Transfer_Learning_multiclass

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: numpy>=1.9.3 in /usr/local/lib/python3.6/dist-packages (from sea
Requirement already satisfied: pandas>=0.15.2 in /usr/local/lib/python3.6/dist-packages (from s
Requirement already satisfied: matplotlib>=1.4.3 in /usr/local/lib/python3.6/dist-packages (fro
Requirement already satisfied: scipy>=0.14.0 in /usr/local/lib/python3.6/dist-packages (from se
Requirement already satisfied: python-dateutil>=2.5.0 in /usr/local/lib/python3.6/dist-packages
Requirement already satisfied: pytz>=2011k in /usr/local/lib/python3.6/dist-packages (from panc
Requirement already satisfied: cycler>=0.10 in /usr/local/lib/python3.6/dist-packages (from mat
Requirement already satisfied: kiwisolver>=1.0.1 in /usr/local/lib/python3.6/dist-packages (fro
Requirement already satisfied: pyparsing!=2.0.4,!=2.1.2,!=2.1.6,>=2.0.1 in /usr/local/lib/pytho
Requirement already satisfied: six>=1.5 in /usr/local/lib/python3.6/dist-packages (from python-
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 08:26:49.199342 139779932305280 __init__.py:56] Some hub symbols are not available becau
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 08:27:13.354345 139779932305280 deprecation.py:323] From /usr/local/lib/python3.6/dist-pa
Instructions for updating:
Colocations handled automatically by placer.
```

```
In [12]: embed_size = embed.get_output_info_dict()['default'].get_shape()[1].value
         embed_size

Out[12]: 512
```

```
In [0]: df=pd.read_csv("labeled_data.csv")

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

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

```
In [7]: df_train.head()

Out[7]:    label                                               text
        0      2  !!! 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 [8]: 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 [9]: category_counts = len(df_train.label.cat.categories)
        category_counts
```

```
Out[9]: 3
```

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

```
In [28]: 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 08:42:20.056455 139779932305280 saver.py:1483] Saver not created because there are no va


_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
input_4 (InputLayer)         (None, 1)                 0
_________________________________________________________________
lambda_3 (Lambda)            (None, 512)               0
_________________________________________________________________
dense_5 (Dense)              (None, 256)               131328
_________________________________________________________________
dense_6 (Dense)              (None, 3)                 771
=================================================================
Total params: 132,099
Trainable params: 132,099
Non-trainable params: 0
_________________________________________________________________
```

```
In [0]: hate=df_train[df_train.label==0]
        offensive=df_train[df_train.label==1]
        neutral=df_train[df_train.label==2]
```

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

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

```
In [0]: new_hate = new_hate.append(new_off)
        new_hate=new_hate.append(new_neutral)
        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 [21]: train_text.shape
```

```
Out[21]: (4290, 1)
```

```
In [23]: train_label.shape
```

```
Out[23]: (4290, 3)
```

1.1 Train Keras model and save weights

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

```
In [29]: 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 3432 samples, validate on 858 samples
Epoch 1/15
3432/3432 [==============================] - 8s 2ms/step - loss: 0.6982 - acc: 0.7165 - val_los
Epoch 2/15
3432/3432 [==============================] - 4s 1ms/step - loss: 0.5297 - acc: 0.7788 - val_los
Epoch 3/15
3432/3432 [==============================] - 4s 1ms/step - loss: 0.5018 - acc: 0.7952 - val_los
Epoch 4/15
3432/3432 [==============================] - 3s 957us/step - loss: 0.4871 - acc: 0.7966 - val_l
```

```
Epoch 5/15
3432/3432 [==============================] - 3s 927us/step - loss: 0.4701 - acc: 0.8086 - val_
Epoch 6/15
3432/3432 [==============================] - 3s 936us/step - loss: 0.4565 - acc: 0.8167 - val_
Epoch 7/15
3432/3432 [==============================] - 3s 934us/step - loss: 0.4396 - acc: 0.8223 - val_
Epoch 8/15
3432/3432 [==============================] - 3s 940us/step - loss: 0.4292 - acc: 0.8234 - val_
Epoch 9/15
3432/3432 [==============================] - 3s 949us/step - loss: 0.4122 - acc: 0.8342 - val_
Epoch 10/15
3432/3432 [==============================] - 3s 938us/step - loss: 0.3945 - acc: 0.8360 - val_
Epoch 11/15
3432/3432 [==============================] - 3s 988us/step - loss: 0.3769 - acc: 0.8470 - val_
Epoch 12/15
3432/3432 [==============================] - 4s 1ms/step - loss: 0.3703 - acc: 0.8473 - val_lo
Epoch 13/15
3432/3432 [==============================] - 4s 1ms/step - loss: 0.3438 - acc: 0.8663 - val_lo
Epoch 14/15
3432/3432 [==============================] - 3s 965us/step - loss: 0.3295 - acc: 0.8677 - val_
Epoch 15/15
3432/3432 [==============================] - 3s 940us/step - loss: 0.3116 - acc: 0.8811 - val_
```

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

```
In [40]: df_train.label
```

```
Out[40]: 10929    0
         731      0
         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
        ..
15195    2
6077     2
18846    2
8386     2
23101    2
19830    2
19010    2
22227    2
2457     2
9870     2
15791    2
16422    2
4970     2
16389    2
5921     2
9893     2
24114    2
15379    2
22896    2
12067    2
21696    2
12071    2
10118    2
```

```
16821    2
2719     2
17122    2
8912     2
20968    2
20458    2
19426    2
Name: label, Length: 4290, dtype: category
Categories (3, int64): [0, 1, 2]
```

```
In [41]: 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 08:52:16.111874 139779932305280 deprecation.py:323] From /usr/local/lib/python3.6/dist-pa
Instructions for updating:
Use tf.cast instead.
```

```
Out[41]: <tf.Tensor 'confusion_matrix_1/SparseTensorDenseAdd:0' shape=(3, 3) dtype=int32>
```

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

```
In [43]: print(report)
```

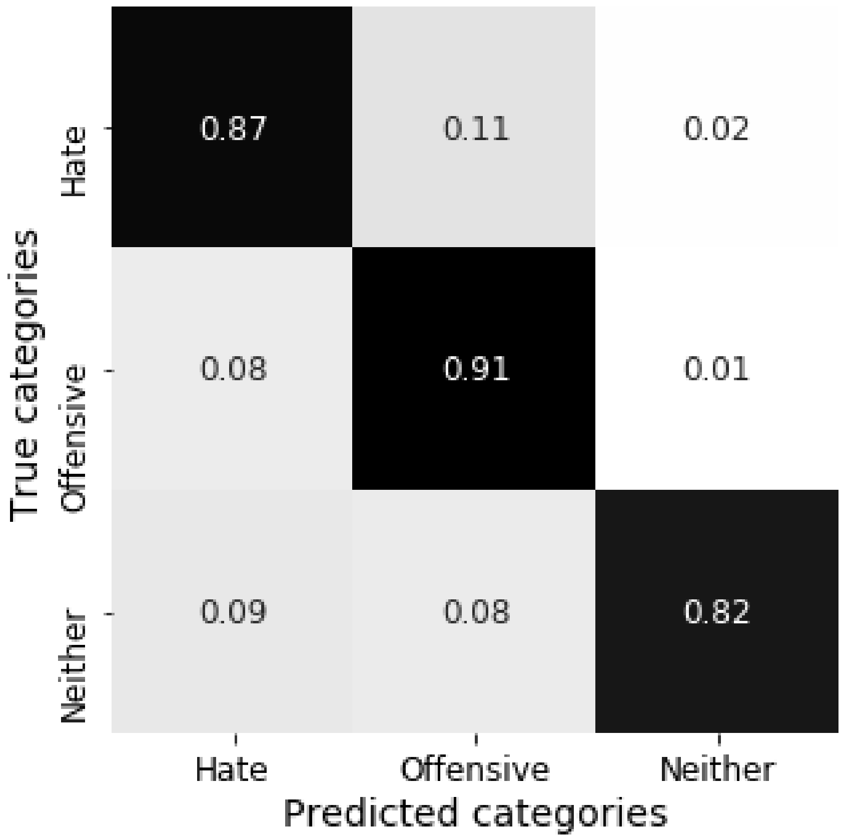
```
              precision    recall  f1-score   support

           0       0.83      0.87      0.85      1430
           1       0.83      0.91      0.86      1430
           2       0.97      0.82      0.89      1430

   micro avg       0.87      0.87      0.87      4290
   macro avg       0.87      0.87      0.87      4290
weighted avg       0.87      0.87      0.87      4290
```

```
In [45]: import seaborn
         from sklearn.metrics import confusion_matrix
         confusion_matrix = confusion_matrix(df_train.label, predict_labels)
         matrix_proportions = np.zeros((3,3))
         for i in range(0,3):
             matrix_proportions[i,:] = confusion_matrix[i,:]/float(confusion_matrix[i,:].sum()
         names=['Hate','Offensive','Neither']
         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)
```


True categories
Hate
Offensive
Neither
Hate
Offensive
Neither
Predicted categories