```
###Name: Niraj Lamichhane
###Group Leader: Niraj Lamichhane
###Group Members:Rojan Shrestha,Saugat Karki,
Niraj Lammichane, Aayush Niraula
###Group: L6CG5
###University_id: 2059514
###Module Leader: Mr.Siman Giri
###Tutor: Mr.Akash Adhikari
```

Name: Niraj Lamichhane

Group Leader: Niraj Lamichhane

Group Members:Rojan Shrestha,Saugat Karki, Niraj Lammichane, Aayush Niraula

Group: L6CG5

University_id: 2059514

Module Leader: Mr.Siman Giri

Tutor: Mr.Akash Adhikari

Recurrent Neural Network for Amazon book review

```
from google.colab import drive   # load drive and mount
drive.mount('/content/drive')
```

```
Drive already mounted at /content/drive; to attempt to forcibly remount, call drive.mount("/content/drive", force_remount=True).
```

```
import pandas as pd
import re
from sklearn.model_selection import train_test_split
from keras.preprocessing.text import Tokenizer
from tensorflow.keras.preprocessing.sequence import pad_sequences
from keras.models import Sequential
from keras.layers import Embedding, LSTM, Dense
from keras.callbacks import EarlyStopping
import matplotlib.pyplot as plt
import tensorflow as tf
from sklearn.metrics import confusion_matrix, f1_score, roc_curve, auc
```

Data Understanding, Analysis, and Cleaning[5]: Understand what is data about, Perform a basic data cleaning:

```
# load the dataset
data_path="/content/drive/MyDrive/Amazon Book Review/kindle_review.csv"
df = pd.read_csv(data_path)
```

```
# print the first five rows of the dataset
print(df.head())
```

```
   Unnamed: 0  rating                                         reviewText  \
0           0       5  This book was the very first bookmobile book I...
1           1       1  When I read the description for this book, I c...
2           2       5  I just had to edit this review. This book is a...
3           3       5  I don't normally buy 'mystery' novels because ...
4           4       5  This isn't the kind of book I normally read, a...

                  summary
0         50 + years ago...
1   Boring! Boring! Boring!
2  Wiggleliscious/new toy ready/!!
```

```
3                Very good read.
4                   Great Story!
```

```
df.isnull().any() # null value checked
```

```
Unnamed: 0    False
rating        False
reviewText    False
summary       False
dtype: bool
```

```
# perform basic cleaning tasks
df = df[['reviewText', 'rating']] # sleect revieew and rating only
df = df.dropna()   # remove the rows with missing values
df = df[df['rating'] != 3] # remove roes where the ratin is 3
df['sentiment'] = df['rating'].apply(lambda x: 1 if x > 3 else 0) ## Create a new 'sentiment' column based on the 'rating' column,
df = df.drop(columns=['rating'])# Drop the 'rating' column, since we no longer need it
```

	reviewText	rating
0	This book was the very first bookmobile book I...	5
1	When I read the description for this book, I c...	1
2	I just had to edit this review. This book is a...	5
3	I don't normally buy 'mystery' novels because ...	5
4	This isn't the kind of book I normally read, a...	5

```
# remove unwanted text and characters
df['reviewText'] = df['reviewText'].apply(lambda x: re.sub('[^a-zA-Z0-9\s]', '', x))
```

```
def remove_urls(text_series):
   # Define a regular expression pattern to match URLs or website addresses
    url_pattern = re.compile(r'https?://\S+|www\.\S+')
    # Use the apply() method to apply the regular expression pattern to each string in the input series, and replace any matches with an empt
    return text_series.apply(lambda x: url_pattern.sub(r'', x))
```

```
text = df['reviewText']
# Pass the 'text' variable containing the 'reviewText' column of the DataFrame to the 'remove_urls' function to remove any URLs or website ad
remove_urls(text)
remove_urls(text)
```

```
0        This book was the very first bookmobile book I...
1        When I read the description for this book I co...
2        I just had to edit this review This book is an...
3        I dont normally buy mystery novels because I j...
4        This isnt the kind of book I normally read alt...
                               ...
11994    After E A Poe came H P Lovecraft in the world ...
11995    Had to read certain passages twicetypos  Wish ...
11997    Dragon Knights is a world where Knights ride d...
11998    Since this story is very short its hard to say...
11999    from 1922 an amazing collection of info on sym...
Name: reviewText, Length: 10000, dtype: object
```

```
# normalize text data
df['reviewText'] = df['reviewText'].apply(lambda x: x.lower())
```

Build Model[5]:

```
# split the dataset into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(df['reviewText'], df['sentiment'], test_size=0.2, random_state=42)
```

```
# tokenize and pad the sequences
tokenizer = Tokenizer(num_words=5000, oov_token='UNK') # Create a tokenizer object
tokenizer.fit_on_texts(X_train)# Fit the tokenizer on the training data to generate a vocabulary of unique words
```

```
X_train_seq = tokenizer.texts_to_sequences(X_train)# Convert each text document in the training data to a sequence of integers using the toke
X_test_seq = tokenizer.texts_to_sequences(X_test)# Convert each text document in the test data to a sequence of integers
X_train_padded = pad_sequences(X_train_seq, maxlen=200) # Pad the sequences of integers with zeros to ensure that they all have the same leng
X_test_padded = pad_sequences(X_test_seq, maxlen=200) # This is necessary because neural networks expect inputs with a fixed size
```

```
# print the shape of the cleaned and preprocessed dataset
print(X_train_padded.shape)
print(X_test_padded.shape)
```

```
(8000, 200)
(2000, 200)
```

```
# define the model architecture
model = Sequential()
model.add(Embedding(input_dim=5000, output_dim=32, input_length=200))
model.add(LSTM(units=64, dropout=0.2, recurrent_dropout=0.2))
model.add(Dense(units=1, activation='sigmoid'))

# compile the model
model.compile(loss='binary_crossentropy', optimizer='adam', metrics=['accuracy'])

# print the model summary
print(model.summary())
```

```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 embedding (Embedding)       (None, 200, 32)           160000

 lstm (LSTM)                 (None, 64)                24832

 dense (Dense)               (None, 1)                 65

=================================================================
Total params: 184,897
Trainable params: 184,897
Non-trainable params: 0
_________________________________________________________________
None
```

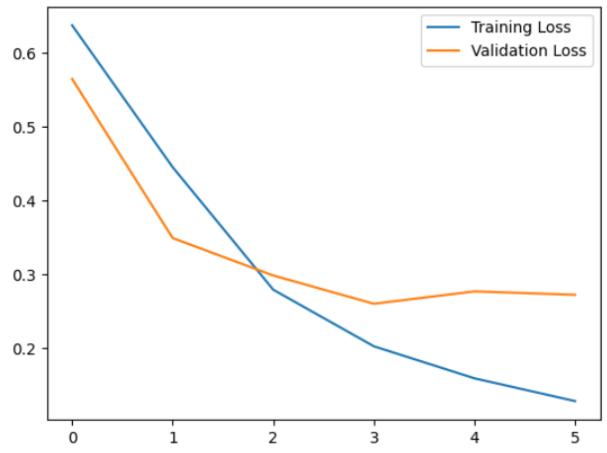
Training of the Model[5]:

```
# Define a custom callback class

class Mycallback(tf.keras.callbacks.Callback):
  def on_epoch_end(self, epoch, logs={}): # Define the `on_epoch_end` method, which will be called by Keras after each training epoch
    if(logs.get("accuracy")>0.95): # Check if the accuracy of the model is greater than 0.95
      print('\nLoss is low so stop training')# Print a message indicating that the training will stop because the loss is low
      self.model.stop_training =True# Set the `stop_training` attribute of the model to True to stop training
```

```
callbacks=Mycallback() #This code creates an instance of the Mycallback class
```

```
# train the model
history = model.fit(X_train_padded, y_train, epochs=10, batch_size=128, validation_data=(X_test_padded, y_test), callbacks=[callbacks])

# plot the training and validation loss
# Plot the training and validation loss over time using Matplotlib
# The `history` object returned by the `fit()` method contains information about the training process
plt.plot(history.history['loss'], label='Training Loss')
plt.plot(history.history['val_loss'], label='Validation Loss')
plt.legend()
plt.show()
```

```
Epoch 1/10
63/63 [==============================] - 38s 533ms/step - loss: 0.6379 - accuracy: 0.6404 - val_loss: 0.5650 - val_accuracy: 0.7715
Epoch 2/10
63/63 [==============================] - 31s 496ms/step - loss: 0.4452 - accuracy: 0.8240 - val_loss: 0.3490 - val_accuracy: 0.8650
Epoch 3/10
63/63 [==============================] - 31s 498ms/step - loss: 0.2789 - accuracy: 0.8880 - val_loss: 0.2982 - val_accuracy: 0.8800
Epoch 4/10
63/63 [==============================] - 31s 498ms/step - loss: 0.2021 - accuracy: 0.9247 - val_loss: 0.2598 - val_accuracy: 0.8965
Epoch 5/10
63/63 [==============================] - 33s 532ms/step - loss: 0.1586 - accuracy: 0.9424 - val_loss: 0.2767 - val_accuracy: 0.9010
Epoch 6/10
63/63 [==============================] - ETA: 0s - loss: 0.1277 - accuracy: 0.9570
Loss is low so stop training
63/63 [==============================] - 31s 500ms/step - loss: 0.1277 - accuracy: 0.9570 - val_loss: 0.2720 - val_accuracy: 0.9000
```



Evaluate the model[2.5]:

```
# evaluate the model
# Evaluate the trained model on the test data using the evaluate() method
# The `X_test_padded` and `y_test` data are used for evaluation
# The `verbose` argument controls the verbosity of the evaluation output
loss, accuracy = model.evaluate(X_test_padded, y_test, verbose=0)
# Print the test loss and accuracy
print('Test Loss:', loss)
print('Test Accuracy:', accuracy)
```

```
Test Loss: 0.27198123931884766
Test Accuracy: 0.8999999761581421
```

```
# get the predicted labels
y_pred = model.predict(X_test_padded)
y_pred = [round(pred[0]) for pred in y_pred]

# create the confusion matrix
cm = confusion_matrix(y_test, y_pred)

# print the confusion matrix
print(cm)
```

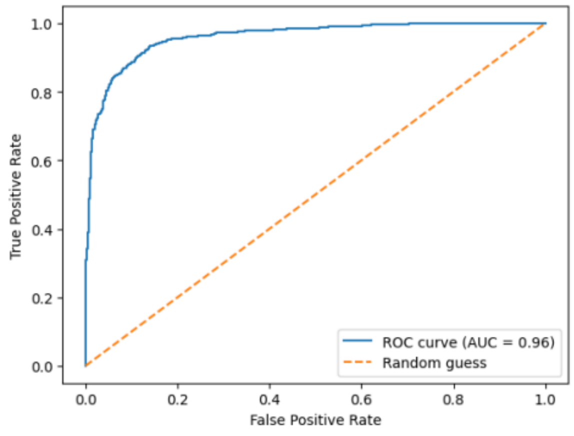
```
63/63 [==============================] - 5s 80ms/step
[[ 705  124]
 [  76 1095]]
```

```
# get the predicted probabilities
y_prob = model.predict(X_test_padded)

# get the predicted labels
y_pred = [round(prob[0]) for prob in y_prob]

# calculate the F1 score
f1 = f1_score(y_test, y_pred)

# print the F1 score
print('F1 score:', f1)
```

```
63/63 [==============================] - 2s 34ms/step
F1 score: 0.9163179916317991
```

```
# calculate the ROC curve
fpr, tpr, thresholds = roc_curve(y_test, y_prob)
```

```
# calculate the AUC score
auc_score = auc(fpr, tpr)

# plot the ROC curve
plt.plot(fpr, tpr, label='ROC curve (AUC = %0.2f)' % auc_score)
plt.plot([0, 1], [0, 1], linestyle='--', label='Random guess')
plt.xlabel('False Positive Rate')
plt.ylabel('True Positive Rate')
plt.legend()
plt.show()
```



Results and Prediction[2.5]:

```
# make predictions on the test set
y_pred = model.predict(X_test_padded)
y_pred = [round(pred[0]) for pred in y_pred]

# print the first 10 true and predicted labels
print('True labels:', list(y_test)[:10])
print('Predicted labels:', y_pred[:10])
```

```
63/63 [==============================] - 2s 35ms/step
True labels: [1, 1, 1, 0, 1, 0, 0, 0, 1, 1]
Predicted labels: [1, 1, 1, 0, 1, 0, 1, 0, 1, 0]
```

```
neg_review = ["I bought this set and returned it.  I couldn't force myself to finish the first book, A Touch of Silk.  ( They are bundled out
```

```
# Let's tokenize it and do the pad_sequence to make it in right format acceptable by model
neg_review_token = tokenizer.texts_to_sequences(neg_review)

# padding
neg_review_padded = pad_sequences(neg_review_token,maxlen=100,padding='post')
```

```
review_predict = (model.predict(neg_review_padded)>0.5).astype('int32')
```

```
1/1 [==============================] - 1s 613ms/step
```

```
# 1 is Positive review and 0 is negative review
if review_predict[0] == 0:
    print("It's a negative review")
else:
    print("It's a positive review")
```

```
It's a negative review
```

```
pos_review = ["This book was the very first bookmobile book I bought when I was in the school book club. I loved the story then and I bet a d
```

```
# Tokenization
pos_review = tokenizer.texts_to_sequences(pos_review)

# padding
pos_review = pad_sequences(pos_review,maxlen=100,padding='post')

# prediction
review_predict = (model.predict(pos_review)>0.5).astype('int')

if review_predict[0] == 0:
    print("It's a negative review")
else:
    print("It's a positive review")
```

```
1/1 [==============================] - 0s 53ms/step
It's a positive review
```