```
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.
```

```
import io
dataset = pd.read_csv('/content/spam.csv', encoding = "ISO-8859-1")
```

```
dataset
```

	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
...	...	...	...	...	...
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

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

```
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_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}
```

```
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_padded = pad_sequences(train_sequences, maxlen=max_length, padding=padding_type, tru
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

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.
```

```
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 (Bidirectiona  (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))
```

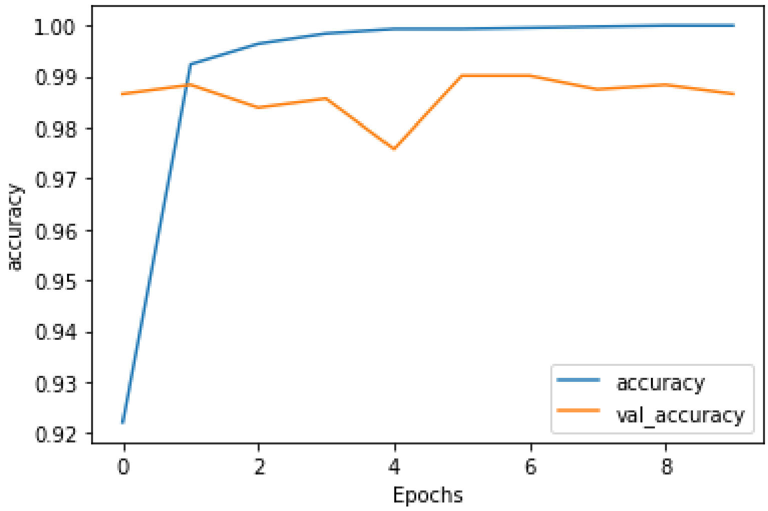
```
{'spam', 'ham'}
```

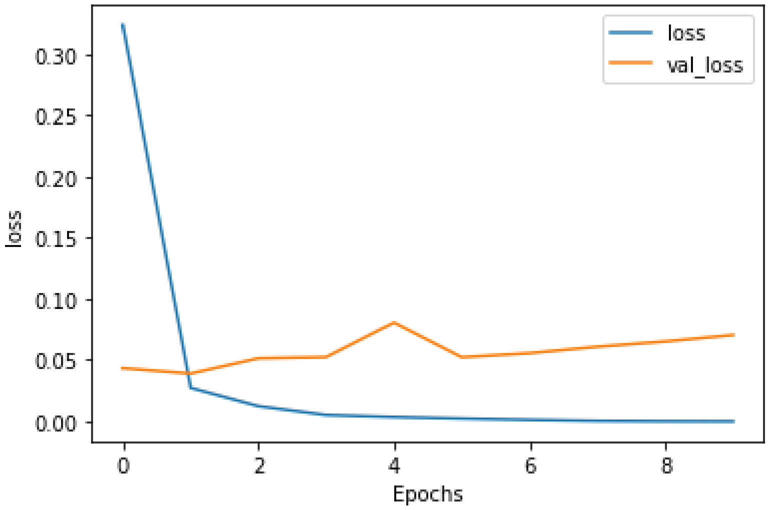
```
model.compile(loss='sparse_categorical_crossentropy', optimizer='adam', metrics=['accuracy
num_epochs = 10
history = model.fit(train_padded, training_label_seq, epochs=num_epochs, validation_data=(
```

```
Epoch 1/10
140/140 - 21s - loss: 0.3239 - accuracy: 0.9221 - val_loss: 0.0432 - val_accuracy: 0
Epoch 2/10
140/140 - 17s - loss: 0.0275 - accuracy: 0.9924 - val_loss: 0.0388 - val_accuracy: 0
Epoch 3/10
140/140 - 17s - loss: 0.0126 - accuracy: 0.9964 - val_loss: 0.0513 - val_accuracy: 0
Epoch 4/10
140/140 - 17s - loss: 0.0053 - accuracy: 0.9984 - val_loss: 0.0523 - val_accuracy: 0
Epoch 5/10
140/140 - 17s - loss: 0.0036 - accuracy: 0.9993 - val_loss: 0.0805 - val_accuracy: 0
Epoch 6/10
140/140 - 17s - loss: 0.0024 - accuracy: 0.9993 - val_loss: 0.0522 - val_accuracy: 0
Epoch 7/10
140/140 - 17s - loss: 0.0014 - accuracy: 0.9996 - val_loss: 0.0555 - val_accuracy: 0
Epoch 8/10
140/140 - 17s - loss: 5.0404e-04 - accuracy: 0.9998 - val_loss: 0.0608 - val_accurac
Epoch 9/10
140/140 - 17s - loss: 1.9660e-04 - accuracy: 1.0000 - val_loss: 0.0651 - val_accurac
Epoch 10/10
140/140 - 17s - loss: 1.0672e-04 - accuracy: 1.0000 - val_loss: 0.0704 - val_accurac
```

```
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")
```





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