Assignment Date	30 October 2022
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Maximum Marks	2 Marks

Spam Classification

Import Libraries

```
In [1]:  import pandas as pd
         import numpy as np
         import matplotlib.pyplot as plt
         import seaborn as sns
         from sklearn.model_selection import train_test_split
         from sklearn.preprocessing import LabelEncoder
         from keras.models import Model
         from keras.layers import LSTM, Activation, Dense, Dropout, Input, Embedding
         from keras.optimizers import RMSprop
         from keras.preprocessing.text import Tokenizer
         from keras.preprocessing import sequence
         from keras.utils import to_categorical
         from keras.callbacks import EarlyStopping
         import tensorflow
         from tensorflow.keras.preprocessing.sequence import pad_sequences
```

Read CSV File

```
In [3]:  df=pd.read_csv("spam.csv",encoding='ISO-8859-1')
```

```
In [4]:  df.head()
```

Out[4]:
	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

```
In [5]:  df.drop(['Unnamed: 2', 'Unnamed: 3', 'Unnamed: 4'], axis=1, inplace=True)
         df.head(10)
```

Out[5]:
	v1	v2
0	ham	Go until jurong point, crazy.. Available only ...
1	ham	Ok lar... Joking wif u oni...
2	spam	Free entry in 2 a wkly comp to win FA Cup fina...
3	ham	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...
5	spam	FreeMsg Hey there darling it's been 3 week's n...
6	ham	Even my brother is not like to speak with me. ...
7	ham	As per your request 'Melle Melle (Oru Minnamin...
8	spam	WINNER!! As a valued network customer you have...
9	spam	Had your mobile 11 months or more? U R entitle...

Model Creation

```
In [6]:  X = df.v2
         Y = df.v1
         le = LabelEncoder()
         Y = le.fit_transform(Y)
         Y = Y.reshape(-1,1)
```

```
In [7]:  X_train, X_test, Y_train, Y_test = train_test_split(X, Y, test_size=0.30, random_state=7)
```

```
In [8]:  max_words = 1000
         max_len = 150
         tok = Tokenizer(num_words=max_words)
         tok.fit_on_texts(X_train)
         sequences = tok.texts_to_sequences(X_train)
         sequences_matrix = pad_sequences(sequences,maxlen=max_len)
```

Adding Layers

```
In [9]:  def RNN_model():
             inputs = Input(name='inputs', shape=[max_len])
             layer = Embedding(max_words, 50, input_length=max_len)(inputs)
             layer = LSTM(64)(layer)
             layer = Dense(256, name='FC1')(layer)
             layer = Activation('relu')(layer)
             layer = Dropout(0.5)(layer)
             layer = Dense(1, name='out_layer')(layer)
             layer = Activation('sigmoid')(layer)
             model = Model(inputs=inputs, outputs=layer)
             return model
```

Model Compilation

```
In [10]:  model = RNN_model()
          model.compile(loss='binary_crossentropy', optimizer='adam', metrics=['accuracy'])
```

```
In [11]:  model.summary()

Model: "model"
_____
 Layer (type)                Output Shape              Param #
=================================================================
 inputs (InputLayer)         [(None, 150)]             0

 embedding (Embedding)       (None, 150, 50)           50000

 lstm (LSTM)                 (None, 64)                29440

 FC1 (Dense)                 (None, 256)               16640

 activation (Activation)     (None, 256)               0

 dropout (Dropout)           (None, 256)               0

 out_layer (Dense)           (None, 1)                 257

 activation_1 (Activation)   (None, 1)                 0

=================================================================
Total params: 96,337
Trainable params: 96,337
Non-trainable params: 0
_____
```

```
In [12]:  data = model.fit(sequences_matrix, Y_train, batch_size=16, epochs=10, validation_split=0.25)

Epoch 1/10
183/183 [==============================] - 17s 69ms/step - loss: 0.1828 - accuracy: 0.9395 - val_loss: 0.0687 - val_accuracy: 0.9815
Epoch 2/10
183/183 [==============================] - 11s 60ms/step - loss: 0.0322 - accuracy: 0.9911 - val_loss: 0.0539 - val_accuracy: 0.9867
Epoch 3/10
183/183 [==============================] - 11s 62ms/step - loss: 0.0145 - accuracy: 0.9969 - val_loss: 0.0602 - val_accuracy: 0.9856
Epoch 4/10
183/183 [==============================] - 11s 61ms/step - loss: 0.0045 - accuracy: 0.9990 - val_loss: 0.0876 - val_accuracy: 0.9867
Epoch 5/10
183/183 [==============================] - 11s 61ms/step - loss: 0.0015 - accuracy: 0.9997 - val_loss: 0.0857 - val_accuracy: 0.9846
Epoch 6/10
183/183 [==============================] - 11s 62ms/step - loss: 0.0070 - accuracy: 0.9983 - val_loss: 0.0934 - val_accuracy: 0.9877
Epoch 7/10
183/183 [==============================] - 11s 62ms/step - loss: 0.0021 - accuracy: 0.9997 - val_loss: 0.0818 - val_accuracy: 0.9836
Epoch 8/10
183/183 [==============================] - 11s 61ms/step - loss: 0.0015 - accuracy: 0.9997 - val_loss: 0.1094 - val_accuracy: 0.9836
Epoch 9/10
183/183 [==============================] - 11s 61ms/step - loss: 1.7969e-04 - accuracy: 1.0000 - val_loss: 0.1135 - val_accuracy: 0.9836
Epoch 10/10
183/183 [==============================] - 11s 62ms/step - loss: 7.7695e-05 - accuracy: 1.0000 - val_loss: 0.1191 - val_accuracy: 0.9836
```

```
In [13]:  plt.figure()
          plt.xlabel('Epochs')
          plt.ylabel('Validation Accuracy')
          plt.plot(data.epoch,data.history['val_accuracy'])
```

Out[13]: [<matplotlib.lines.Line2D at 0x1f044ed7850>]
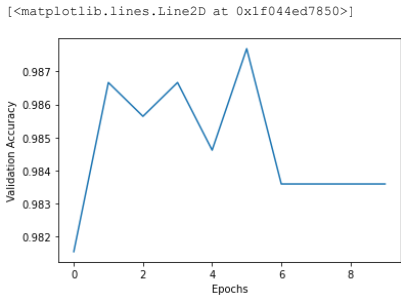

```
In [14]:  plt.figure()
          plt.xlabel('Epochs')
          plt.ylabel('Training Loss')
          plt.plot(data.epoch, data.history['loss'])
```

Out[14]: [<matplotlib.lines.Line2D at 0x1f045f88e20>]
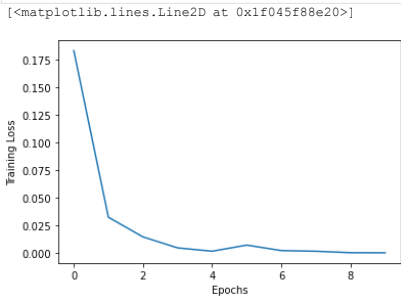
Saving Model

```
In [15]:  model.save('Spam_Detector_model1.h5')
```

Testing the Model

```
In [16]:  test_sequences = tok.texts_to_sequences(X_test)
          test_sequences_matrix = pad_sequences(test_sequences,maxlen=max_len)
```

```
In [17]:  test_accuracy = model.evaluate(test_sequences_matrix, Y_test)
```

```
53/53 [==============================] - 1s 26ms/step - loss: 0.1555 - accuracy: 0.9779
```

In [18]:
```
model.metrics_names
```

Out[18]: ['loss', 'accuracy']

In [19]:
```
print('Test Loss: {: 0.4f} and Test Accuracy: {: 0.2f}%'.format(test_accuracy[0], test_accuracy[1]*100))
```

Test Loss: 0.1555 and Test Accuracy: 97.79%

In [18]:
```
model.metrics_names
```

Out[18]: ['loss', 'accuracy']

In [19]:
```
print('Test Loss: {: 0.4f} and Test Accuracy: {: 0.2f}%'.format(test_accuracy[0], test_accuracy[1]*100))
```

Test Loss: 0.1555 and Test Accuracy: 97.79%