```
In [1]:
        import pandas as pd
        import numpy as np
        import re
        import nltk
        import seaborn as sn
        import gensim
        import matplotlib.pyplot as plt
In [2]:
        import sklearn
        from sklearn import preprocessing
        from sklearn.preprocessing import OneHotEncoder
        from sklearn import model selection
        from sklearn.model selection import train test split
        import re
        import tensorflow as tf
        import keras
In [3]:
        from tensorflow.keras.preprocessing.text import Tokenizer
        from tensorflow.keras.callbacks import EarlyStopping
        from tensorflow.keras.models import load model
        from tensorflow.keras.layers import Dense, Embedding
        from tensorflow.keras.models import Sequential
        from tensorflow.keras.preprocessing.sequence import pad sequences
In [4]:
        import contractions
In [5]:
        from nltk.corpus import stopwords
        from nltk.stem import PorterStemmer
        from nltk.tokenize import word tokenize
        from nltk.stem import WordNetLemmatizer
        import contractions
        import nltk
        import re
        nltk.download('stopwords')
        from sklearn.naive bayes import MultinomialNB
        from sklearn.pipeline import Pipeline
        from sklearn.feature extraction.text import TfidfTransformer
        from sklearn.linear model import SGDClassifier
        from sklearn.linear model import LogisticRegression
        from sklearn.metrics import classification report
        from sklearn.feature extraction.text import CountVectorizer
        import spacy
        [nltk data] Downloading package stopwords to
        [nltk_data] C:\Users\pesar\AppData\Roaming\nltk data...
        [nltk data] Package stopwords is already up-to-date!
In [6]:
        df = pd.read csv("C:\Code\D213\Task two\IMDB data - Sheet1.csv")
In [7]:
Out[7]:
                                            text label
```

A very, very, very slow-moving, aimless movie ...

1	Not sure who was more lost - the flat characte	0			
2	Attempting artiness with black & white and cle	0			
3	Very little music or anything to speak of.	0			
4	The best scene in the movie was when Gerardo i	1			
•••					
743					
744					
745	In a word, it is embarrassing.	0			
746	Exceptionally bad!	0			
747	All in all its an insult to one's intelligence	0			
740					

## 748 rows $\times$ 2 columns

Out[10]:

```
In [8]:
        df.dtypes
       text object label int64
Out[8]:
        dtype: object
In [9]:
        lemma = WordNetLemmatizer()
        def clean_text(text):
           text = re.sub('[^A-Za-z0-9]', '', text)
            text = text.lower()
            text = contractions.fix(text)
            text = word tokenize(text)
            text = [lemma.lemmatize(word) for word in text if not word in stopwords.words('engl:
            text = ' '.join(text)
            return text
        df['clean text'] = df['text'].apply(lambda x : clean text(x))
```

In [10]: df

	text	label	clean_text
0	A very, very, very slow-moving, aimless movie	0	slow moving aimless movie distressed drifting
1	Not sure who was more lost - the flat characte	0	sure lost flat character audience nearly half
2	Attempting artiness with black & white and cle	0	attempting artiness black white clever camera
3	Very little music or anything to speak of.	0	little music anything speak
4	The best scene in the movie was when Gerardo i	1	best scene movie gerardo trying find song keep
•••			
743	I just got bored watching Jessice Lange take h	0	got bored watching jessice lange take clothes
744	Unfortunately, any virtue in this film's produ	0	unfortunately virtue film production work lost
745	In a word, it is embarrassing.	0	word embarrassing
746	Exceptionally bad!	0	exceptionally bad
747	All in all its an insult to one's intelligence	0	insult one intelligence huge waste money

```
In [11]:
          #dropping original text column
         df = df.drop(['text'], axis = 1)
In [12]:
          #exporting cleaned data
         df.to csv('cleaned data.csv')
In [13]:
         def buildDictionary(texts):
              Build the dictionary of words where key is the word and value is the index.
             hashmap = {}
             for text in texts:
                  for word in text.split():
                     hashmap[word] = hashmap.get(word, 0) + 1
              return {w:i+1 for i, w in enumerate(list(hashmap.keys()))}
In [14]:
         dictionary = buildDictionary(df['clean text'])
```

## In [15]: print(dictionary)

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```

```
712, '2005': 2713, 'judith': 2714, 'favorite': 2715, 'sad': 2716, 'cutie': 2717, 'confid
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         'jessice': 2741, 'clothes': 2742, 'virtue': 2743, 'regrettable': 2744, 'exceptionally':
         2745}
In [16]:
          dictionary list = [ ]
          for i in dictionary:
              dictionary list.append(i)
In [17]:
          dictionary df = pd.DataFrame(dictionary list)
In [18]:
          dictionary df
Out[18]:
                       0
                     slow
                  moving
            2
                   aimless
                   movie
            4
                 distressed
         2740
                   jessice
         2741
                   clothes
         2742
                   virtue
         2743
                regrettable
         2744 exceptionally
        2745 rows × 1 columns
In [19]:
          col names = ['word', 'count']
In [20]:
          value counts = dictionary df.value counts()
          value count df = pd.DataFrame(value counts)
In [21]:
         print(value count df)
                       0
         0
         0
         prelude
         practical
         practically 1
         pray
```

feeling

2701, 'vessel': 2702, 'taken': 2703, 'mighty': 2704, 'frost': 2705, 'added': 2706, 'fest': 2707, 'spoiled': 2708, 'brat': 2709, 'babysitting': 2710, 'sunday': 2711, 'march': 2

```
fellowes
        zombiez
        [2745 rows x 1 columns]
In [22]:
         X = np.array(df['clean text'])
         Y = df['label'].values
In [23]:
         X train, x test, y train, y test = train test split(X,Y, test size = 0.20)
In [24]:
         y train = pd.Series(y train)
         y test = pd.Series(y test)
In [25]:
         from keras.utils.np utils import to categorical
         y train = to categorical(y train, num classes = 2)
         y test = to categorical(y test, num classes = 2)
In [26]:
         pd.DataFrame(X train).to csv('x train.csv')
         pd.DataFrame(x test).to csv('x test.csv')
         pd.DataFrame(y train).to csv('y train.csv')
         pd.DataFrame(y test).to csv('y test.csv')
        Model initialization
In [27]:
         vocab size = 5000
         oov tok = "<oov>"
         embedding dim = 16
         max length = 50
         trunc type = 'post'
         padding type = 'post'
In [28]:
         tokenizer = Tokenizer(num words=vocab size, oov token = oov tok)
         tokenizer.fit on texts(X train)
         word index = tokenizer.word index
In [29]:
          #applying padding to data
         sequences train = tokenizer.texts to sequences(X train)
         padded train = pad sequences (sequences train, maxlen= max length, padding = 'post', true
In [30]:
         #applying padding to data
         sequences test = tokenizer.texts to sequences(x test)
         padded test = pad sequences (sequences test, maxlen= max length, padding = 'post', trunce
In [31]:
         training padded = np.array(padded train)
         training label = np.array(y train)
```

test padded = np.array(padded test)

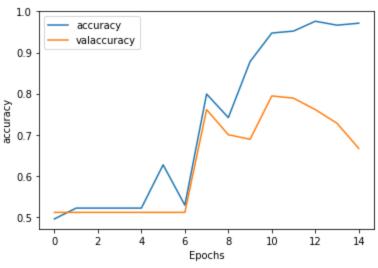
test label = np.array(y test)

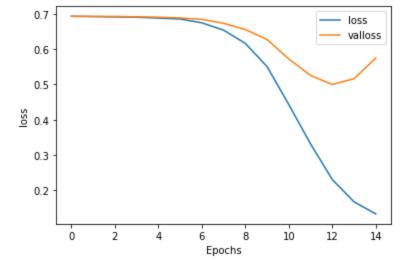
feisty

```
In [55]: training_padded[1]
        array([326, 327, 492, 9, 238, 867, 144, 868, 0, 0, 0, 0, 0,
Out[55]:
                 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
                                                                        0,
                 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
                                                                         0,
                                       0,
                    Ο,
                        Ο,
                              0, 0,
                                           Ο,
                                                0,
                                                     Ο,
                                                          0,
                 Ο,
                                                                01)
In [32]:
        print(len(training padded))
        print(len(training label))
        print(len(test padded))
        print(len(test label))
        598
        598
        150
        150
In [33]:
         pd.DataFrame(training padded).to csv('training padded.csv')
         pd.DataFrame(training label).to csv('training label.csv')
         pd.DataFrame(test padded).to csv('test padded.csv')
         pd.DataFrame(test label).to csv('test label.csv')
In [34]:
         # WORD2VEC
         W2V SIZE = 300
         W2V WINDOW = 7
         W2V EPOCH = 32
         W2V MIN COUNT = 10
In [35]:
         # KERAS
         SEQUENCE LENGTH = 300
        EPOCHS = 8
        BATCH SIZE = 1024
In [36]:
         # SENTIMENT
         POSITIVE = "POSITIVE"
         NEGATIVE = "NEGATIVE"
         NEUTRAL = "NEUTRAL"
         SENTIMENT THRESHOLDS = (0.4, 0.7)
In [37]:
         # EXPORT
         KERAS MODEL = "model.h5"
         WORD2VEC MODEL = "model.w2v"
         TOKENIZER MODEL = "tokenizer.pkl"
         ENCODER MODEL = "encoder.pkl"
In [38]:
         w2v model = gensim.models.word2vec.Word2Vec(
                                                   window=W2V WINDOW,
                                                   min count=W2V MIN COUNT,
                                                   workers=8)
In [39]:
        words = w2v model.wv.index to key
In [40]:
        vocab size = len(tokenizer.word index) + 1
        print(vocab size)
```

```
In [41]:
       activation = 'softmax'
       loss = 'categorical crossentropy'
       optimizer = 'adam'
       num epochs = 20
In [42]:
       early stopping monitor = EarlyStopping(patience = 2)
In [43]:
       model = tf.keras.Sequential([
          tf.keras.layers.Embedding(vocab size, embedding dim, input length=max length),
          tf.keras.layers.GlobalAveragePooling1D(),
          tf.keras.layers.Dense(100, activation = 'relu'),
          tf.keras.layers.Dense(50, activation = 'relu'),
          tf.keras.layers.Dense(2, activation=activation)
       ])
In [44]:
       model.compile(loss = loss, optimizer = optimizer, metrics=['accuracy'])
       model.summary()
      Model: "sequential"
       Layer (type)
                            Output Shape
                                                Param #
      ______
       embedding (Embedding)
                           (None, 50, 16)
                                                39696
       global average pooling1d (G (None, 16)
       lobalAveragePooling1D)
                            (None, 100)
       dense (Dense)
                                                1700
       dense 1 (Dense)
                            (None, 50)
                                                5050
       dense 2 (Dense)
                                                102
                            (None, 2)
      ______
      Total params: 46,548
      Trainable params: 46,548
      Non-trainable params: 0
In [45]:
       history = model.fit(training padded, training label, batch size = 32, epochs = num epoc
                     validation split = 0.3, callbacks = [early stopping monitor], verbose
      Epoch 1/20
      14/14 [==================== ] - 1s 13ms/step - loss: 0.6933 - accuracy: 0.4952
      - val loss: 0.6929 - val accuracy: 0.5111
      Epoch 2/20
      val loss: 0.6928 - val accuracy: 0.5111
      Epoch 3/20
      val loss: 0.6927 - val accuracy: 0.5111
      Epoch 4/20
      val loss: 0.6918 - val accuracy: 0.5111
      Epoch 5/20
      val loss: 0.6906 - val accuracy: 0.5111
      Epoch 6/20
```

```
val loss: 0.6885 - val accuracy: 0.5111
    Epoch 7/20
    val loss: 0.6845 - val accuracy: 0.5111
    Epoch 8/20
    val loss: 0.6733 - val accuracy: 0.7611
    Epoch 9/20
    val loss: 0.6557 - val accuracy: 0.7000
    Epoch 10/20
    val loss: 0.6273 - val accuracy: 0.6889
    Epoch 11/20
    val loss: 0.5723 - val accuracy: 0.7944
    Epoch 12/20
    val loss: 0.5255 - val accuracy: 0.7889
    Epoch 13/20
    val loss: 0.5000 - val accuracy: 0.7611
    Epoch 14/20
    val loss: 0.5164 - val accuracy: 0.7278
    Epoch 15/20
    val loss: 0.5748 - val accuracy: 0.6667
In [46]:
    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')
```





Predicted: Negative review Actual: Negative review

print('Predicted review text:', x test[i], "\n")

In [58]:

```
In [47]:
         #getting accuracy for testing set
         score = model.evaluate(test padded, test label, verbose=0)
         print(f'Test loss: {score[0]} / Test accuracy: {score[1]}')
        Test loss: 0.6051126718521118 / Test accuracy: 0.6800000071525574
In [48]:
         #getting accuracy for training set for comparison
         score = model.evaluate(training padded, training label, verbose=0)
         print(f'Test loss: {score[0]} / Test accuracy: {score[1]}')
         Test loss: 0.2785325050354004 / Test accuracy: 0.8545150756835938
In [49]:
         model.save('SentimentAnalysisModel.h5')
         my model = load model('SentimentAnalysisModel.h5')
In [50]:
         predictions = my model.predict(test padded)
In [55]:
         i = 24
         print('Predicted review text:', x test[i], "\n")
         print('Predicted:', 'Negative' if predictions[i][0] >= 0.5 else 'Positive', 'review')
         print('Actual:', 'Negative' if y test[i][1] == 0 else 'Positive', 'review' )
        Predicted review text: filmiing le expansive
        Predicted: Negative review
        Actual: Negative review
In [56]:
         i = 67
         print('Predicted review text:', x test[i], "\n")
         print('Predicted:', 'Negative' if predictions[i][0] >= 0.5 else 'Positive', 'review')
         print('Actual:', 'Negative' if y test[i][1] == 0 else 'Positive', 'review' )
        Predicted review text: movie join revenge boogeyman zombiez part hellish trinity horror
        film
```

```
print('Predicted:', 'Negative' if predictions[i][0] >= 0.5 else 'Positive', 'review')
print('Actual:', 'Negative' if y_test[i][1] == 0 else 'Positive', 'review')
```

Predicted review text: directing sloppy best

Predicted: Negative review Actual: Negative review