Transfer_Learning_binary_classification

May 14, 2019

1 Getting Started

This section sets up the environment for access to the Universal Sentence Encoder on TF Hub and provides examples of applying the encoder to words, sentences, and paragraphs. Tutorial followed: https://www.dlology.com/blog/keras-meets-universal-sentence-encoder-transfer-learning-for-text-data/

In [1]:
```
# Install the latest Tensorflow version.
!pip3 install --quiet "tensorflow>=1.7"
# Install TF-Hub.
!pip3 install --quiet tensorflow-hub
!pip3 install seaborn
```

```
Requirement already satisfied: seaborn in /usr/local/lib/python3.6/dist-packages (0.9.0)
Requirement already satisfied: matplotlib>=1.4.3 in /usr/local/lib/python3.6/dist-packages (fr
Requirement already satisfied: scipy>=0.14.0 in /usr/local/lib/python3.6/dist-packages (from s
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Requirement already satisfied: pandas>=0.15.2 in /usr/local/lib/python3.6/dist-packages (from s
Requirement already satisfied: pyparsing!=2.0.4,!=2.1.2,!=2.1.6,>=2.0.1 in /usr/local/lib/pyth
Requirement already satisfied: cycler>=0.10 in /usr/local/lib/python3.6/dist-packages (from mat
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Requirement already satisfied: six in /usr/local/lib/python3.6/dist-packages (from cycler>=0.10
Requirement already satisfied: setuptools in /usr/local/lib/python3.6/dist-packages (from kiwis
```

More detailed information about installing Tensorflow can be found at https://www.tensorflow.org/install/.

In [2]:
```
import tensorflow as tf
import tensorflow_hub as hub
import matplotlib.pyplot as plt
import numpy as np
import os
import pandas as pd
import re
```

```
        import seaborn as sns
        import keras.layers as layers
        from keras.models import Model
        from keras import backend as K
        np.random.seed(10)
```

```
WARNING: Logging before flag parsing goes to stderr.
W0513 09:12:56.696139 140177703028608 __init__.py:56] Some hub symbols are not available becaus
Using TensorFlow backend.
```

```
In [0]: module_url = "https://tfhub.dev/google/universal-sentence-encoder-large/3" #@param ["h
```

```
In [4]: # Import the Universal Sentence Encoder's TF Hub module
        embed = hub.Module(module_url)
```

```
WARNING:tensorflow:From /usr/local/lib/python3.6/dist-packages/tensorflow/python/ops/control_fl
Instructions for updating:
Colocations handled automatically by placer.
```

```
W0513 09:12:58.129595 140177703028608 deprecation.py:323] From /usr/local/lib/python3.6/dist-pa
Instructions for updating:
Colocations handled automatically by placer.
```

```
In [5]: embed_size = embed.get_output_info_dict()['default'].get_shape()[1].value
        embed_size
```

```
Out[5]: 512
```

```
In [6]: df=pd.read_csv("labeled_data.csv")

        df_train=df[['class', 'tweet']]
        # df.class = df.class.astype('category')
        df_train.loc[df_train['class'] == 2, 'class'] = 1
```

```
/usr/local/lib/python3.6/dist-packages/pandas/core/indexing.py:543: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/stable/indexing.html
  self.obj[item] = s
```

```
In [0]: df_train.columns = ["label","text"]
```

```
In [8]: df_train.head()
```

```
Out[8]:    label                                               text
        0      1  !!! RT @mayasolovely: As a woman you shouldn't...
        1      1  !!!!! RT @mleew17: boy dats cold...tyga dwn ba...
        2      1  !!!!!!! RT @UrKindOfBrand Dawg!!!! RT @80sbaby...
        3      1  !!!!!!!!! RT @C_G_Anderson: @viva_based she lo...
        4      1  !!!!!!!!!!!!! RT @ShenikaRoberts: The shit you...

In [9]: df_train.label = df_train.label.astype('category')

/usr/local/lib/python3.6/dist-packages/pandas/core/generic.py:5096: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/stable/indexing.html
  self[name] = value


In [10]: category_counts = len(df_train.label.cat.categories)
         category_counts

Out[10]: 2

In [0]: def UniversalEmbedding(x):
            return embed(tf.squeeze(tf.cast(x, tf.string)), signature="default", as_dict=True)

In [12]: input_text = layers.Input(shape=(1,), dtype=tf.string)
         embedding = layers.Lambda(UniversalEmbedding, output_shape=(embed_size,))(input_text)
         dense = layers.Dense(256, activation='relu')(embedding)
         pred = layers.Dense(category_counts, activation='softmax')(dense)
         model = Model(inputs=[input_text], outputs=pred)
         model.compile(loss='categorical_crossentropy', optimizer='adam', metrics=['accuracy'])
         model.summary()

INFO:tensorflow:Saver not created because there are no variables in the graph to restore


I0513 09:13:47.110457 140177703028608 saver.py:1483] Saver not created because there are no va


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Layer (type)                 Output Shape              Param #
=================================================================
input_1 (InputLayer)         (None, 1)                 0
_________________________________________________________________
lambda_1 (Lambda)            (None, 512)               0
_________________________________________________________________
dense_1 (Dense)              (None, 256)               131328
_________________________________________________________________
dense_2 (Dense)              (None, 2)                 514
```

```
=================================================================
Total params: 131,842
Trainable params: 131,842
Non-trainable params: 0
_________________________________________________________________
```

```
In [0]: hate=df_train[df_train.label==0]
        offensive=df_train[df_train.label==1]

In [0]: hate=hate.sample(frac=1)
        offensive=offensive=offensive.sample(frac=1)

In [0]: new_hate=hate[:min(len(hate), len(offensive))]
        new_off=offensive[:min(len(hate), len(offensive))]

In [0]: new_hate = new_hate.append(new_off)
        df_train=new_hate

In [0]: train_text = df_train['text'].tolist()
        train_text = np.array(train_text, dtype=object)[:, np.newaxis]

        train_label = np.asarray(pd.get_dummies(df_train.label), dtype = np.int8)

In [18]: train_text.shape

Out[18]: (2860, 1)

In [19]: train_label.shape

Out[19]: (2860, 2)
```

1.1 Train Keras model and save weights

This only train and save our Keras layers not the embed module' weights.

```
In [21]: with tf.Session() as session:
           K.set_session(session)
           session.run(tf.global_variables_initializer())
           session.run(tf.tables_initializer())
           history = model.fit(train_text,
                     train_label,
                     validation_split=0.2,
                     epochs=15,
                     batch_size=32)
           model.save_weights('./model.h5')
```

```
Train on 2288 samples, validate on 572 samples
Epoch 1/15
  96/2288 [>...] - ETA: 23s - loss: 0.6691 - acc: 0.6146
```

```
Exception ignored in: <bound method BaseSession._Callable.__del__ of <tensorflow.python.client
Traceback (most recent call last):
  File "/usr/local/lib/python3.6/dist-packages/tensorflow/python/client/session.py", line 1455
    self._session._session, self._handle, status)
  File "/usr/local/lib/python3.6/dist-packages/tensorflow/python/framework/errors_impl.py", lin
    c_api.TF_GetCode(self.status.status))
tensorflow.python.framework.errors_impl.CancelledError: Session has been closed.


2240/2288 [============================>.] - ETA: 0s - loss: 0.4946 - acc: 0.7433

Exception ignored in: <bound method BaseSession._Callable.__del__ of <tensorflow.python.client
Traceback (most recent call last):
  File "/usr/local/lib/python3.6/dist-packages/tensorflow/python/client/session.py", line 1455
    self._session._session, self._handle, status)
  File "/usr/local/lib/python3.6/dist-packages/tensorflow/python/framework/errors_impl.py", lin
    c_api.TF_GetCode(self.status.status))
tensorflow.python.framework.errors_impl.CancelledError: Session has been closed.


2288/2288 [==============================] - 4s 2ms/step - loss: 0.4926 - acc: 0.7448 - val_los
Epoch 2/15
2288/2288 [==============================] - 2s 1ms/step - loss: 0.4047 - acc: 0.8129 - val_los
Epoch 3/15
2288/2288 [==============================] - 2s 1ms/step - loss: 0.3891 - acc: 0.8239 - val_los
Epoch 4/15
2288/2288 [==============================] - 2s 929us/step - loss: 0.3751 - acc: 0.8330 - val_l
Epoch 5/15
2288/2288 [==============================] - 2s 926us/step - loss: 0.3623 - acc: 0.8405 - val_l
Epoch 6/15
2288/2288 [==============================] - 2s 920us/step - loss: 0.3506 - acc: 0.8523 - val_l
Epoch 7/15
2288/2288 [==============================] - 2s 945us/step - loss: 0.3364 - acc: 0.8549 - val_l
Epoch 8/15
2288/2288 [==============================] - 2s 925us/step - loss: 0.3234 - acc: 0.8636 - val_l
Epoch 9/15
2288/2288 [==============================] - 2s 925us/step - loss: 0.3048 - acc: 0.8820 - val_l
Epoch 10/15
2288/2288 [==============================] - 2s 921us/step - loss: 0.2925 - acc: 0.8802 - val_l
Epoch 11/15
2288/2288 [==============================] - 2s 923us/step - loss: 0.2746 - acc: 0.8929 - val_l
Epoch 12/15
2288/2288 [==============================] - 2s 924us/step - loss: 0.2572 - acc: 0.8973 - val_l
Epoch 13/15
2288/2288 [==============================] - 2s 932us/step - loss: 0.2420 - acc: 0.9047 - val_l
Epoch 14/15
2288/2288 [==============================] - 2s 935us/step - loss: 0.2240 - acc: 0.9148 - val_l
Epoch 15/15
```

```
2288/2288 [==============================] - 2s 923us/step - loss: 0.2111 - acc: 0.9248 - val_l
```

1.2 Make predictions

```
In [0]: # new_text = list(s.comments)
        # new_text = np.array(new_text, dtype=object)[:, np.newaxis]
        new_text=train_text
        with tf.Session() as session:
          K.set_session(session)
          session.run(tf.global_variables_initializer())
          session.run(tf.tables_initializer())
          model.load_weights('./model.h5')
          predicts = model.predict(new_text, batch_size=32)
```

```
In [23]: categories = df_train.label.cat.categories.tolist()
         predict_logits = predicts.argmax(axis=1)
         predict_labels = [categories[logit] for logit in predict_logits]
         predict_labels
```

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In [24]: df_train.label
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Out[24]: 10929    0
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         15654    0
         6487     0
         5362     0
         14198    0
         17757    0
         23325    0
         2704     0
         6348     0
         5513     0
         18038    0
         3006     0
         13413    0
         12254    0
         2521     0
         13722    0
         20266    0
         6454     0
         6683     0
         18676    0
         15269    0
         5580     0
         11681    0
         3902     0
         9066     0
         14591    0
         2472     0
         19351    0
         7029     0
                 ..
         6959     1
```

```
23262    1
4823     1
16316    1
8670     1
19907    1
19328    1
6795     1
17000    1
606      1
16066    1
23951    1
12734    1
16608    1
9583     1
23466    1
9601     1
17598    1
20461    1
14899    1
3030     1
11003    1
21150    1
14061    1
14112    1
8654     1
5911     1
5391     1
2787     1
14194    1
Name: label, Length: 2860, dtype: category
Categories (2, int64): [0, 1]
```

```
In [25]: tf.confusion_matrix(df_train.label, predict_labels)
```

```
WARNING:tensorflow:From /usr/local/lib/python3.6/dist-packages/tensorflow/python/ops/confusion_
Instructions for updating:
Use tf.cast instead.


W0513 09:16:08.399286 140177703028608 deprecation.py:323] From /usr/local/lib/python3.6/dist-pa
Instructions for updating:
Use tf.cast instead.
```

```
Out[25]: <tf.Tensor 'confusion_matrix/SparseTensorDenseAdd:0' shape=(2, 2) dtype=int32>
```

```
In [0]: from sklearn.metrics import classification_report
        report = classification_report(df_train.label, predict_labels)
```

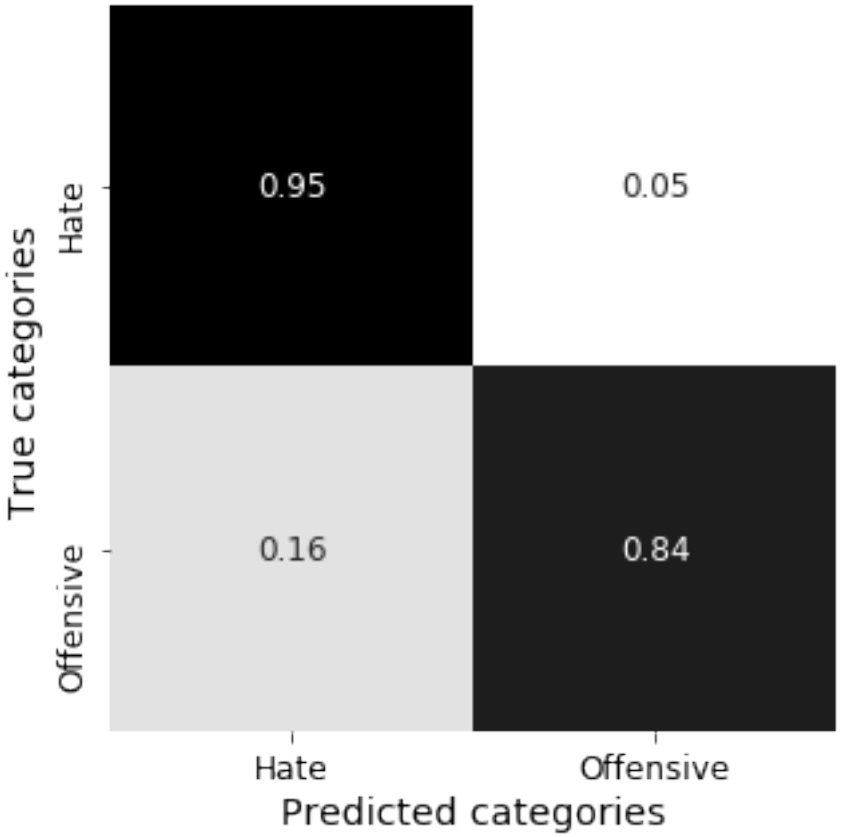
In [27]:
```
print(report)
```

```
              precision    recall  f1-score   support

           0       0.86      0.95      0.90      1430
           1       0.94      0.84      0.89      1430

   micro avg       0.89      0.89      0.89      2860
   macro avg       0.90      0.89      0.89      2860
weighted avg       0.90      0.89      0.89      2860
```

In [30]:
```
import seaborn
from sklearn.metrics import confusion_matrix
confusion_matrix = confusion_matrix(df_train.label, predict_labels)
matrix_proportions = np.zeros((2,2))
for i in range(0,2):
    matrix_proportions[i,:] = confusion_matrix[i,:]/float(confusion_matrix[i,:].sum())
names=['Hate','Offensive']
confusion_df = pd.DataFrame(matrix_proportions, index=names,columns=names)
plt.figure(figsize=(5,5))
seaborn.heatmap(confusion_df,annot=True,annot_kws={"size": 12},cmap='gist_gray_r',cba
plt.ylabel(r'True categories',fontsize=14)
plt.xlabel(r'Predicted categories',fontsize=14)
plt.tick_params(labelsize=12)
```


0.95
0.05
0.16
0.84
Hate
Offensive
True categories
Hate
Offensive
Predicted categories