fake-news-analysis-lstm

January 31, 2024

0.1 Dataset Information

Develop a Deep learning program to identify when an article might be fake news.

0.1.1 Attributes

- id: unique id for a news article
- title: the title of a news article
- author: author of the news article
- text: the text of the article; could be incomplete
- label: a label that marks the article as potentially unreliable
  - 1: unreliable
  - 0: reliable

0.2 Import Modules

[21]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from wordcloud import WordCloud
import re
import nltk
import warnings
%matplotlib inline

warnings.filterwarnings('ignore')
```

0.3 Loading the Dataset

[10]:
```
df = pd.read_csv('train.csv')
df.head()
```

[10]:
```
   id                                              title              author  \
0   0  House Dem Aide: We Didn’t Even See Comey’s Let…       Darrell Lucus
1   1  FLYNN: Hillary Clinton, Big Woman on Campus - …     Daniel J. Flynn
2   2                  Why the Truth Might Get You Fired  Consortiumnews.com
3   3  15 Civilians Killed In Single US Airstrike Hav…     Jessica Purkiss
```

```
4   4  Iranian woman jailed for fictional unpublished…      Howard Portnoy

                                                    text  label
0  House Dem Aide: We Didn’t Even See Comey’s Let…      1
1  Ever get the feeling your life circles the rou…      0
2  Why the Truth Might Get You Fired October 29, …      1
3  Videos 15 Civilians Killed In Single US Airstr…      1
4  Print \nAn Iranian woman has been sentenced to…      1
```

[5]:
```
df['title'][0]
```

[5]:
```
'House Dem Aide: We Didn’t Even See Comey’s Letter Until Jason Chaffetz Tweeted
It'
```

[6]:
```
df['text'][0]
```

[6]:
```
'House Dem Aide: We Didn’t Even See Comey’s Letter Until Jason Chaffetz Tweeted
It By Darrell Lucus on October 30, 2016 Subscribe Jason Chaffetz on the stump in
American Fork, Utah ( image courtesy Michael Jolley, available under a Creative
Commons-BY license) \nWith apologies to Keith Olbermann, there is no doubt who
the Worst Person in The World is this week–FBI Director James Comey. But
according to a House Democratic aide, it looks like we also know who the second-
worst person is as well. It turns out that when Comey sent his now-infamous
letter announcing that the FBI was looking into emails that may be related to
Hillary Clinton’s email server, the ranking Democrats on the relevant committees
didn’t hear about it from Comey. They found out via a tweet from one of the
Republican committee chairmen. \nAs we now know, Comey notified the Republican
chairmen and Democratic ranking members of the House Intelligence, Judiciary,
and Oversight committees that his agency was reviewing emails it had recently
discovered in order to see if they contained classified information. Not long
after this letter went out, Oversight Committee Chairman Jason Chaffetz set the
political world ablaze with this tweet. FBI Dir just informed me, "The FBI has
learned of the existence of emails that appear to be pertinent to the
investigation." Case reopened \n— Jason Chaffetz (@jasoninthehouse) October 28,
2016 \nOf course, we now know that this was not the case . Comey was actually
saying that it was reviewing the emails in light of "an unrelated case"–which we
now know to be Anthony Weiner’s sexting with a teenager. But apparently such
little things as facts didn’t matter to Chaffetz. The Utah Republican had
already vowed to initiate a raft of investigations if Hillary wins–at least two
years’ worth, and possibly an entire term’s worth of them. Apparently Chaffetz
thought the FBI was already doing his work for him–resulting in a tweet that
briefly roiled the nation before cooler heads realized it was a dud. \nBut
according to a senior House Democratic aide, misreading that letter may have
been the least of Chaffetz’ sins. That aide told Shareblue that his boss and
other Democrats didn’t even know about Comey’s letter at the time–and only found
out when they checked Twitter. "Democratic Ranking Members on the relevant
committees didn’t receive Comey’s letter until after the Republican Chairmen. In
```

```
fact, the Democratic Ranking Members didn’ receive it until after the Chairman
of the Oversight and Government Reform Committee, Jason Chaffetz, tweeted it out
and made it public." \nSo let’s see if we’ve got this right. The FBI director
tells Chaffetz and other GOP committee chairmen about a major development in a
potentially politically explosive investigation, and neither Chaffetz nor his
other colleagues had the courtesy to let their Democratic counterparts know
about it. Instead, according to this aide, he made them find out about it on
Twitter. \nThere has already been talk on Daily Kos that Comey himself provided
advance notice of this letter to Chaffetz and other Republicans, giving them
time to turn on the spin machine. That may make for good theater, but there is
nothing so far that even suggests this is the case. After all, there is nothing
so far that suggests that Comey was anything other than grossly incompetent and
tone-deaf. \nWhat it does suggest, however, is that Chaffetz is acting in a way
that makes Dan Burton and Darrell Issa look like models of responsibility and
bipartisanship. He didn’t even have the decency to notify ranking member Elijah
Cummings about something this explosive. If that doesn’t trample on basic
standards of fairness, I don’t know what does. \nGranted, it’s not likely that
Chaffetz will have to answer for this. He sits in a ridiculously Republican
district anchored in Provo and Orem; it has a Cook Partisan Voting Index of
R+25, and gave Mitt Romney a punishing 78 percent of the vote in 2012. Moreover,
the Republican House leadership has given its full support to Chaffetz’ planned
fishing expedition. But that doesn’t mean we can’t turn the hot lights on him.
After all, he is a textbook example of what the House has become under
Republican control. And he is also the Second Worst Person in the World. About
Darrell Lucus \nDarrell is a 30-something graduate of the University of North
Carolina who considers himself a journalist of the old school. An attempt to
turn him into a member of the religious right in college only succeeded in
turning him into the religious right\'s worst nightmare--a charismatic Christian
who is an unapologetic liberal. His desire to stand up for those who have been
scared into silence only increased when he survived an abusive three-year
marriage. You may know him on Daily Kos as Christian Dem in NC . Follow him on
Twitter @DarrellLucus or connect with him on Facebook . Click here to buy
Darrell a Mello Yello. Connect'
```

[7]:
```python
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 20800 entries, 0 to 20799
Data columns (total 5 columns):
 #   Column  Non-Null Count  Dtype
---  ------  --------------  -----
 0   id      20800 non-null  int64
 1   title   20242 non-null  object
 2   author  18843 non-null  object
 3   text    20761 non-null  object
 4   label   20800 non-null  int64
dtypes: int64(2), object(3)
```

```
memory usage: 812.6+ KB
```

0.4 Data Proprocessing

```
[11]: # drop unnecessary columns
      df = df.drop(columns=['id', 'title', 'author'], axis=1)
```

```
[12]: # drop null values
      df = df.dropna(axis=0)
```

```
[13]: len(df)
```

```
[13]: 20761
```

```
[ ]: # remove special characters and punctuations
```

```
[14]: df['clean_news'] = df['text'].str.lower()
      df['clean_news']
```

```
[14]: 0        house dem aide: we didn’t even see comey’s let…
      1        ever get the feeling your life circles the rou…
      2        why the truth might get you fired october 29, …
      3        videos 15 civilians killed in single us airstr…
      4        print \nan iranian woman has been sentenced to…
                                     …
      20795    rapper t. i. unloaded on black celebrities who…
      20796    when the green bay packers lost to the washing…
      20797    the macy’s of today grew from the union of sev…
      20798    nato, russia to hold parallel exercises in bal…
      20799      david swanson is an author, activist, journa…
      Name: clean_news, Length: 20761, dtype: object
```

```
[19]: df['clean_news'] = df['clean_news'].str.replace('[^A-Za-z0-9\s]', '')
      df['clean_news'] = df['clean_news'].str.replace('\n', '')
      df['clean_news'] = df['clean_news'].str.replace('\s+', ' ')
      df['clean_news']
```

```
[19]: 0        house dem aide we didnt even see comeys letter…
      1        ever get the feeling your life circles the rou…
      2        why the truth might get you fired october 29 2…
      3        videos 15 civilians killed in single us airstr…
      4        print an iranian woman has been sentenced to s…
                                     …
      20795    rapper t i unloaded on black celebrities who m…
      20796    when the green bay packers lost to the washing…
      20797    the macys of today grew from the union of seve…
      20798    nato russia to hold parallel exercises in balk…
```

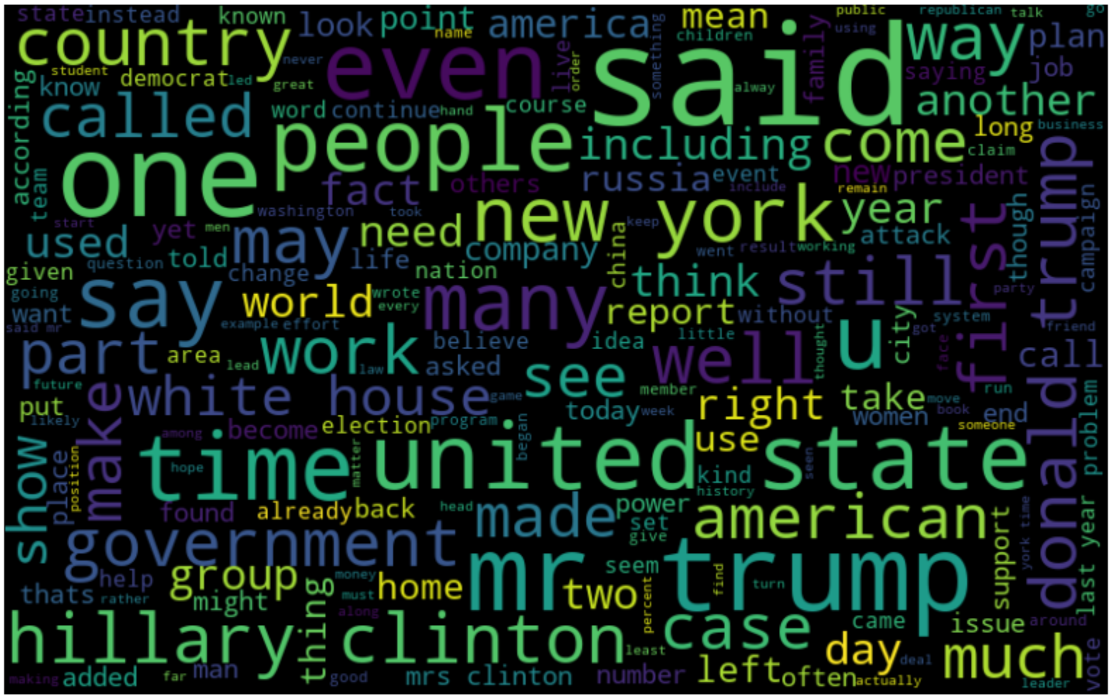
```
20799     david swanson is an author activist journalis…
Name: clean_news, Length: 20761, dtype: object
```

[20]:
```
# remove stopwords
from nltk.corpus import stopwords
stop = stopwords.words('english')
df['clean_news'] = df['clean_news'].apply(lambda x: " ".join([word for word in␣
 ↪x.split() if word not in stop]))
df.head()
```

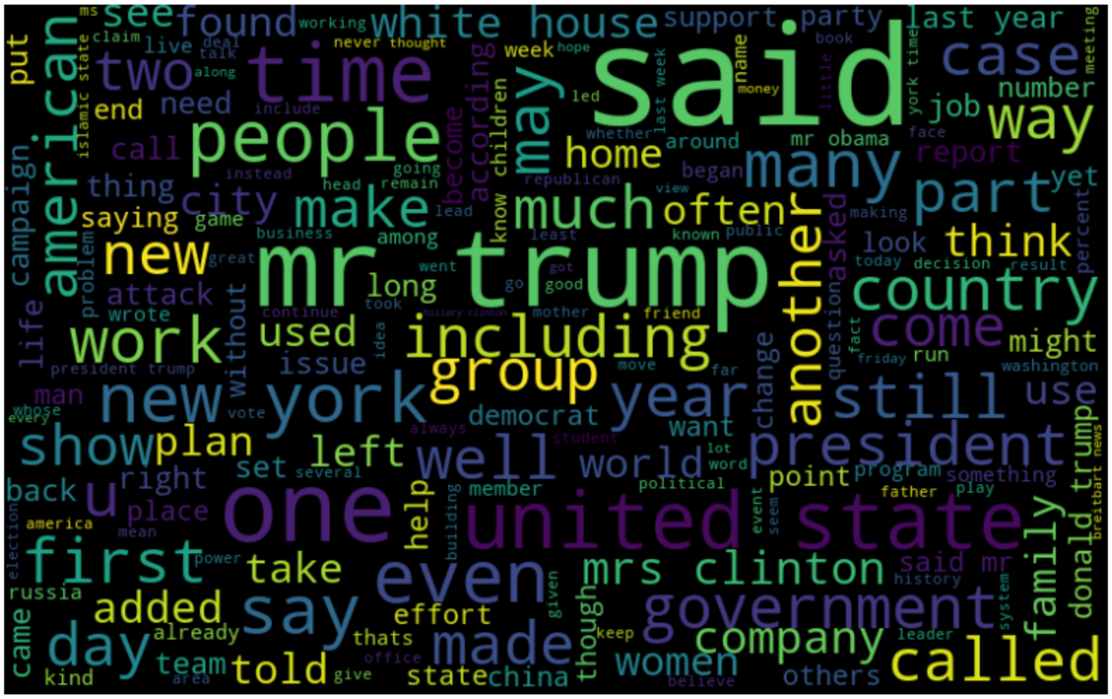
[20]:
```
                                                text  label  \
0  House Dem Aide: We Didn’t Even See Comey’s Let…      1
1  Ever get the feeling your life circles the rou…      0
2  Why the Truth Might Get You Fired October 29, …      1
3  Videos 15 Civilians Killed In Single US Airstr…      1
4  Print \nAn Iranian woman has been sentenced to…      1

                                          clean_news
0  house dem aide didnt even see comeys letter ja…
1  ever get feeling life circles roundabout rathe…
2  truth might get fired october 29 2016 tension …
3  videos 15 civilians killed single us airstrike…
4  print iranian woman sentenced six years prison…
```

0.5 Exploratory Data Analysis

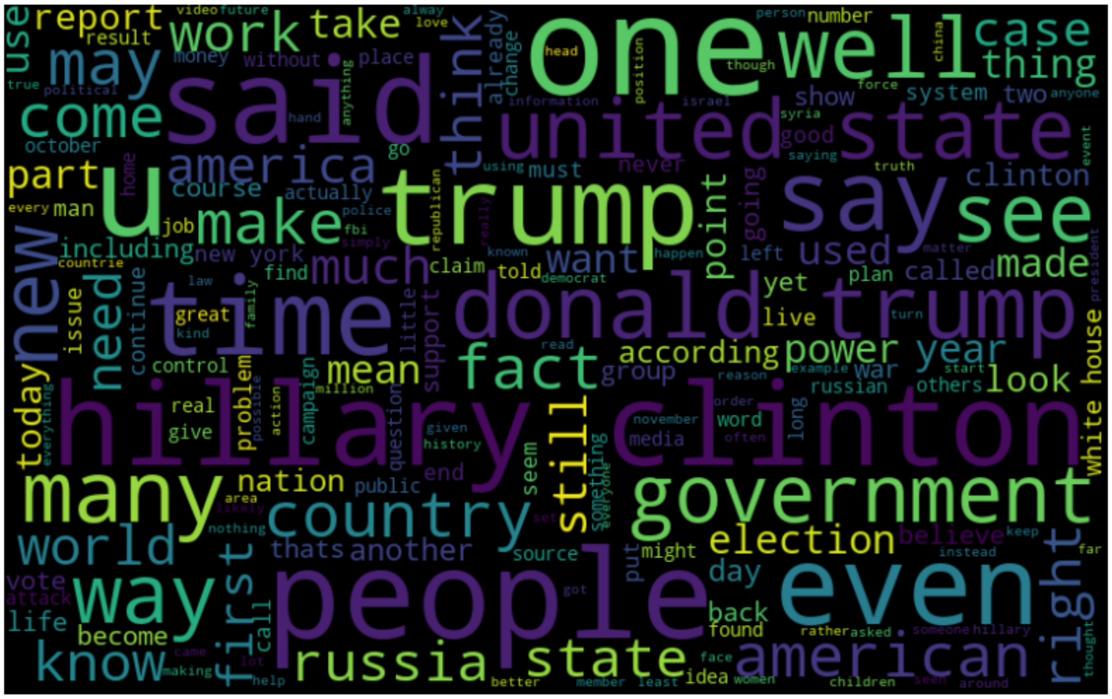
[22]:
```
# visualize the frequent words
all_words = " ".join([sentence for sentence in df['clean_news']])

wordcloud = WordCloud(width=800, height=500, random_state=42,␣
 ↪max_font_size=100).generate(all_words)

# plot the graph
plt.figure(figsize=(15, 9))
plt.imshow(wordcloud, interpolation='bilinear')
plt.axis('off')
plt.show()
```



```
[23]: # visualize the frequent words for genuine news
all_words = " ".join([sentence for sentence in␣
  ↪df['clean_news'][df['label']==0]])

wordcloud = WordCloud(width=800, height=500, random_state=42,␣
  ↪max_font_size=100).generate(all_words)

# plot the graph
plt.figure(figsize=(15, 9))
plt.imshow(wordcloud, interpolation='bilinear')
plt.axis('off')
plt.show()
```



```
[24]: # visualize the frequent words for fake news
      all_words = " ".join([sentence for sentence in␣
       ↪df['clean_news'][df['label']==1]])

      wordcloud = WordCloud(width=800, height=500, random_state=42,␣
       ↪max_font_size=100).generate(all_words)

      # plot the graph
      plt.figure(figsize=(15, 9))
      plt.imshow(wordcloud, interpolation='bilinear')
      plt.axis('off')
      plt.show()
```



0.6 Create Word Embeddings

[26]:
```
from keras.preprocessing.text import Tokenizer
from keras.preprocessing.sequence import pad_sequences
```

[27]:
```
# tokenize text
tokenizer = Tokenizer()
tokenizer.fit_on_texts(df['clean_news'])
word_index = tokenizer.word_index
vocab_size = len(word_index)
vocab_size
```

[27]:
```
199536
```

[48]:
```
# padding data
sequences = tokenizer.texts_to_sequences(df['clean_news'])
padded_seq = pad_sequences(sequences, maxlen=500, padding='post',␣
 ↪truncating='post')
```

[40]:
```
# create embedding index
embedding_index = {}
with open('glove.6B.100d.txt', encoding='utf-8') as f:
    for line in f:
        values = line.split()
        word = values[0]
        coefs = np.asarray(values[1:], dtype='float32')
        embedding_index[word] = coefs
```

[42]:
```
# create embedding matrix
embedding_matrix = np.zeros((vocab_size+1, 100))
for word, i in word_index.items():
    embedding_vector = embedding_index.get(word)
    if embedding_vector is not None:
        embedding_matrix[i] = embedding_vector
```

[45]:
```
embedding_matrix[1]
```

[45]:
```
array([-0.13128   , -0.45199999,  0.043399  , -0.99798   , -0.21053   ,
       -0.95867997, -0.24608999,  0.48413   ,  0.18178   ,  0.47499999,
       -0.22305   ,  0.30063999,  0.43496001, -0.36050001,  0.20245001,
       -0.52594   , -0.34707999,  0.0075873 , -1.04970002,  0.18673   ,
        0.57369   ,  0.43814   ,  0.098659  ,  0.38769999, -0.22579999,
        0.41911   ,  0.043602  , -0.73519999, -0.53583002,  0.19276001,
       -0.21961001,  0.42515001, -0.19081999,  0.47187001,  0.18826   ,
        0.13357   ,  0.41839001,  1.31379998,  0.35677999, -0.32172   ,
       -1.22570002, -0.26635   ,  0.36715999, -0.27586001, -0.53245997,
        0.16786   , -0.11253   , -0.99958998, -0.60706002, -0.89270997,
        0.65156001, -0.88783997,  0.049233  ,  0.67110997, -0.27553001,
       -2.40050006, -0.36989   ,  0.29135999,  1.34979999,  1.73529994,
        0.27000001,  0.021299  ,  0.14421999,  0.023784  ,  0.33643001,
       -0.35475999,  1.09210002,  1.48450005,  0.49430001,  0.15688001,
        0.34678999, -0.57221001,  0.12093   , -1.26160002,  1.05410004,
        0.064335  , -0.002732  ,  0.19038001, -1.76429999,  0.055068  ,
        1.47370005, -0.41782001, -0.57341999, -0.12129   , -1.31690001,
       -0.73882997,  0.17682   , -0.019991  , -0.49175999, -0.55247003,
        1.06229997, -0.62879002,  0.29098001,  0.13237999, -0.70414001,
        0.67128003, -0.085462  , -0.30526   , -0.045495  ,  0.56509   ])
```

0.7 Input Split

[49]:
```
padded_seq[1]
```

[49]:
```
array([   258,     28,   1557,     92,   4913,  27340,    415,   2246,
         2067,    377,    532,   1558,   5339,     29,     12,    796,
          179,    361,   1917,  17459,    829,  20147,   2990,   2626,
          640,    747,    252,   2025,   3113,  10995,    125,     39,
         2086,  78618,   3022,   3646,   3561,   3113,    835,    153,
         3458,     29,   9775,  51963,   3724,     18,    218,     20,
         3234,  20147,  10024,    625,     11,    481,   2494,   2417,
         8173,    442,    701,    613,    147,     14,  22280,    902,
          324,      8,    164,   3712,     60,  11541,    867,   2644,
           16,     864,    4422,     176,    5305,    2086,    4253,      40,
          257,     835,     192,      10,    2403,      10,    2086,    9775,
           58,    8372,   11246,  104297,   20952,    3713,   20953,   78619,
       104298,    5459,   31169,   25044,    7998,   19120,   65806,    4403,
          168,     261,   25045,    4403,     162,     355,     904,    1581,
          424,    1302,      20,     344,      37,    1963,     187,     394,
           59,    8107,    3658,   18529,     177,    1356,     745,    7401,
         2379,    7787,    1602,    2532,     152,      12,     458,   10153,
        11900,   17701,    8681,     128,     102,   22769,   10582,   10025,
        13518,    9418,     316,       7,     136,     626,     480,     370,
           95,   47538,    2439,   19434,    1139,    9775,    7163,    3591,
         8173,       4,     840,     169,     625,   14079,     414,      51,
          465,     177,       1,     446,    1139,     446,    1078,    1139,
           10,      39,     369,     182,     446,    1139,    8031,      51,
           51,    1557,   30058,    1703,     516,      16,    2633,   19772,
         1139,    8031,     957,   11901,     165,      60,     493,     957,
           16,     588,       6,   19772,   13107,   35329,    1635,    1688,
         3751,    2121,     254,      12,     104,   19772,    1099,     287,
         8032,   12768,    1159,   19121,      52,   14721,    8208,      22,
            6,       3,   20548,    3724,      69,    3241,      69,     292,
          893,    2020,   17201,      37,    1615,     250,     448,    2825,
        14721,      12,     562,  104299,     471,    7358,    1910,    2322,
         1438,    1502,    1212,     592,     448,     674,    1452,      22,
            6,    2420,    1387,     592,     197,   12000,     142,     192,
           42,      49,       6,     102,   14885,    1502,     230,     292,
          973,    1019,     137,     209,     627,     994,   17202,       8,
           15,       6,    4785,    3640,      29,      12,    9944,     907,
           86,    2648,    1521,     229,     176,   13108,    1376,   20147,
          481,      95,      11,     164,    2557,      12,    9203,      70,
          146,     604,    1732,    2688,     263,   25735,   41482,    4166,
           21,   20147,   13639,    4977,     118,      39,      43,    8681,
           86,     320,    2478,     447,    1049,     335,    1304,    1273,
          447,    1049,     247,     891,    1871,     335,     179,     361,
         1917,    4311,     361,      44,      41,    7472,     489,    1464,
           16,     335,    1453,     683,     737,    1032,     169,     934,
           30,    3341,     557,      11,     361,    5797,    7952,   20954,
         6089,     148,   51964,    7203,    1387,     637,     418,    1615,
           37,      53,       8,    1809,   47539,   11442,    3561,      53,
        19773,     981,   12649,       0,       0,       0,       0,       0,
            0,       0,       0,       0,       0,       0,       0,       0,
            0,       0,       0,       0,       0,       0,       0,       0,
            0,       0,       0,       0,       0,       0,       0,       0,
            0,       0,       0,       0,       0,       0,       0,       0,
            0,       0,       0,       0,       0,       0,       0,       0,
            0,       0,       0,       0,       0,       0,       0,       0,
            0,       0,       0,       0,       0,       0,       0,       0,
            0,       0,       0,       0,       0,       0,       0,       0,
            0,       0,       0,       0,       0,       0,       0,       0,
            0,       0,       0,       0,       0,       0,       0,       0,
            0,       0,       0,       0,       0,       0,       0,       0,
            0,       0,       0,       0,       0,       0,       0,       0,
            0,       0,       0,       0,       0,       0,       0,       0,
            0,       0,       0,       0,       0,       0,       0,       0,
            0,       0,       0,       0])
```

[50]:
```
from sklearn.model_selection import train_test_split
x_train, x_test, y_train, y_test = train_test_split(padded_seq, df['label'],␣
 ↪test_size=0.20, random_state=42, stratify=df['label'])
```

0.8 Model Training

[63]:
```
from keras.layers import LSTM, Dropout, Dense, Embedding
from keras import Sequential

# model = Sequential([
#     Embedding(vocab_size+1, 100, weights=[embedding_matrix], trainable=False),
#     Dropout(0.2),
#     LSTM(128, return_sequences=True),
#     LSTM(128),
#     Dropout(0.2),
#     Dense(512),
#     Dropout(0.2),
#     Dense(256),
#     Dense(1, activation='sigmoid')
# ])

model = Sequential([
    Embedding(vocab_size+1, 100, weights=[embedding_matrix], trainable=False),
    Dropout(0.2),
    LSTM(128),
    Dropout(0.2),
    Dense(256),
    Dense(1, activation='sigmoid')
])
```

[64]:
```
model.compile(loss='binary_crossentropy', optimizer='adam', metrics='accuracy')
model.summary()
```

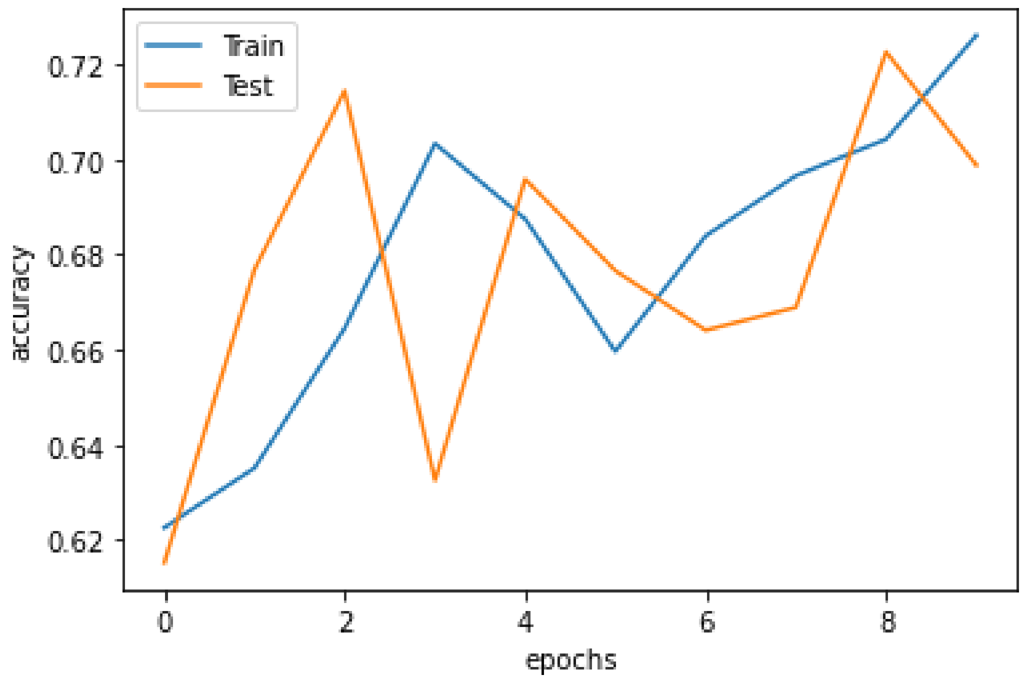
```
Model: "sequential_2"

_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
embedding_2 (Embedding)      (None, None, 100)         19953700

_________________________________________________________________
```

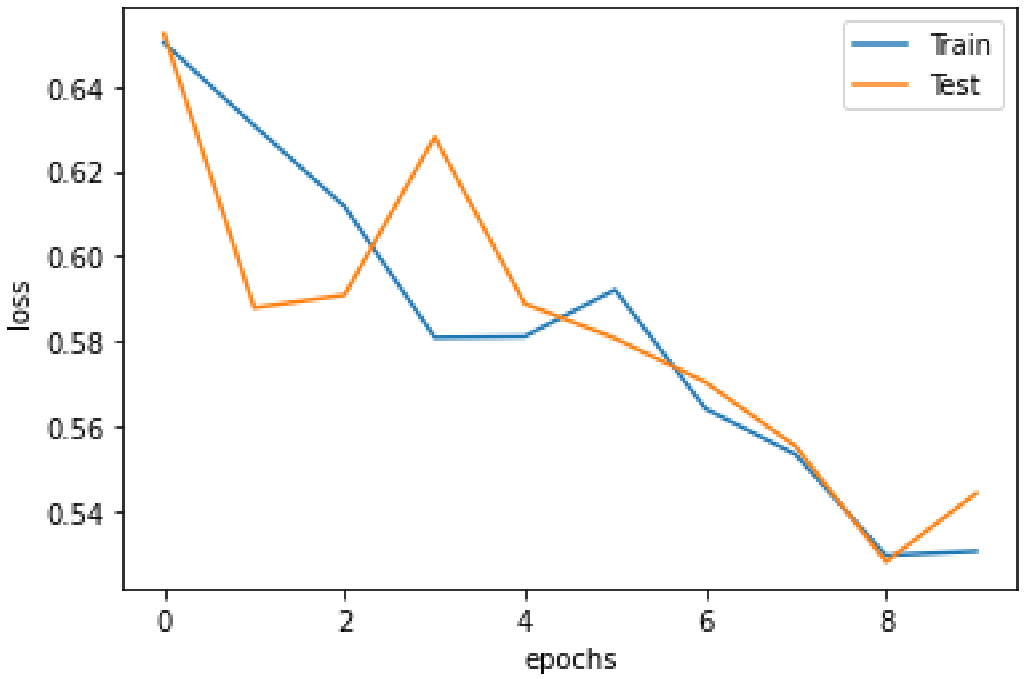
```
dropout_5 (Dropout)          (None, None, 100)         0

_________________________________________________________________
lstm_3 (LSTM)                (None, 128)               117248

_________________________________________________________________
dropout_6 (Dropout)          (None, 128)               0

_________________________________________________________________
dense_5 (Dense)              (None, 1)                 129
=================================================================
Total params: 20,071,077
Trainable params: 117,377
Non-trainable params: 19,953,700

_________________________________________________________________
```

[61]:
```
# train the model
history = model.fit(x_train, y_train, epochs=10, batch_size=256,␣
 ↪validation_data=(x_test, y_test))
```

```
Epoch 1/10
65/65 [==============================] - 42s 617ms/step - loss: 0.6541 -
accuracy: 0.6098 - val_loss: 0.6522 - val_accuracy: 0.6152
Epoch 2/10
65/65 [==============================] - 39s 607ms/step - loss: 0.6436 -
accuracy: 0.6241 - val_loss: 0.5878 - val_accuracy: 0.6769
Epoch 3/10
65/65 [==============================] - 40s 611ms/step - loss: 0.6057 -
accuracy: 0.6688 - val_loss: 0.5908 - val_accuracy: 0.7144
Epoch 4/10
65/65 [==============================] - 40s 613ms/step - loss: 0.5693 -
accuracy: 0.7239 - val_loss: 0.6280 - val_accuracy: 0.6326
Epoch 5/10
65/65 [==============================] - 40s 612ms/step - loss: 0.5990 -
accuracy: 0.6699 - val_loss: 0.5887 - val_accuracy: 0.6959
Epoch 6/10
65/65 [==============================] - 40s 614ms/step - loss: 0.6060 -
accuracy: 0.6593 - val_loss: 0.5807 - val_accuracy: 0.6766
Epoch 7/10
65/65 [==============================] - 40s 609ms/step - loss: 0.5546 -
accuracy: 0.6906 - val_loss: 0.5704 - val_accuracy: 0.6641
Epoch 8/10
65/65 [==============================] - 39s 606ms/step - loss: 0.5517 -
accuracy: 0.6973 - val_loss: 0.5553 - val_accuracy: 0.6689
Epoch 9/10
65/65 [==============================] - 33s 508ms/step - loss: 0.5400 -
accuracy: 0.6855 - val_loss: 0.5281 - val_accuracy: 0.7226
Epoch 10/10
65/65 [==============================] - 40s 609ms/step - loss: 0.5244 -
accuracy: 0.7236 - val_loss: 0.5442 - val_accuracy: 0.6988
```

[62]:
```python
# visualize the results
plt.plot(history.history['accuracy'])
plt.plot(history.history['val_accuracy'])
plt.xlabel('epochs')
plt.ylabel('accuracy')
plt.legend(['Train', 'Test'])
plt.show()

plt.plot(history.history['loss'])
plt.plot(history.history['val_loss'])
plt.xlabel('epochs')
plt.ylabel('loss')
plt.legend(['Train', 'Test'])
plt.show()
```




Train
Test
loss
epochs
0.64
0.62
0.60
0.58
0.56
0.54
0
2
4
6
8

```
[ ]:
```