In [1]:
```
# DataFrame
import pandas as pd

# Matplot
import matplotlib.pyplot as plt
%matplotlib inline

# Scikit-learn
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import LabelEncoder
from sklearn.metrics import confusion_matrix, classification_report, accuracy_sc
from sklearn.manifold import TSNE
from sklearn.feature_extraction.text import TfidfVectorizer

# Keras
from keras.preprocessing.text import Tokenizer
from keras.preprocessing.sequence import pad_sequences
from keras.models import Sequential
from keras.layers import Activation, Dense, Dropout, Embedding, Flatten, Conv1D,
from keras import utils
from keras.callbacks import ReduceLROnPlateau, EarlyStopping

# nltk
import nltk
from nltk.corpus import stopwords
from  nltk.stem import SnowballStemmer

# Word2vec
import gensim

# Utility
import re
import numpy as np
import os
from collections import Counter
import logging
import time
import pickle
import itertools

# Set log
logging.basicConfig(format='%(asctime)s : %(levelname)s : %(message)s', level=lo
```

```
Using TensorFlow backend.
```

In [2]:
```
data = pd.read_csv(r'C:\Users\user\Downloads\tweets-sentiment-analysis\data.csv'
# Keeping only the neccessary columns
data = data[['Text','Sentiment']]
```

In [3]:
```
TRAIN_SIZE = 0.8

# TEXT CLENAING
TEXT_CLEANING_RE = "@\S+|https?:\S+|http?:\S|[^A-Za-z0-9]+"

# WORD2VEC
W2V_SIZE = 300
W2V_WINDOW = 7
W2V_EPOCH = 32
W2V_MIN_COUNT = 10

# KERAS
SEQUENCE_LENGTH = 300
EPOCHS = 11
BATCH_SIZE = 40

# SENTIMENT
POSITIVE = "POSITIVE"
NEGATIVE = "NEGATIVE"
SENTIMENT_THRESHOLDS = (0.4, 0.7)

# EXPORT
KERAS_MODEL = "model.h5"
WORD2VEC_MODEL = "model.w2v"
TOKENIZER_MODEL = "tokenizer.pkl"
ENCODER_MODEL = "encoder.pkl"
```

In [4]:
```
decode_map = {0: "NEGATIVE", 1: "POSITIVE"}
def decode_sentiment(label):
    return decode_map[int(label)]
```

In [5]:
```
%%time
data.Sentiment = data.Sentiment.apply(lambda x: decode_sentiment(x))
```

```
Wall time: 109 ms
```

In [6]:
```
stop_words = stopwords.words("english")
stemmer = SnowballStemmer("english")
```

In [7]:
```
def preprocess(text, stem=False):
    # Remove link,user and special characters
    text = re.sub(TEXT_CLEANING_RE, ' ', str(text).lower()).strip()
    tokens = []
    for token in text.split():
        if token not in stop_words:
            if stem:
                tokens.append(stemmer.stem(token))
            else:
                tokens.append(token)
    return " ".join(tokens)
```

In [8]:
```
%%time
data.Text = data.Text.apply(lambda x: preprocess(x))
```

```
Wall time: 1.12 s
```

In [9]:
```
data_train, data_test = train_test_split(data, test_size=1-TRAIN_SIZE, random_st
print("TRAIN size:", len(data_train))
print("TEST size:", len(data_test))
```

```
TRAIN size: 22408
TEST size: 5602
```

In [10]:
```
%%time
documents = [_text.split() for _text in data_train.Text]
```

```
Wall time: 23.1 ms
```

In [11]:
```
w2v_model = gensim.models.word2vec.Word2Vec(size=W2V_SIZE, window=W2V_WINDOW, mi
```

In [12]:
```
w2v_model.build_vocab(documents)
```

```
2019-12-03 01:21:22,911 : INFO : collecting all words and their counts
2019-12-03 01:21:22,911 : INFO : PROGRESS: at sentence #0, processed 0 words, k
eeping 0 word types
2019-12-03 01:21:22,970 : INFO : PROGRESS: at sentence #10000, processed 67069
words, keeping 12807 word types
2019-12-03 01:21:22,995 : INFO : PROGRESS: at sentence #20000, processed 133318
words, keeping 19655 word types
2019-12-03 01:21:23,005 : INFO : collected 21136 word types from a corpus of 14
9115 raw words and 22408 sentences
2019-12-03 01:21:23,007 : INFO : Loading a fresh vocabulary
2019-12-03 01:21:23,027 : INFO : effective_min_count=10 retains 1929 unique wor
ds (9% of original 21136, drops 19207)
2019-12-03 01:21:23,028 : INFO : effective_min_count=10 leaves 113603 word corp
us (76% of original 149115, drops 35512)
2019-12-03 01:21:23,042 : INFO : deleting the raw counts dictionary of 21136 it
ems
2019-12-03 01:21:23,047 : INFO : sample=0.001 downsamples 65 most-common words
2019-12-03 01:21:23,050 : INFO : downsampling leaves estimated 99310 word corpu
s (87.4% of prior 113603)
2019-12-03 01:21:23,059 : INFO : estimated required memory for 1929 words and 3
00 dimensions: 5594100 bytes
2019-12-03 01:21:23,064 : INFO : resetting layer weights
```

In [13]:
```
words = w2v_model.wv.vocab.keys()
vocab_size = len(words)
print("Vocab size", vocab_size)
```

```
Vocab size 1929
```

In [14]:
```
%%time
w2v_model.train(documents, total_examples=len(documents), epochs=W2V_EPOCH)
```

```
2019-12-03 01:21:23,243 : INFO : training model with 8 workers on 1929 vocabu
lary and 300 features, using sg=0 hs=0 sample=0.001 negative=5 window=7
2019-12-03 01:21:23,424 : INFO : worker thread finished; awaiting finish of 7
more threads
2019-12-03 01:21:23,439 : INFO : worker thread finished; awaiting finish of 6
more threads
2019-12-03 01:21:23,472 : INFO : worker thread finished; awaiting finish of 5
more threads
2019-12-03 01:21:23,479 : INFO : worker thread finished; awaiting finish of 4
more threads
2019-12-03 01:21:23,481 : INFO : worker thread finished; awaiting finish of 3
more threads
2019-12-03 01:21:23,488 : INFO : worker thread finished; awaiting finish of 2
more threads
2019-12-03 01:21:23,494 : INFO : worker thread finished; awaiting finish of 1
more threads
2019-12-03 01:21:23,502 : INFO : worker thread finished; awaiting finish of 0
more threads
2019-12-03 01:21:23,505 : INFO : EPOCH - 1 : training on 149115 raw words (99
```

In [15]:
```
w2v_model.most_similar("shit")
```

```
C:\Users\user\Anaconda3\lib\site-packages\ipykernel_launcher.py:1: DeprecationW
arning: Call to deprecated `most_similar` (Method will be removed in 4.0.0, use
self.wv.most_similar() instead).
  """Entry point for launching an IPython kernel.
2019-12-03 01:21:31,779 : INFO : precomputing L2-norms of word weight vectors
```

Out[15]:
```
[('houston', 0.6412621140480042),
 ('idk', 0.5971338748931885),
 ('happens', 0.594658613204956),
 ('flu', 0.5935021042823792),
 ('fuck', 0.5872336626052856),
 ('car', 0.5779306888580322),
 ('wit', 0.5757883787155151),
 ('dnt', 0.5722609758377075),
 ('starting', 0.5669007301330566),
 ('boo', 0.5645122528076172)]
```

In [16]:
```
%%time
tokenizer = Tokenizer()
tokenizer.fit_on_texts(data_train.Text)

vocab_size = len(tokenizer.word_index) + 1
print("Total words", vocab_size)
```

```
Total words 21137
Wall time: 479 ms
```

In [17]:
```
%%time
x_train = pad_sequences(tokenizer.texts_to_sequences(data_train.Text), maxlen=SE
x_test = pad_sequences(tokenizer.texts_to_sequences(data_test.Text), maxlen=SEQU
```

```
Wall time: 665 ms
```

In [18]:
```
labels = data_train.Sentiment.unique().tolist()
labels
```

Out[18]:
```
['NEGATIVE', 'POSITIVE']
```

In [19]:
```
encoder = LabelEncoder()
encoder.fit(data_train.Sentiment.tolist())

y_train = encoder.transform(data_train.Sentiment.tolist())
y_test = encoder.transform(data_test.Sentiment.tolist())

y_train = y_train.reshape(-1,1)
y_test = y_test.reshape(-1,1)

print("y_train",y_train.shape)
print("y_test",y_test.shape)
```

```
y_train (22408, 1)
y_test (5602, 1)
```

In [20]:
```
print("x_train", x_train.shape)
print("y_train", y_train.shape)
print()
print("x_test", x_test.shape)
print("y_test", y_test.shape)
```

```
x_train (22408, 300)
y_train (22408, 1)

x_test (5602, 300)
y_test (5602, 1)
```

In [21]:
```
y_train[:10]
```

Out[21]:
```
array([[0],
       [1],
       [1],
       [1],
       [1],
       [0],
       [1],
       [0],
       [0],
       [1]], dtype=int64)
```

In [22]:
```
embedding_matrix = np.zeros((vocab_size, W2V_SIZE))
for word, i in tokenizer.word_index.items():
  if word in w2v_model.wv:
    embedding_matrix[i] = w2v_model.wv[word]
print(embedding_matrix.shape)
```

```
(21137, 300)
```

In [23]:
```
embedding_layer = Embedding(vocab_size, W2V_SIZE, weights=[embedding_matrix], in
```

In [24]:
```
model = Sequential()
model.add(embedding_layer)
model.add(Dropout(0.5))
model.add(LSTM(100, dropout=0.2, recurrent_dropout=0.2))
model.add(Dense(1, activation='sigmoid'))

model.summary()
```

```
WARNING:tensorflow:From C:\Users\user\Anaconda3\lib\site-packages\tensorflow\py
thon\framework\op_def_library.py:263: colocate_with (from tensorflow.python.fra
mework.ops) is deprecated and will be removed in a future version.
Instructions for updating:
Colocations handled automatically by placer.

2019-12-03 01:21:33,996 : WARNING : From C:\Users\user\Anaconda3\lib\site-packa
ges\tensorflow\python\framework\op_def_library.py:263: colocate_with (from tens
orflow.python.framework.ops) is deprecated and will be removed in a future vers
ion.
Instructions for updating:
Colocations handled automatically by placer.

WARNING:tensorflow:From C:\Users\user\Anaconda3\lib\site-packages\keras\backend
\tensorflow_backend.py:3445: calling dropout (from tensorflow.python.ops.nn_op
s) with keep_prob is deprecated and will be removed in a future version.
Instructions for updating:
Please use `rate` instead of `keep_prob`. Rate should be set to `rate = 1 - kee
p_prob`.

2019-12-03 01:21:34,298 : WARNING : From C:\Users\user\Anaconda3\lib\site-packa
ges\keras\backend\tensorflow_backend.py:3445: calling dropout (from tensorflow.
python.ops.nn_ops) with keep_prob is deprecated and will be removed in a future
version.
Instructions for updating:
Please use `rate` instead of `keep_prob`. Rate should be set to `rate = 1 - kee
p_prob`.

_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
embedding_1 (Embedding)      (None, 300, 300)          6341100
_________________________________________________________________
dropout_1 (Dropout)          (None, 300, 300)          0
_________________________________________________________________
lstm_1 (LSTM)                (None, 100)               160400
_________________________________________________________________
dense_1 (Dense)              (None, 1)                 101
=================================================================
Total params: 6,501,601
Trainable params: 160,501
Non-trainable params: 6,341,100
_________________________________________________________________
```

In [25]:
```
model.compile(loss='binary_crossentropy',optimizer="adam", metrics=['accuracy'])
```

In [26]:
```
callbacks = [ ReduceLROnPlateau(monitor='val_loss', patience=5, cooldown=0),Early
```

In [27]:
```
%%time
history = model.fit(x_train, y_train,batch_size=BATCH_SIZE,epochs=EPOCHS, valida
```

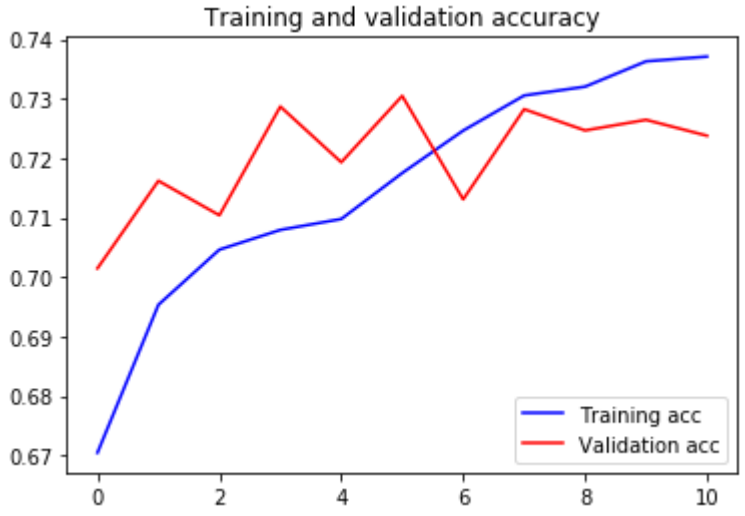
```
WARNING:tensorflow:From C:\Users\user\Anaconda3\lib\site-packages\tensorflow\py
thon\ops\math_ops.py:3066: to_int32 (from tensorflow.python.ops.math_ops) is de
precated and will be removed in a future version.
Instructions for updating:
Use tf.cast instead.

2019-12-03 01:21:35,269 : WARNING : From C:\Users\user\Anaconda3\lib\site-packa
ges\tensorflow\python\ops\math_ops.py:3066: to_int32 (from tensorflow.python.op
s.math_ops) is deprecated and will be removed in a future version.
Instructions for updating:
Use tf.cast instead.

Train on 20167 samples, validate on 2241 samples
Epoch 1/11
20167/20167 [==============================] - 295s 15ms/step - loss: 0.5962 -
acc: 0.6705 - val_loss: 0.5576 - val_acc: 0.7015
Epoch 2/11
20167/20167 [==============================] - 291s 14ms/step - loss: 0.5687 -
acc: 0.6953 - val_loss: 0.5462 - val_acc: 0.7162
Epoch 3/11
20167/20167 [==============================] - 282s 14ms/step - loss: 0.5585 -
acc: 0.7046 - val_loss: 0.5442 - val_acc: 0.7104
Epoch 4/11
20167/20167 [==============================] - 267s 13ms/step - loss: 0.5493 -
acc: 0.7079 - val_loss: 0.5342 - val_acc: 0.7287
Epoch 5/11
20167/20167 [==============================] - 267s 13ms/step - loss: 0.5507 -
acc: 0.7098 - val_loss: 0.5383 - val_acc: 0.7193
Epoch 6/11
20167/20167 [==============================] - 278s 14ms/step - loss: 0.5385 -
acc: 0.7175 - val_loss: 0.5355 - val_acc: 0.7305
Epoch 7/11
20167/20167 [==============================] - 278s 14ms/step - loss: 0.5304 -
acc: 0.7246 - val_loss: 0.5418 - val_acc: 0.7131
Epoch 8/11
20167/20167 [==============================] - 294s 15ms/step - loss: 0.5246 -
acc: 0.7305 - val_loss: 0.5349 - val_acc: 0.7282
Epoch 9/11
20167/20167 [==============================] - 294s 15ms/step - loss: 0.5184 -
acc: 0.7320 - val_loss: 0.5340 - val_acc: 0.7247
Epoch 10/11
20167/20167 [==============================] - 286s 14ms/step - loss: 0.5132 -
acc: 0.7363 - val_loss: 0.5346 - val_acc: 0.7265
Epoch 11/11
20167/20167 [==============================] - 287s 14ms/step - loss: 0.5088 -
acc: 0.7371 - val_loss: 0.5350 - val_acc: 0.7238
Wall time: 52min 2s
```

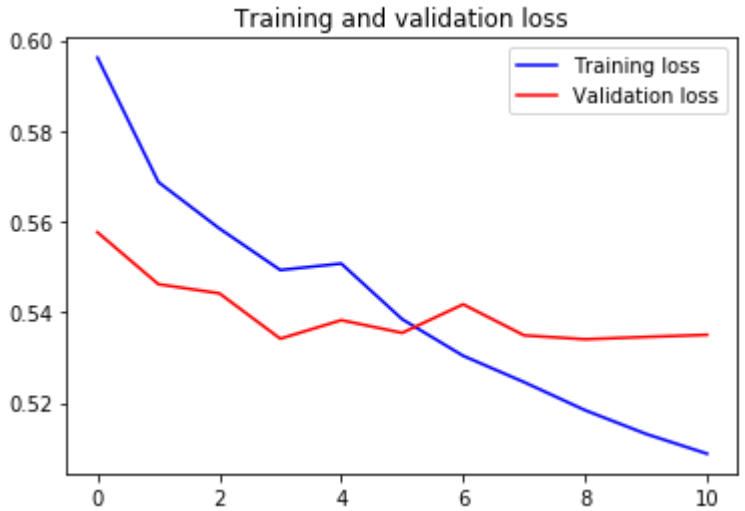
In [28]:

```
%%time
score = model.evaluate(x_test, y_test, batch_size=BATCH_SIZE)
print()
print("ACCURACY:",score[1])
print("LOSS:",score[0])
```

```
5602/5602 [==============================] - 17s 3ms/step

ACCURACY: 0.7209924997835659
LOSS: 0.5405287037961656
Wall time: 17.2 s
```

In [29]:
```
acc = history.history['acc']
val_acc = history.history['val_acc']
loss = history.history['loss']
val_loss = history.history['val_loss']

epochs = range(len(acc))

plt.plot(epochs, acc, 'b', label='Training acc')
plt.plot(epochs, val_acc, 'r', label='Validation acc')
plt.title('Training and validation accuracy')
plt.legend()

plt.figure()

plt.plot(epochs, loss, 'b', label='Training loss')
plt.plot(epochs, val_loss, 'r', label='Validation loss')
plt.title('Training and validation loss')
plt.legend()

plt.show()
```





In [48]:
```
def decode_sentiment(score):
    return NEGATIVE if score < 0.5 else POSITIVE
```

In [49]:
```
def predict(text):
    start_at = time.time()
    # Tokenize text
    x_test = pad_sequences(tokenizer.texts_to_sequences([text]), maxlen=SEQUENCE_
    # Predict
    score = model.predict([x_test])[0]
    # Decode sentiment
    label = decode_sentiment(score)

    return {"label": label, "score": float(score),
       "elapsed_time": time.time()-start_at}
```

In [50]:
```
predict("I love the music")
```

Out[50]:
```
{'label': 'POSITIVE',
 'score': 0.9497664570808411,
 'elapsed_time': 0.04703187942504883}
```

In [51]:
```
predict("oh shit")
```

Out[51]:
```
{'label': 'NEGATIVE',
 'score': 0.20520807802677155,
 'elapsed_time': 0.041028499603271484}
```

In [55]:

In [ ]: