0    0    0    0    0    0    0    0
    0    0    0    0    0    0    0    0    0    0    0    0    0    0
    0    0    0    0    0    0    0    0    0    0    0    0    0    0
    0    0    0    0    0    0    0    0    0    0    0    0    0    0
    0    0    0    0    0    0    0    0    0    0    0    0    0    0
    0    0    0    0    0    0    0    0    0    0    0    0    0    0
    0    0    0    0    0    0    0    0    0    0    0    0    0    0
    0    0    0    0    0    0    0    0    0    0    0    0    0    0
    0    0    0    0]
```

```
validation_sequences = tokenizer.texts_to_sequences(validation_articles)
validation_padded = pad_sequences(validation_sequences, maxlen=max_length,
padding=padding_type, truncating=trunc_type)

print(len(validation_sequences))
print(validation_padded.shape)
```

```
1115
(1115, 200)
```

```
label_tokenizer = Tokenizer()
label_tokenizer.fit_on_texts(labels)

training_label_seq =
np.array(label_tokenizer.texts_to_sequences(train_labels))
validation_label_seq =
np.array(label_tokenizer.texts_to_sequences(validation_labels))
print(training_label_seq[0])
print(training_label_seq[1])
print(training_label_seq[2])
print(training_label_seq.shape)

print(validation_label_seq[0])
print(validation_label_seq[1])
print(validation_label_seq[2])
print(validation_label_seq.shape)
```

```
[1]
[1]
[2]
(4457, 1)
[1]
[2]
[1]
(1115, 1)
```

```
reverse_word_index = dict([(value, key) for (key, value) in
word_index.items()])

def decode_article(text):
    return ' '.join([reverse_word_index.get(i, '?') for i in text])
print(decode_article(train_padded[10]))
print('---')
print(train_articles[10])
```

```
i'm gonna home soon want talk stuff anymore tonight k i've cried enough
today ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ?
? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ?
? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ?
? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ?
? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ?
? ? ? ?
---
I'm gonna home soon want talk stuff anymore tonight, k? I've cried enough
today.
```

To implement LSTM

```
model = tf.keras.Sequential([

    tf.keras.layers.Embedding(vocab_size, embedding_dim),
    tf.keras.layers.Bidirectional(tf.keras.layers.LSTM(embedding_dim)),
    tf.keras.layers.Dense(embedding_dim, activation='relu'),
    tf.keras.layers.Dense(6, activation='softmax')
])
model.summary()
```

```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 embedding (Embedding)       (None, None, 64)          320000

 bidirectional (Bidirectional  (None, 128)              66048
 l)

 dense (Dense)               (None, 64)                8256

 dense_1 (Dense)             (None, 6)                 390

=================================================================
Total params: 394,694
Trainable params: 394,694
Non-trainable params: 0
_________________________________________________________________
```

```
print(set(labels))
```

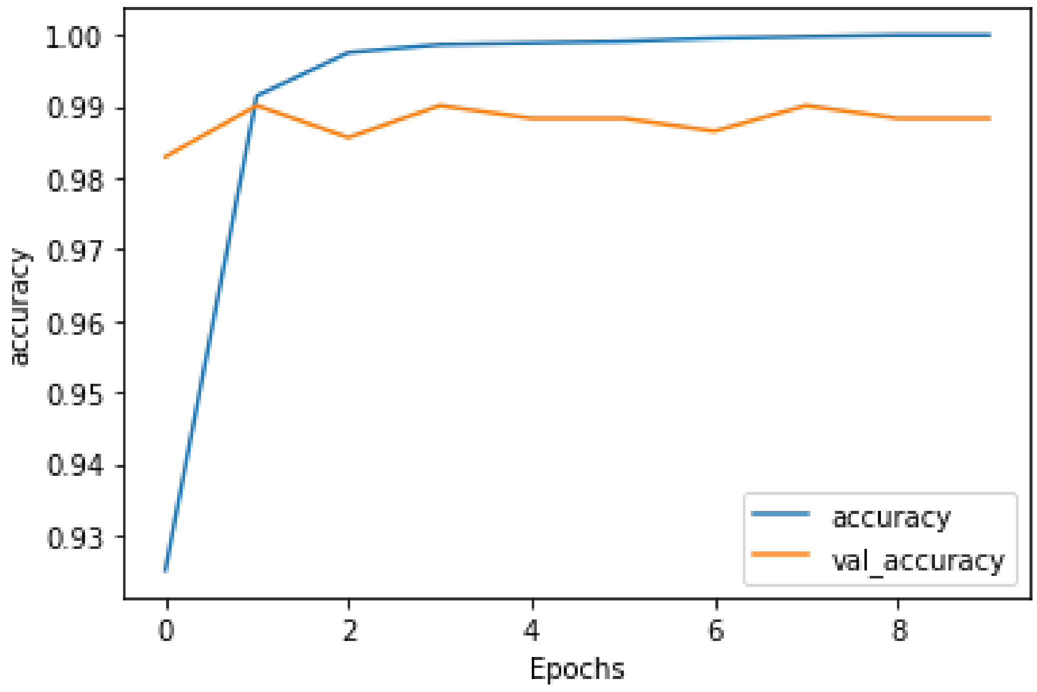
```
{'spam', 'ham'}
```

```
model.compile(loss='sparse_categorical_crossentropy', optimizer='adam',
metrics=['accuracy'])
num_epochs = 10
history = model.fit(train_padded, training_label_seq, epochs=num_epochs,
validation_data=(validation_padded, validation_label_seq), verbose=2)
```

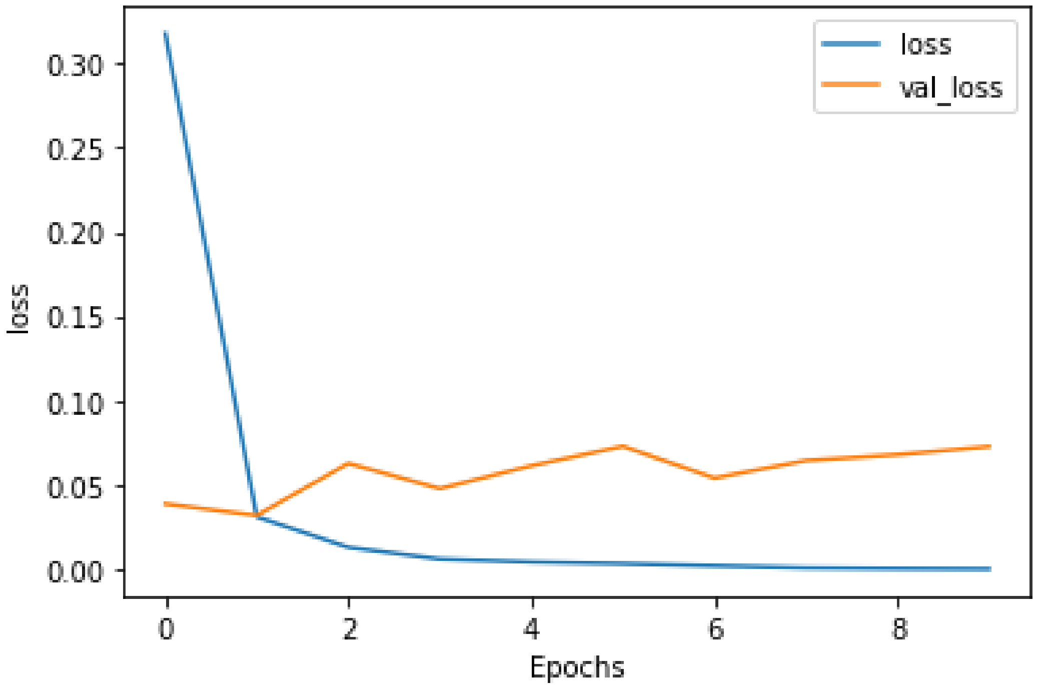
```
Epoch 1/10
140/140 - 37s - loss: 0.3177 - accuracy: 0.9251 - val_loss: 0.0387 -
val_accuracy: 0.9830 - 37s/epoch - 265ms/step
Epoch 2/10
140/140 - 35s - loss: 0.0310 - accuracy: 0.9915 - val_loss: 0.0318 -
val_accuracy: 0.9901 - 35s/epoch - 252ms/step
Epoch 3/10
140/140 - 32s - loss: 0.0130 - accuracy: 0.9975 - val_loss: 0.0627 -
val_accuracy: 0.9857 - 32s/epoch - 230ms/step
Epoch 4/10
140/140 - 31s - loss: 0.0060 - accuracy: 0.9987 - val_loss: 0.0478 -
val_accuracy: 0.9901 - 31s/epoch - 220ms/step
Epoch 5/10
140/140 - 30s - loss: 0.0042 - accuracy: 0.9989 - val_loss: 0.0613 -
val_accuracy: 0.9883 - 30s/epoch - 215ms/step
Epoch 6/10
140/140 - 29s - loss: 0.0033 - accuracy: 0.9991 - val_loss: 0.0728 -
val_accuracy: 0.9883 - 29s/epoch - 210ms/step
Epoch 7/10
140/140 - 29s - loss: 0.0020 - accuracy: 0.9996 - val_loss: 0.0540 -
val_accuracy: 0.9865 - 29s/epoch - 208ms/step
Epoch 8/10
140/140 - 31s - loss: 7.6466e-04 - accuracy: 0.9998 - val_loss: 0.0644 -
val_accuracy: 0.9901 - 31s/epoch - 219ms/step
Epoch 9/10
140/140 - 30s - loss: 3.9159e-04 - accuracy: 1.0000 - val_loss: 0.0678 -
val_accuracy: 0.9883 - 30s/epoch - 211ms/step
Epoch 10/10
140/140 - 29s - loss: 1.7514e-04 - accuracy: 1.0000 - val_loss: 0.0726 -
val_accuracy: 0.9883 - 29s/epoch - 208ms/step
```

```
def plot_graphs(history, string):
  plt.plot(history.history[string])
  plt.plot(history.history['val_'+string])
  plt.xlabel("Epochs")
  plt.ylabel(string)
  plt.legend([string, 'val_'+string])
  plt.show()

plot_graphs(history, "accuracy")
plot_graphs(history, "loss")
```



1.00
0.99
0.98
0.97
0.96
0.95
0.94
0.93
accuracy
0
2
4
6
8
Epochs
accuracy
val_accuracy



0.30
0.25
0.20
0.15
0.10
0.05
0.00
loss
0
2
4
6
8
Epochs
loss
val_loss