Diaster-Tweets

April 20, 2024

[ ]:
```python
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
```

```
/usr/lib/python3/dist-packages/scipy/__init__.py:146: UserWarning: A NumPy
version >=1.17.3 and <1.25.0 is required for this version of SciPy (detected
version 1.26.3
  warnings.warn(f"A NumPy version >={np_minversion} and <{np_maxversion}"
```

0.0.1 EDA

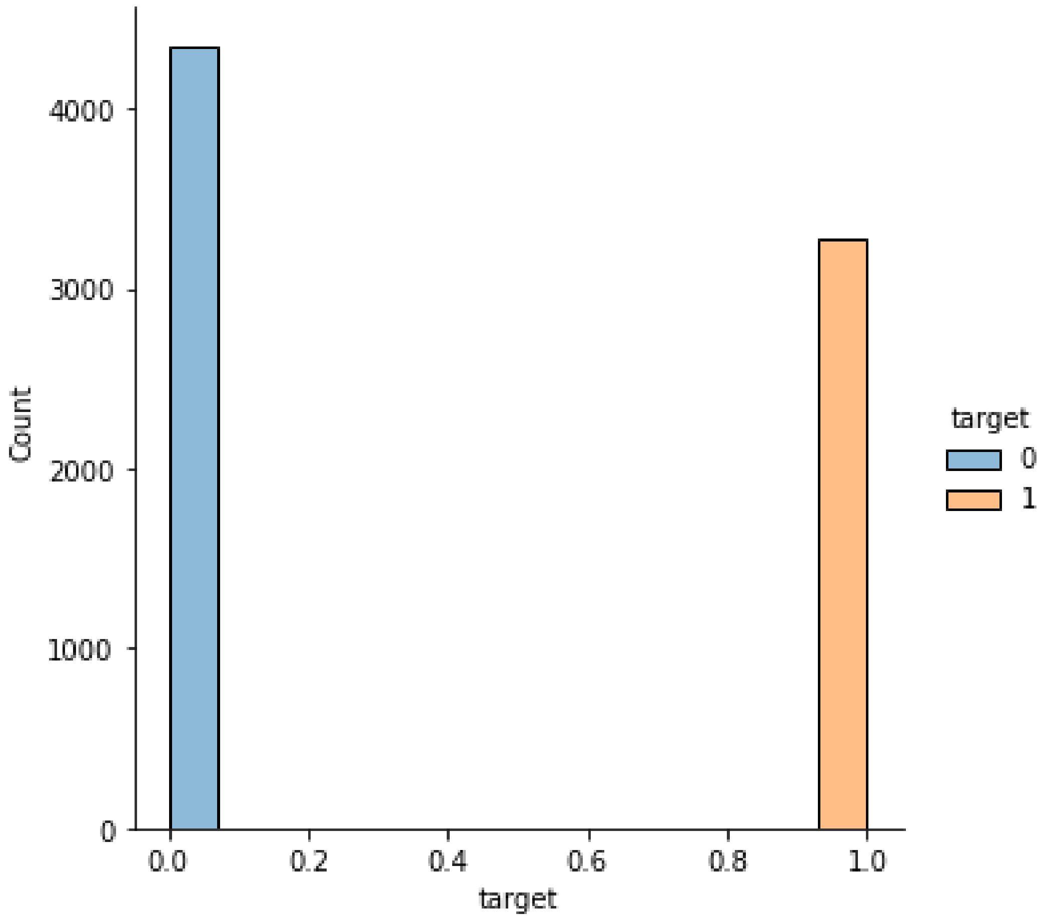
[ ]:
```python
df_train = pd.read_csv("data/train.csv",index_col='id')
df_test = pd.read_csv("data/test.csv",index_col='id')
```

[ ]:
```python
df_train.head()
```

[ ]:
```
   keyword location                                               text  target
id
1      NaN      NaN  Our Deeds are the Reason of this #earthquake M…       1
4      NaN      NaN             Forest fire near La Ronge Sask. Canada       1
5      NaN      NaN  All residents asked to 'shelter in place' are …       1
6      NaN      NaN  13,000 people receive #wildfires evacuation or…       1
7      NaN      NaN  Just got sent this photo from Ruby #Alaska as …       1
```

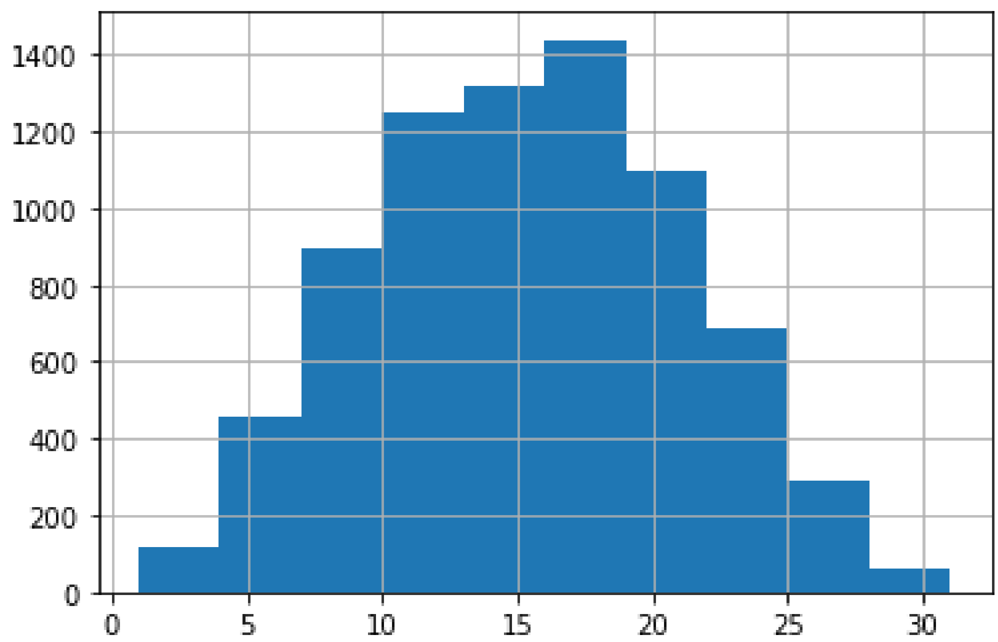
[ ]:
```python
sns.displot(data=df_train, x='target', hue='target')
```

[ ]:
```
<seaborn.axisgrid.FacetGrid at 0x7f8865821ba0>
```



[ ]:
```
df_train['length'] =  df_train['text'].apply(lambda x: len(x.split())).values
df_train['length'].hist()
```

[ ]: <AxesSubplot:>



0.0.2 Data Cleaning

[ ]:
```
import string, re
import nltk
nltk.download('punkt')
nltk.download('stopwords')
from nltk.tokenize import word_tokenize
from nltk.corpus import stopwords
```

```
[nltk_data] Downloading package punkt to /home/tkindvall/nltk_data…
[nltk_data]   Package punkt is already up-to-date!
[nltk_data] Downloading package stopwords to
[nltk_data]     /home/tkindvall/nltk_data…
[nltk_data]   Package stopwords is already up-to-date!
```

[ ]:
```
def clean_text(t):
    t  = "".join([char for char in t if char not in string.punctuation])
    t = re.sub('[0-9]+', '', t)

    t = t.lower() # lowercase

    t = t.replace(r"\#","",True) # replaces hashtags
    t = t.replace(r"http\S+","URL", True )  # remove URL addresses
    t = t.replace(r"@","",  True )
    t = t.replace("\s{2,}", " ", True ) # remove multiple contiguous spaces
```

```
    return t
```

```
[ ]: df_train['text'] = df_train['text'].apply(lambda t: clean_text(t))
df_test['text'] = df_test['text'].apply(lambda t: clean_text(t))

#df_train_clean.head()
```

0.0.3 Model Architecture

LTSM and Gated Recurrent Unit In this lesson we will use LTSM and Gradient Recurrent Units to train models. Both LTSM and GRU are types of RRN's. We will start by downloading and using some pre made embedings then train models on top of the embedings. These embeddings have had a hight amount of training behind them already, training on a scale that I couldn't acheive on my own. So this gives us a headstart for training our models.

```
[ ]: import tensorflow as tf
import tensorflow_hub as hub
import tensorflow_text
from tensorflow.keras.preprocessing import text, sequence
from tensorflow.keras.layers import Dropout
from tensorflow.keras.metrics import Recall
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import LSTM, GRU, Bidirectional, Dense, Embedding,␣
↪Dropout
from tensorflow.keras.layers import TextVectorization
from keras.callbacks import EarlyStopping, ReduceLROnPlateau

from sklearn.model_selection import train_test_split
from sklearn.utils.class_weight import compute_class_weight
```

```
2024-03-08 17:27:21.827539: I external/local_tsl/tsl/cuda/cudart_stub.cc:31]
Could not find cuda drivers on your machine, GPU will not be used.
2024-03-08 17:27:22.307256: E
external/local_xla/xla/stream_executor/cuda/cuda_dnn.cc:9261] Unable to register
cuDNN factory: Attempting to register factory for plugin cuDNN when one has
already been registered
2024-03-08 17:27:22.307408: E
external/local_xla/xla/stream_executor/cuda/cuda_fft.cc:607] Unable to register
cuFFT factory: Attempting to register factory for plugin cuFFT when one has
already been registered
2024-03-08 17:27:22.372958: E
external/local_xla/xla/stream_executor/cuda/cuda_blas.cc:1515] Unable to
register cuBLAS factory: Attempting to register factory for plugin cuBLAS when
one has already been registered
2024-03-08 17:27:22.541057: I external/local_tsl/tsl/cuda/cudart_stub.cc:31]
Could not find cuda drivers on your machine, GPU will not be used.
2024-03-08 17:27:22.549496: I tensorflow/core/platform/cpu_feature_guard.cc:182]
```

```
This TensorFlow binary is optimized to use available CPU instructions in
performance-critical operations.
To enable the following instructions: AVX2 FMA, in other operations, rebuild
TensorFlow with the appropriate compiler flags.
2024-03-08 17:27:24.826278: W
tensorflow/compiler/tf2tensorrt/utils/py_utils.cc:38] TF-TRT Warning: Could not
find TensorRT
```

[ ]:
```
xtrain, xtest, ytrain, ytest = train_test_split(
    df_train['text'].values,
    df_train['target'].values,
    shuffle=True,
    test_size=0.2)
```

[ ]:
```
max_text_len = max(df_train['text'].apply(lambda x: len(x.split())).values) #␣
 ↪we know this from the EDA
max_words = 50000
tokenizer = text.Tokenizer(num_words = max_words)

tokenizer.fit_on_texts(xtrain) #fit tokens on training data

xtrain_seq = tokenizer.texts_to_sequences(xtrain)
xtest_seq = tokenizer.texts_to_sequences(xtest)
```

[ ]:
```
xtrain_pad = sequence.pad_sequences(xtrain_seq, maxlen=max_text_len)
xtest_pad = sequence.pad_sequences(xtest_seq, maxlen=max_text_len)
word_index = tokenizer.word_index

print('text example:', xtrain[0])
print('sequence of indices(before padding):', xtrain_seq[0])
print('sequence of indices(after padding):', xtrain_pad[0])
```

```
text example: the hobbit the desolation of smaug  ed sheeran i see fire hd
httptcooxrwrjzmnu
sequence of indices(before padding): [1, 1415, 1, 487, 5, 1217, 2902, 3761, 7,
114, 40, 2347, 5707]
sequence of indices(after padding): [   0    0    0    0    0    0    0    0
0    0    0    0    0    0
    0    0    0    0    1 1415    1  487    5 1217 2902 3761    7  114
   40 2347 5707]
```

[ ]:
```
#Run on first time only

#https://nlp.stanford.edu/projects/glove/
#!wget https://nlp.stanford.edu/data/glove.6B.zip
#!unzip g*zip
```

```
[ ]: %%time
embedding_vectors = {}
with open('glove.6B.300d.txt','r',encoding='utf-8') as file: #glove.42B.300d.txt
    for row in file:
        values = row.split(' ')
        word = values[0]
        weights = np.asarray([float(val) for val in values[1:]])
        embedding_vectors[word] = weights
print(f"Size of vocabulary in GloVe: {len(embedding_vectors)}")
```

```
Size of vocabulary in GloVe: 400000
CPU times: user 19.9 s, sys: 6.31 s, total: 26.2 s
Wall time: 26.2 s
```

```
[ ]: emb_dim = 300
vocab_len = max_words if max_words is not None else len(word_index)+1
embedding_matrix = np.zeros((vocab_len, emb_dim))
oov_count = 0
oov_words = []
for word, idx in word_index.items():
    if idx < vocab_len:
        embedding_vector = embedding_vectors.get(word)
        if embedding_vector is not None:
            embedding_matrix[idx] = embedding_vector
        else:
            oov_count += 1
            oov_words.append(word)
#print some of the out of vocabulary words
print(f'Some out of valubulary words: {oov_words[0:5]}')
print(f'{oov_count} out of {vocab_len} words were OOV.')
```

```
Some out of valubulary words: ['\x89û', '\x89ûò', 're\x89û', 'yearold',
'typhoondevastated']
8059 out of 50000 words were OOV.
```

```
[ ]: earlystopper = EarlyStopping(monitor='val_loss', patience=2, verbose=1,␣
 ↪restore_best_weights=True)
reducel = ReduceLROnPlateau(monitor='val_loss', patience=1, verbose=1, factor=0.
 ↪1)


callbacks_list = [reducel, earlystopper]
```

```
[ ]: def plot_model_acc(model_history):
    acc = model_history.history['accuracy']
    val_acc = model_history.history['val_accuracy']
    loss = model_history.history['loss']
```

```
    val_loss = model_history.history['val_loss']

    epochs = range(1, len(acc) + 1)

    plt.plot(epochs, acc, 'bo', label='Training Accuracy')
    plt.plot(epochs, val_acc, 'b', label='Validation Accuracy')
    plt.title('Training and Validation Accuracy')
    plt.legend()
    plt.figure()

    plt.plot(epochs, loss, 'bo', label='Training loss')
    plt.plot(epochs, val_loss, 'b', label='Validation loss')
    plt.title('Training and Validation loss')
    plt.legend()
    plt.figure()
```

After seting up some general model stuructre above I create and train an LSTM model.

[ ]:
```
model_lstm = Sequential(name='model_lstm')
model_lstm.add(Embedding(vocab_len, emb_dim, trainable = False,␣
 ↪weights=[embedding_matrix]))
#model_lstm.add(Embedding(vocab_len, emb_dim, trainable = True))
model_lstm.add(LSTM(64, activation='tanh', return_sequences=False))
model_lstm.add(Dense(128, activation='relu'))
model_lstm.add(tf.keras.layers.BatchNormalization())
model_lstm.add(Dropout(0.2)) # Adding Dropout layer with rate of 0.2
model_lstm.add(Dense(256, activation='relu'))
model_lstm.add(Dense(128, activation='relu'))
model_lstm.add(Dense(64, activation='relu'))
model_lstm.add(Dense(1, activation='sigmoid'))
model_lstm.compile(loss='binary_crossentropy', optimizer='adam',␣
 ↪metrics=['accuracy',tf.keras.metrics.Recall(), tf.keras.metrics.AUC()])
model_lstm.summary()
```

```
2024-03-08 17:28:53.217237: W
external/local_tsl/tsl/framework/cpu_allocator_impl.cc:83] Allocation of
60000000 exceeds 10% of free system memory.
2024-03-08 17:28:53.263367: W
external/local_tsl/tsl/framework/cpu_allocator_impl.cc:83] Allocation of
60000000 exceeds 10% of free system memory.
2024-03-08 17:28:53.314626: W
external/local_tsl/tsl/framework/cpu_allocator_impl.cc:83] Allocation of
60000000 exceeds 10% of free system memory.
2024-03-08 17:28:53.659213: W
external/local_tsl/tsl/framework/cpu_allocator_impl.cc:83] Allocation of
60000000 exceeds 10% of free system memory.
```

```
Model: "model_lstm"
```

```
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 embedding (Embedding)       (None, None, 300)         15000000

 lstm (LSTM)                 (None, 64)                93440

 dense (Dense)               (None, 128)               8320

 batch_normalization (Batch  (None, 128)               512
 Normalization)

 dropout (Dropout)           (None, 128)               0

 dense_1 (Dense)             (None, 256)               33024

 dense_2 (Dense)             (None, 128)               32896

 dense_3 (Dense)             (None, 64)                8256

 dense_4 (Dense)             (None, 1)                 65

=================================================================
Total params: 15176513 (57.89 MB)
Trainable params: 176257 (688.50 KB)
Non-trainable params: 15000256 (57.22 MB)
_________________________________________________________________
```

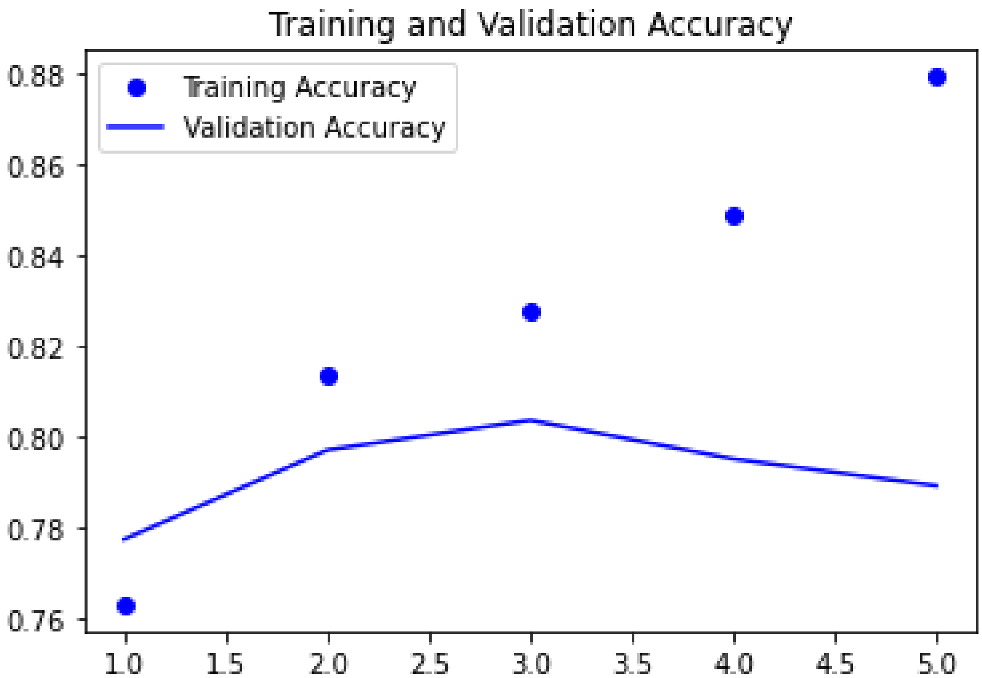
[ ]:
```
%%time
batch_size = 32
epochs  = 20
history_lstm = model_lstm.fit(xtrain_pad,
    np.asarray(ytrain),
    validation_data=(xtest_pad, np.asarray(ytest)),
    batch_size = batch_size,
    epochs = epochs,
    callbacks = callbacks_list)
```

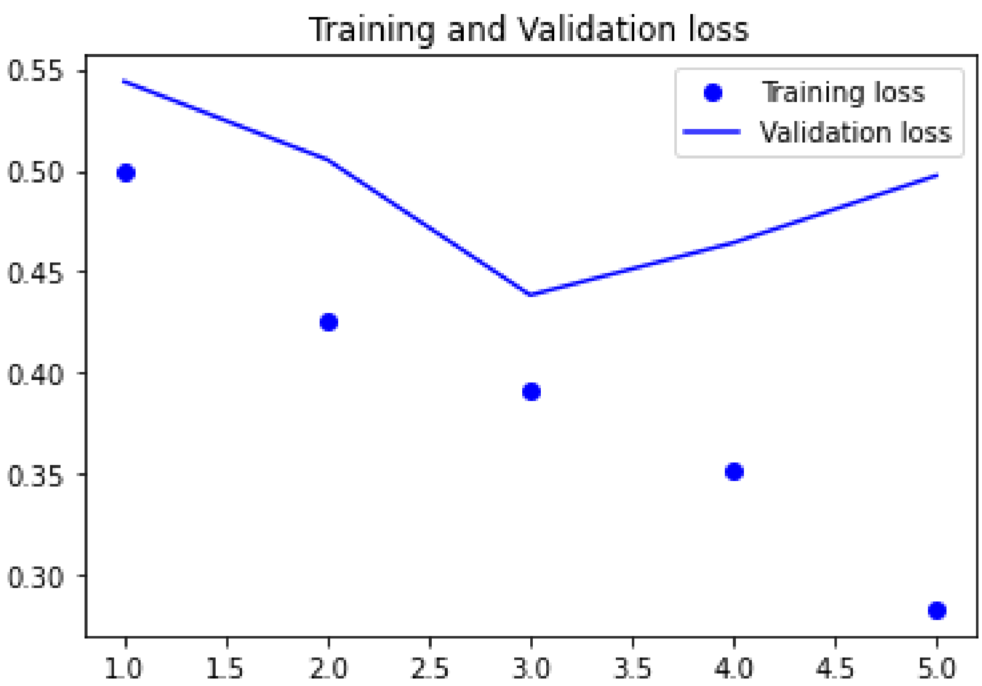
```
Epoch 1/20
190/191 [============================>.] - ETA: 0s - loss: 0.5000 - accuracy:
0.7630 - recall: 0.6338 - auc: 0.8229

2024-03-08 17:29:03.341443: W
external/local_tsl/tsl/framework/cpu_allocator_impl.cc:83] Allocation of
60000000 exceeds 10% of free system memory.

191/191 [==============================] - 9s 33ms/step - loss: 0.4998 -
accuracy: 0.7631 - recall: 0.6343 - auc: 0.8232 - val_loss: 0.5439 -
val_accuracy: 0.7774 - val_recall: 0.8441 - val_auc: 0.8747 - lr: 0.0010
```

```
Epoch 2/20
191/191 [==============================] - 6s 29ms/step - loss: 0.4247 -
accuracy: 0.8138 - recall: 0.7018 - auc: 0.8739 - val_loss: 0.5053 -
val_accuracy: 0.7971 - val_recall: 0.5764 - val_auc: 0.8629 - lr: 0.0010
Epoch 3/20
191/191 [==============================] - 5s 27ms/step - loss: 0.3908 -
accuracy: 0.8281 - recall: 0.7238 - auc: 0.8955 - val_loss: 0.4382 -
val_accuracy: 0.8037 - val_recall: 0.6252 - val_auc: 0.8700 - lr: 0.0010
Epoch 4/20
191/191 [==============================] - ETA: 0s - loss: 0.3517 - accuracy:
0.8491 - recall: 0.7568 - auc: 0.9143
Epoch 4: ReduceLROnPlateau reducing learning rate to 0.00010000000474974513.
191/191 [==============================] - 5s 25ms/step - loss: 0.3517 -
accuracy: 0.8491 - recall: 0.7568 - auc: 0.9143 - val_loss: 0.4641 -
val_accuracy: 0.7951 - val_recall: 0.7118 - val_auc: 0.8495 - lr: 0.0010
Epoch 5/20
189/191 [============================>.] - ETA: 0s - loss: 0.2832 - accuracy:
0.8795 - recall: 0.7951 - auc: 0.9474
Epoch 5: ReduceLROnPlateau reducing learning rate to 1.0000000474974514e-05.
Restoring model weights from the end of the best epoch: 3.
191/191 [==============================] - 5s 26ms/step - loss: 0.2829 -
accuracy: 0.8795 - recall: 0.7951 - auc: 0.9475 - val_loss: 0.4974 -
val_accuracy: 0.7892 - val_recall: 0.7339 - val_auc: 0.8490 - lr: 1.0000e-04
Epoch 5: early stopping
CPU times: user 1min 22s, sys: 32 s, total: 1min 54s
Wall time: 29.9 s
```

[ ]:

```
plot_model_acc(history_lstm)
```






```
&lt;Figure size 432x288 with 0 Axes&gt;
```

Here we see that the preformance of the LTSM is not great. I played arround with many differnet setting and optimisers but this was the best performance I was able to acheive with the LSTM.

I am now going to use the slightly different archtechure of GRU's to hopefully have better preformance.

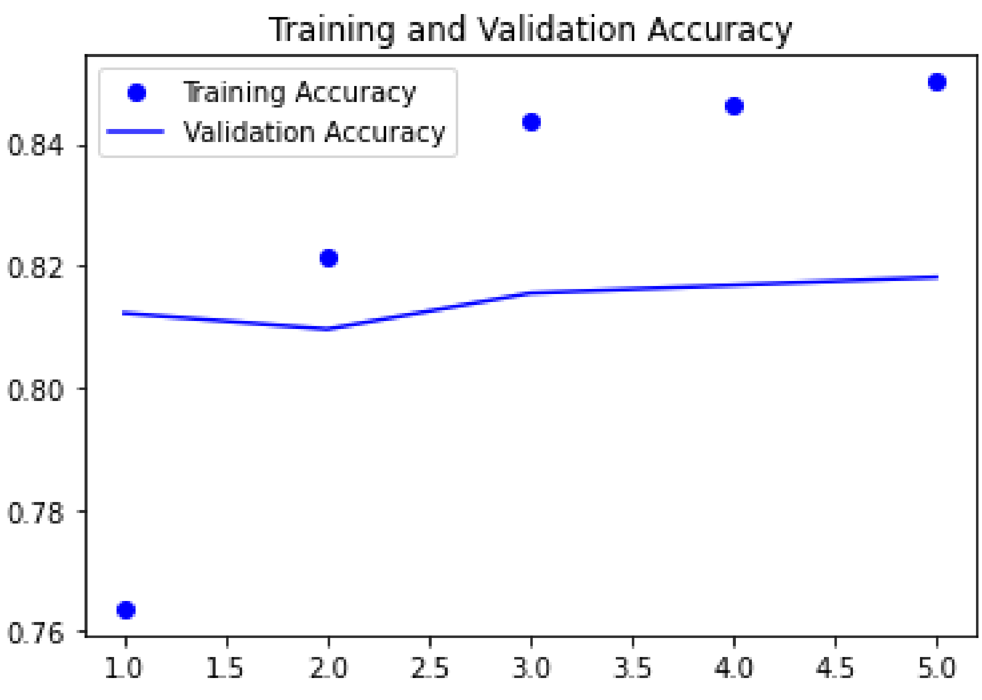
[ ]:
```
emb_dim = embedding_matrix.shape[1]
model_gru = Sequential(name='model_gru')
model_gru.add(Embedding(vocab_len, emb_dim, trainable = False,
 ↪weights=[embedding_matrix]))
model_gru.add(GRU(128, return_sequences=False))
model_gru.add(Dropout(0.5))
model_gru.add(Dense(1, activation = 'sigmoid'))
model_gru.compile(loss='binary_crossentropy', optimizer='adam',
 ↪metrics=['accuracy'])
model_gru.summary()
```

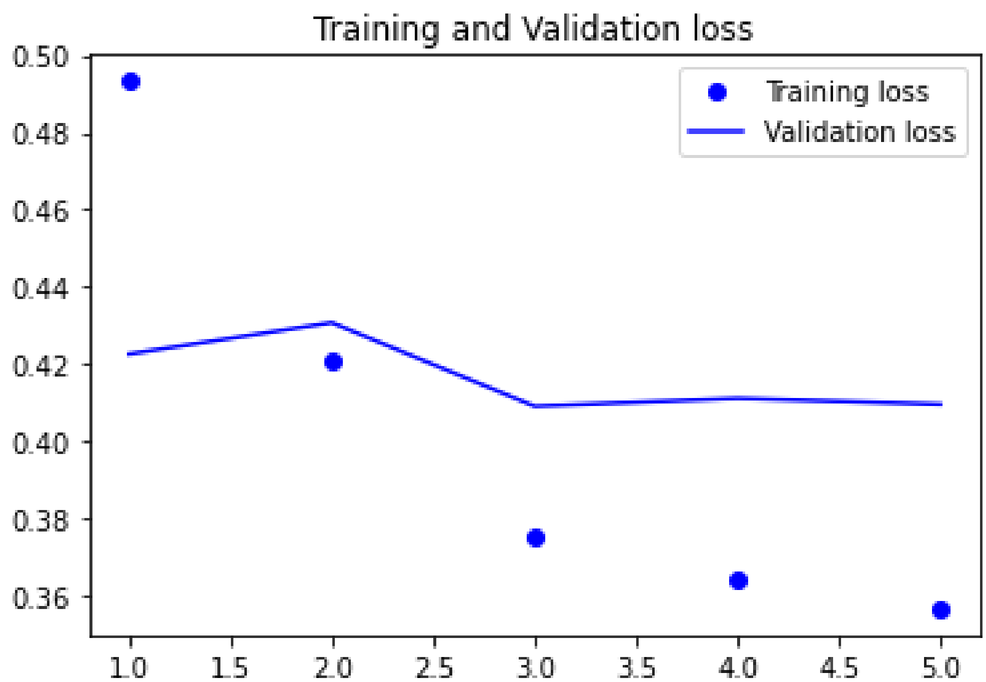
```
Model: "model_gru"

_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 embedding_1 (Embedding)     (None, None, 300)         15000000

 gru (GRU)                   (None, 128)               165120

 dropout_1 (Dropout)         (None, 128)               0

 dense_5 (Dense)             (None, 1)                 129

=================================================================
Total params: 15165249 (57.85 MB)
Trainable params: 165249 (645.50 KB)
Non-trainable params: 15000000 (57.22 MB)
_________________________________________________________________
```

[ ]:
```
batch_size = 32
epochs  = 20
history_gru = model_gru.fit(xtrain_pad,
                         np.asarray(ytrain),
                         validation_data=(xtest_pad, np.asarray(ytest)),
                         batch_size = batch_size,
                         epochs = epochs,
                         callbacks = callbacks_list)

plot_model_acc(history_gru)
```

```
Epoch 1/20
191/191 [==============================] - 9s 39ms/step - loss: 0.4933 -
accuracy: 0.7637 - val_loss: 0.4226 - val_accuracy: 0.8122 - lr: 0.0010
Epoch 2/20
```

```
191/191 [==============================] - ETA: 0s - loss: 0.4206 - accuracy:
0.8215
Epoch 2: ReduceLROnPlateau reducing learning rate to 0.0001000000474974513.
191/191 [==============================] - 7s 35ms/step - loss: 0.4206 -
accuracy: 0.8215 - val_loss: 0.4307 - val_accuracy: 0.8096 - lr: 0.0010
Epoch 3/20
191/191 [==============================] - 7s 35ms/step - loss: 0.3754 -
accuracy: 0.8438 - val_loss: 0.4090 - val_accuracy: 0.8155 - lr: 1.0000e-04
Epoch 4/20
191/191 [==============================] - ETA: 0s - loss: 0.3639 - accuracy:
0.8463
Epoch 4: ReduceLROnPlateau reducing learning rate to 1.0000000474974514e-05.
191/191 [==============================] - 7s 35ms/step - loss: 0.3639 -
accuracy: 0.8463 - val_loss: 0.4111 - val_accuracy: 0.8168 - lr: 1.0000e-04
Epoch 5/20
191/191 [==============================] - ETA: 0s - loss: 0.3565 - accuracy:
0.8502
Epoch 5: ReduceLROnPlateau reducing learning rate to 1.0000000656873453e-06.
Restoring model weights from the end of the best epoch: 3.
191/191 [==============================] - 7s 35ms/step - loss: 0.3565 -
accuracy: 0.8502 - val_loss: 0.4095 - val_accuracy: 0.8181 - lr: 1.0000e-05
Epoch 5: early stopping
```






```
<Figure size 432x288 with 0 Axes>
```

0.1 Results and Analysis

After some tinkering with the setting and number of layers I finaly ended with this model. While this isnt superb performance it is much better than LTSM so this is what I will use for my submission. 81% accuarcy on the validation set is a solid preformance. especially since I am training my a laptop without dedicated graphics. If I had more computational power I would probably look to do more instensive layers and modeling.

0.2 Conclusion

GRU models are better for this dataset than LTSM models. While this should be expected as GRU models have been replacing LTSM models for many NLP problems it is good to see that the results are consistent and work well. In the future I would hope to have a cluster of GPU's that would allow for more layers and epochs to be ran at the same time. This increase in computational power would certainly improve my results.

Generating submission

[ ]:
```
X_test= df_test['text'].values
X_test_seq = tokenizer.texts_to_sequences(X_test)
X_test_pad = sequence.pad_sequences(X_test_seq, maxlen=max_text_len)
predictions_prob = model_gru.predict(X_test_pad)
predictions = tf.round(predictions_prob)
#print(predictions)
```

```
print(df_test.columns)
df_out = pd.DataFrame()
df_out.index = df_test.index
df_out['target'] = predictions
df_out = df_out.astype({"target": int})
df_out.to_csv('submission.csv')
```

```
102/102 [==============================] - 1s 11ms/step
Index(['keyword', 'location', 'text'], dtype='object')
```