24_CNN_Classification_Assign

October 8, 2020

1 Imports

[ ]:
```
import re
import os
import warnings
warnings.filterwarnings("ignore")

import nltk
import numpy as np
import pandas as pd
import random as rn
from tqdm import tqdm, trange
import matplotlib.pyplot as plt
from nltk import pos_tag as Tag
from nltk import ne_chunk as Chunk
from nltk import sent_tokenize as S_Tokenize
from nltk import word_tokenize as W_Tokenize
from sklearn.model_selection import train_test_split as Split
from sklearn.preprocessing import OneHotEncoder as OHE

import tensorflow as tf
import tensorflow_addons as tfa
from tensorflow.keras.utils import plot_model
from tensorflow.keras.callbacks import TensorBoard, ModelCheckpoint
from tensorflow.keras.callbacks import EarlyStopping, ReduceLROnPlateau
from tensorflow.keras.layers import Conv1D, Embedding, Flatten, Dropout
from tensorflow.keras.layers import Input, Concatenate, MaxPool1D, Dense
from tensorflow.keras.preprocessing.text import Tokenizer as tf_Tokenizer
from tensorflow.keras.preprocessing.sequence import pad_sequences as␣
 ↪tf_pad_sequences

print(tf.__version__)
tf.compat.v1.logging.set_verbosity(tf.compat.v1.logging.ERROR)
```

```
2.3.0
```

2 Preprocessing

[ ]:
```
def extract_emails(line, emails):
    emails_l = re.findall(r"[A-Za-z0-9._%+-]+@[A-Za-z0-9.-]+\.[A-Za-z]{2,4}",␣
 ↪line)
    emails +=emails_l
    if len(emails_l) !=0:
        for email in emails_l:
            line = re.sub(re.escape(email), ' ', line).lower()
    return line, emails

def extract_Subject(line, Subject):
    line = re.sub('Subject:', '', line)
    line = re.sub('\w+:', '', line)
    line = re.sub('[^A-Za-z0-9]+', ' ', line)
    line = re.sub("[\\n\\t ]", " ", line)
    Subject.append(line.strip())
    line = ' '
    return line, Subject

def remove_word_endcolon(line):
    l = ''
    for word in line.split(' '):
        if re.search(':$', word) == None:
            l = l + ' ' + word
    return l

def decontracted(phrase):
    # specific
    phrase = re.sub(r"won't", "will not", phrase)
    phrase = re.sub(r"can\'t", "can not", phrase)

    # general
    phrase = re.sub(r"n\'t", " not", phrase)
    phrase = re.sub(r"\'re", " are", phrase)
    phrase = re.sub(r"\'s", " is", phrase)
    phrase = re.sub(r"\'d", " would", phrase)
    phrase = re.sub(r"\'ll", " will", phrase)
    phrase = re.sub(r"\'t", " not", phrase)
    phrase = re.sub(r"\'ve", " have", phrase)
    phrase = re.sub(r"\'m", " am", phrase)
    return phrase

def Chukit(Line):
    for sent in S_Tokenize(Line):
        for chunk in Chunk(Tag(W_Tokenize(sent))):
```

```
            rem = ' '.join(c[0] for c in chunk)
            if hasattr(chunk, 'label') and chunk.label() == 'PERSON':
                Line = re.sub(re.escape(rem), ' ', Line)
            elif hasattr(chunk, 'label'):
                change = '_'.join(c[0] for c in chunk)
                Line = re.sub(re.escape(rem), change, Line)
    return Line

def remove_word_endunderscore(line):
    for word in line.split():
        word_ = re.sub('_$', '', re.sub('^_','', word))
        line = re.sub(re.escape(word), word_, line)
    return line

def remove_1_2_split_by_(line):
    for word in line.split():
        if len(word.split('_'))>=2:
            if '_' in word and len(word.split('_')[0])<=2:
                line = re.sub(re.escape(word), word.split('_')[1], line)
    return line

def remove_word_short_long(line):
    l = ''
    for word in line.split():
        if 2 < len(word) < 14:
            l = l +' '+ word

    line = l.lower()
    return line

def remove_words_except_alpha(line):
    line = re.sub('[\W]+', ' ', line)
    return line
```

[ ]:
```
def regex_process(line):
    line = re.sub('<.*?>', ' ', line)           # 6
    line = re.sub('[\(.*?\)\)\[]]', '', line)   # 7
    line = re.sub('[-\\t\\n \\.\\\]', ' ', line)# 8
    line = remove_word_endcolon(line)           # 9
    line = decontracted(line)                   # 10
    line = Chukit(line)                         # 11, 12
    line = re.sub('[0-9]+', ' ', line)          # 13
    line = remove_word_endunderscore(line)      # 14
    line = remove_1_2_split_by_(line)           # 15
    line = remove_word_short_long(line)         # 16
    line = remove_words_except_alpha(line)      # 17
    return line
```

[ ]:
```
def preprocess(file_name):
    """Do all the Preprocessing and return a tuple contain
    preprocess_email,preprocess_subject,preprocess_text for the Given␣
 ↪Text_data"""
    preprocessed_emails = [] ; Subjects = [] ; preprocessed_text = []

    fi = open(f'documents/{file_name}', "r+", encoding='ISO-8859-1')
    fo = open(f'out_files/{file_name}', "w+")
    text = '' ; Subject = [] ; emails = [] ;
    for line in fi:
        line = line.strip().lower()
        line, emails = extract_emails(line, emails) # 1, 2
        if 'Subject:' in line:
            line, Subject = extract_Subject(line, Subject) ; continue # 3,4
        if 'Write to:' in line or 'From:' in line:
            line = ' '  ; continue       # 5
        line = regex_process(line)
        text = text + line
        fo.write(line)
    fo.close()
    new_words = [] ; words = None
    for email in emails:
        words = email.split('@')[1].split('.')
        new_words += [word for word in words if (len(word)>2) and word != 'com'␣
 ↪]
    prep_email = ' '.join(new_words)
    Subjects = ' '.join(Subject)
    prep_text = text.strip()
    fi.close()
    return (prep_email, Subjects, prep_text)
```

[ ]:
```
#nltk.download('punkt')
#nltk.download('averaged_perceptron_tagger')
#nltk.download('maxent_ne_chunker')
#nltk.download('words')
```

[ ]:
```
#!pip install unrar
#!unrar x '/content/documents.rar'
```

[ ]:
```
os.chdir('/content/drive/My Drive/Colab Notebooks/24_ Doc classification - CNN')
```

[ ]:
```
%%time
if  not os.path.isfile('Data.csv'):

    if not os.path.isdir('out_files'):
        os.makedirs('out_files')
```

```
    files = os.listdir('documents')
    Names = []  ;  Labels = []  ; Preped_Data = []
    for file in tqdm(files):
        label = file.split('_')[0] ;  Name = file.split('_')[1].split('.')[0]
        Labels.append(label)  ; Names.append(Name)

        Prep = preprocess(file)  # Preprocessed File
        Preped_Data.append(Prep)

        df = pd.DataFrame(Preped_Data,
                          columns =['prep_email', 'Subjects', 'prep_text'])
        df['Names'] = Names ; df['label'] = Labels

        df['All_text'] = df['prep_email']+df['Subjects']+df['prep_text']
        df = df.drop(['prep_email', 'Subjects', 'prep_text'], axis=1)
        df = df[['Names', 'All_text', 'label']]

        Data = df.to_csv('Data.csv',index=False)
```

```
CPU times: user 1.48 ms, sys: 94 µs, total: 1.58 ms
Wall time: 1.58 s
```

3 Load Data and Getting Ready

[ ]:
```
df = pd.read_csv('Data.csv')
X = df.drop(['Names', 'label'], axis=1)
Y = df[['label']]
df.head()
```

[ ]:
```
    Names  …                     label
0   54770  …        talk.politics.guns
1  103167  …           rec.motorcycles
2   60400  …  comp.sys.ibm.pc.hardware
3  105160  …        rec.sport.baseball
4  105008  …           rec.motorcycles

[5 rows x 3 columns]
```

[ ]:
```
X_tr, X_te, Y_train, Y_test = Split(X, Y, test_size=0.25, stratify=Y,␣
 ↪random_state=42)
X_Train = X_tr.reset_index(drop=True)
X_Test = X_te.reset_index(drop=True)
print(X_Train.shape, X_Test.shape)

# one Hot encoding of the target param
```

```
Encode = OHE(sparse=False)
Y_Train = Encode.fit_transform(Y_train.reset_index(drop=True))
Y_Test = Encode.fit_transform(Y_test.reset_index(drop=True))
print(Y_Train.shape, Y_Test.shape)
```

```
(14121, 1) (4707, 1)
(14121, 20) (4707, 20)
```

[ ]:
```
#!wget http://nlp.stanford.edu/data/glove.6B.zip
#!unzip 'archive.zip'
```

[ ]:
```
The_Dictionery = {}
Glove = open('glove.6B.300d.txt', encoding="utf8")
for line in tqdm(Glove):
    Word_Vec = line.split()
    Word, Vector = Word_Vec[0] ,np.array(Word_Vec[1:], dtype='float32')
    The_Dictionery[Word] = Vector

Glove.close()
```

```
400000it [00:34, 11575.11it/s]
```

[ ]:
```
from sklearn.metrics import f1_score

class f1_Metrics(tf.keras.callbacks.Callback):
    def __init__(self, model):
        self.model=model

    def on_train_begin(self, logs={}):
        self.history={'f1_score': []}

    def on_epoch_end(self, epoch, logs={}):
        y_pred = np.asarray(self.model.predict(Test)).astype(int))
        logs['f1_score'] = f1_score(Y_Test, y_pred, average='micro',␣
 ↪zero_division=1)
        self.history['f1_score'].append(logs.get('f1_score'))
        print('  - f1_score: ', self.history['f1_score'][-1])
```

[ ]:
```
# Adam Optimiser with lr=0.001 as the optimiser
Opt = tf.keras.optimizers.Adam()

# Accuracy and Micro-F1score as Metrics
Metrics = ['acc']

# Stop training if no improvement in consecutive epochs
earlystop = EarlyStopping(monitor='val_acc', patience=2, verbose=1)
```

```
# Saves Model if improved from prev epoch
def checkpoint(M):
    return ModelCheckpoint(f'/content/logs/best_model_L{M}_'+'{val_acc:.4f}.
 ↪h5', 'val_acc',
                           save_best_only=True)

# Reducs Learning rate to half, if learning stagnates
reduce_lr = ReduceLROnPlateau(monitor='val_acc', factor=0.5, patience=1)

# Logs for Tensorboard
tensorboard_cb = TensorBoard(log_dir="/content/logs")
```

[ ]:
```
def Convol1D(f, k):
    return Conv1D(filters=f, kernel_size=k, padding = 'same',
                  activation='relu')

def Dense_(n):
    return Dense(n, activation='relu')
```

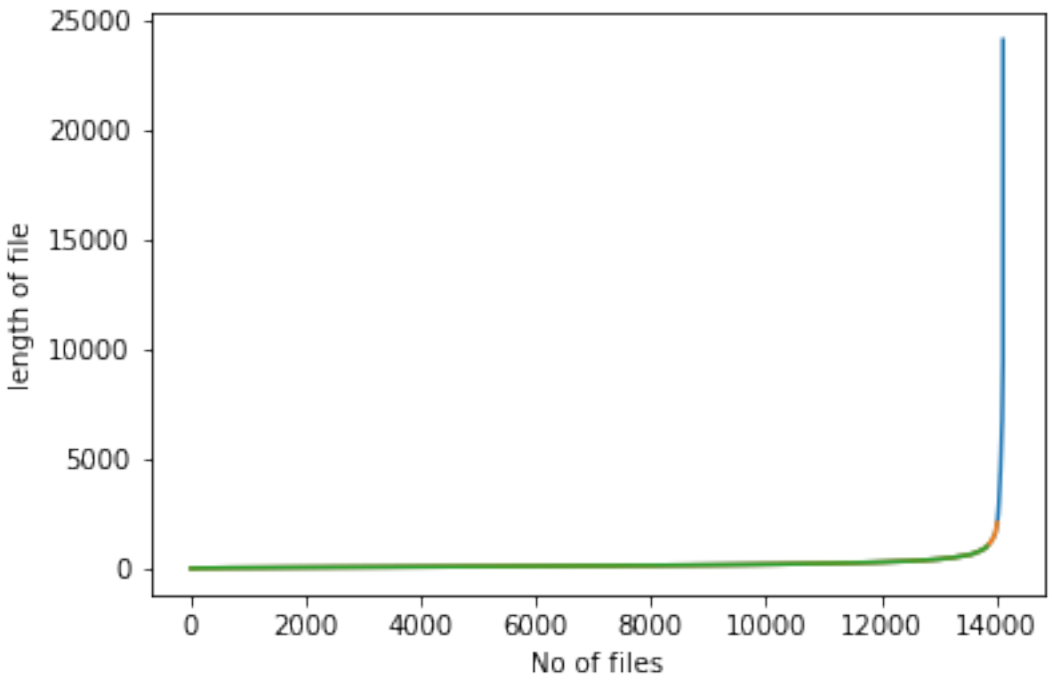
4 Model - 1

Using Word Embedding with Glove Vectors.

4.1 Tokenizing

[ ]:
```
Lenths = [len(row.split()) for row in X_Train['All_text']]
Sorted_len = np.sort(Lenths)
plt.plot(Sorted_len) ; plt.plot(Sorted_len[:-100]) ; plt.plot(Sorted_len[:-284])
plt.xlabel('No of files')  ; plt.ylabel('length of file')
print(Sorted_len[-284])
print(f"Percentage of lengths above 1000 : {(1-283/14121)*100}")
```

```
1012
Percentage of lengths above 1000 : 97.99589264216415
```



Almost 98% of the points have their length under 1000(Words). So taking Max_len =1000 woud be the best trade off between the Retention of maximum data and time and computational limitations. (Based on Elbow theory)

[ ]:
```
def Seq(text_data, Tok):
    lst = list(text_data['All_text'].astype(str))
    sequences = Tok.texts_to_sequences(lst)
    Padded_Seq = tf_pad_sequences(sequences, maxlen=1000)

    return Padded_Seq
```

[ ]:
```
%%time
# Custom filtered Tokenizer to excluse '_' from filtering out.
Tok = tf_Tokenizer(filters='!"#$%&()*+,-./:;<=>?
 ↪@[\\]^`{|}~\t\n',oov_token='<OOV>')
Tokens = Tok.fit_on_texts(X_Train['All_text'].astype(str))
Voc_len = len(Tok.word_index)
print( 'Voc_len: ', Voc_len)

Train = Seq(X_Train, Tok)
Test = Seq(X_Test, Tok)
in_shape = Train.shape[1]
print(Train.shape, Test.shape)
```

```
Voc_len:  98562
```

```
(14121, 1000) (4707, 1000)
CPU times: user 4.51 s, sys: 56.3 ms, total: 4.57 s
Wall time: 4.56 s
```

4.2 Embedding matrix

[ ]:
```
EMBD_MX = np.zeros((Voc_len+1, 300))
for Word, i in Tok.word_index.items():
    EMBD_MX[i] = The_Dictionery.get(Word)
EMBD_MX = np.nan_to_num(EMBD_MX)   # making zero vectors for those words absent␣
 ↪in Glove
```

4.3 Model

[ ]:
```
# defining the model
def Model_():
    input = Input(shape=(in_shape,))
    x = Embedding(Voc_len+1,300, weights = [EMBD_MX],␣
 ↪input_length=in_shape)(input)
    M = Convol1D(16, 7)(x)
    N = Convol1D(16, 9)(x)
    O = Convol1D(16, 11)(x)
    Conc = Concatenate(axis=1)([M,N,O])
    Maxpool = MaxPool1D(2, 2)(Conc)
    i = Convol1D(16, 3)(Maxpool)
    j = Convol1D(16, 5)(Maxpool)
    k = Convol1D(16, 7)(Maxpool)
    Conc_2 = Concatenate(axis=1)([i,j,k])
    Maxpool_2 = MaxPool1D(2,2)(Conc_2)
    x = Conv1D(filters=16, kernel_size=5, activation='relu')(Maxpool_2)
    x = Flatten()(x)
    x = Dense_(64)(x)
    x = Dropout(0.6)(x)
    x = Dense_(32)(x)
    out = Dense(20, activation='softmax')(x)

    Model_1 = tf.keras.Model(inputs=input, outputs=out)
    return Model_1
# summarize the model
Model_1 = Model_()
print(Model_1.summary())
```

```
Model: "functional_1"
_________________________________________________________________________________
__________________
```

```
Layer (type)                    Output Shape         Param #     Connected to
==================================================================================
==================
input_1 (InputLayer)            [(None, 1000)]       0
----------------------------------------------------------------------------------
------------------
embedding (Embedding)           (None, 1000, 300)    29568900    input_1[0][0]
----------------------------------------------------------------------------------
------------------
conv1d (Conv1D)                 (None, 1000, 16)     33616       embedding[0][0]
----------------------------------------------------------------------------------
------------------
conv1d_1 (Conv1D)               (None, 1000, 16)     43216       embedding[0][0]
----------------------------------------------------------------------------------
------------------
conv1d_2 (Conv1D)               (None, 1000, 16)     52816       embedding[0][0]
----------------------------------------------------------------------------------
------------------
concatenate (Concatenate)       (None, 3000, 16)     0           conv1d[0][0]
                                                                 conv1d_1[0][0]
                                                                 conv1d_2[0][0]
----------------------------------------------------------------------------------
------------------
max_pooling1d (MaxPooling1D)    (None, 1500, 16)     0
concatenate[0][0]
----------------------------------------------------------------------------------
------------------
conv1d_3 (Conv1D)               (None, 1500, 16)     784
max_pooling1d[0][0]
----------------------------------------------------------------------------------
------------------
conv1d_4 (Conv1D)               (None, 1500, 16)     1296
max_pooling1d[0][0]
----------------------------------------------------------------------------------
------------------
conv1d_5 (Conv1D)               (None, 1500, 16)     1808
max_pooling1d[0][0]
----------------------------------------------------------------------------------
------------------
concatenate_1 (Concatenate)     (None, 4500, 16)     0           conv1d_3[0][0]
                                                                 conv1d_4[0][0]
                                                                 conv1d_5[0][0]
----------------------------------------------------------------------------------
------------------
max_pooling1d_1 (MaxPooling1D)  (None, 2250, 16)     0
concatenate_1[0][0]
----------------------------------------------------------------------------------
------------------
```

```
conv1d_6 (Conv1D)               (None, 2246, 16)     1296
max_pooling1d_1[0][0]
__________________________________________________________________________________
__________________
flatten (Flatten)               (None, 35936)        0           conv1d_6[0][0]
__________________________________________________________________________________
__________________
dense (Dense)                   (None, 64)           2299968     flatten[0][0]
__________________________________________________________________________________
__________________
dropout (Dropout)               (None, 64)           0           dense[0][0]
__________________________________________________________________________________
__________________
dense_1 (Dense)                 (None, 32)           2080        dropout[0][0]
__________________________________________________________________________________
__________________
dense_2 (Dense)                 (None, 20)           660         dense_1[0][0]
==================================================================================
==================
Total params: 32,006,440
Trainable params: 32,006,440
Non-trainable params: 0
__________________________________________________________________________________
__________________
None
```

[ ]:
```
CB = [f1_Metrics(Model_1), checkpoint(1), tensorboard_cb, earlystop, reduce_lr]

!rm -rf /content/logs # Clear Logs
# compile the model
Model_1.compile(Opt, loss='categorical_crossentropy', metrics = Metrics)

with tf.device('/device:GPU:0'):
    # Execute the model
    Model_1.fit(Train, Y_Train, epochs= 50, batch_size=64, callbacks=CB,
              validation_data = (Test, Y_Test),
              use_multiprocessing=True)
```

```
Epoch 1/50
221/221 [==============================] - ETA: 0s - loss: 2.8649 - acc: 0.1016
- f1_score:  0.0
221/221 [==============================] - 51s 233ms/step - loss: 2.8649 - acc:
0.1016 - val_loss: 2.4469 - val_acc: 0.2794
Epoch 2/50
221/221 [==============================] - ETA: 0s - loss: 2.1123 - acc: 0.3017
- f1_score:  0.01893939393939394
221/221 [==============================] - 50s 227ms/step - loss: 2.1123 - acc:
0.3017 - val_loss: 1.5081 - val_acc: 0.4925
```

```
Epoch 3/50
221/221 [==============================] - ETA: 0s - loss: 1.5547 - acc: 0.4418
- f1_score:  0.021437578814627996
221/221 [==============================] - 50s 227ms/step - loss: 1.5547 - acc:
0.4418 - val_loss: 1.2555 - val_acc: 0.5785
Epoch 4/50
221/221 [==============================] - ETA: 0s - loss: 1.2468 - acc: 0.5430
- f1_score:  0.04810284055567074
221/221 [==============================] - 50s 227ms/step - loss: 1.2468 - acc:
0.5430 - val_loss: 0.9859 - val_acc: 0.6643
Epoch 5/50
221/221 [==============================] - ETA: 0s - loss: 0.9966 - acc: 0.6155
- f1_score:  0.10201612903225807
221/221 [==============================] - 50s 228ms/step - loss: 0.9966 - acc:
0.6155 - val_loss: 0.8678 - val_acc: 0.7064
Epoch 6/50
221/221 [==============================] - ETA: 0s - loss: 0.8602 - acc: 0.6696
- f1_score:  0.11606964178507104
221/221 [==============================] - 50s 225ms/step - loss: 0.8602 - acc:
0.6696 - val_loss: 0.8167 - val_acc: 0.7368
Epoch 7/50
221/221 [==============================] - ETA: 0s - loss: 0.7053 - acc: 0.7271
- f1_score:  0.15809039326941893
221/221 [==============================] - 48s 219ms/step - loss: 0.7053 - acc:
0.7271 - val_loss: 0.7882 - val_acc: 0.7593
Epoch 8/50
221/221 [==============================] - ETA: 0s - loss: 0.6200 - acc: 0.7695
- f1_score:  0.14240631163708084
221/221 [==============================] - 48s 215ms/step - loss: 0.6200 - acc:
0.7695 - val_loss: 0.7847 - val_acc: 0.7597
Epoch 9/50
221/221 [==============================] - ETA: 0s - loss: 0.5496 - acc: 0.7947
- f1_score:  0.19093353822512485
221/221 [==============================] - 48s 215ms/step - loss: 0.5496 - acc:
0.7947 - val_loss: 0.7401 - val_acc: 0.7754
Epoch 10/50
221/221 [==============================] - ETA: 0s - loss: 0.4674 - acc: 0.8305
- f1_score:  0.24380242311276795
221/221 [==============================] - 47s 215ms/step - loss: 0.4674 - acc:
0.8305 - val_loss: 0.7656 - val_acc: 0.7941
Epoch 11/50
221/221 [==============================] - ETA: 0s - loss: 0.4213 - acc: 0.8513
- f1_score:  0.22828130876269273
221/221 [==============================] - 47s 210ms/step - loss: 0.4213 - acc:
0.8513 - val_loss: 0.8075 - val_acc: 0.7888
Epoch 12/50
221/221 [==============================] - ETA: 0s - loss: 0.3258 - acc: 0.8883
- f1_score:  0.28628592215351034
```

```
221/221 [==============================] - 47s 212ms/step - loss: 0.3258 - acc:
0.8883 - val_loss: 0.8013 - val_acc: 0.8056
Epoch 13/50
221/221 [==============================] - ETA: 0s - loss: 0.2982 - acc: 0.9014
- f1_score:  0.29645697758496026
221/221 [==============================] - 47s 211ms/step - loss: 0.2982 - acc:
0.9014 - val_loss: 0.8316 - val_acc: 0.8054
Epoch 14/50
221/221 [==============================] - ETA: 0s - loss: 0.2699 - acc: 0.9094
- f1_score:  0.30777518405458787
221/221 [==============================] - 48s 216ms/step - loss: 0.2699 - acc:
0.9094 - val_loss: 0.8674 - val_acc: 0.8116
Epoch 15/50
221/221 [==============================] - ETA: 0s - loss: 0.2490 - acc: 0.9174
- f1_score:  0.3277176804397943
221/221 [==============================] - 48s 216ms/step - loss: 0.2490 - acc:
0.9174 - val_loss: 0.8616 - val_acc: 0.8232
Epoch 16/50
221/221 [==============================] - ETA: 0s - loss: 0.2287 - acc: 0.9233
- f1_score:  0.3410170684497625
221/221 [==============================] - 47s 211ms/step - loss: 0.2287 - acc:
0.9233 - val_loss: 0.9112 - val_acc: 0.8198
Epoch 17/50
221/221 [==============================] - ETA: 0s - loss: 0.2245 - acc: 0.9290
- f1_score:  0.33897110641296685
221/221 [==============================] - 47s 212ms/step - loss: 0.2245 - acc:
0.9290 - val_loss: 0.9125 - val_acc: 0.8271
Epoch 18/50
221/221 [==============================] - ETA: 0s - loss: 0.2130 - acc: 0.9310
- f1_score:  0.35024492652204336
221/221 [==============================] - 46s 210ms/step - loss: 0.2130 - acc:
0.9310 - val_loss: 0.9511 - val_acc: 0.8281
Epoch 19/50
221/221 [==============================] - ETA: 0s - loss: 0.2104 - acc: 0.9352
- f1_score:  0.35357766143106456
221/221 [==============================] - 45s 205ms/step - loss: 0.2104 - acc:
0.9352 - val_loss: 0.9662 - val_acc: 0.8230
Epoch 20/50
221/221 [==============================] - ETA: 0s - loss: 0.1981 - acc: 0.9367
- f1_score:  0.362182829336114
221/221 [==============================] - 46s 208ms/step - loss: 0.1981 - acc:
0.9367 - val_loss: 0.9759 - val_acc: 0.8262
Epoch 00020: early stopping
```

[ ]:
```
!tensorboard dev upload --logdir /content/logs \
  --name "Doc Classification using 1D CNN Model_1" \
```

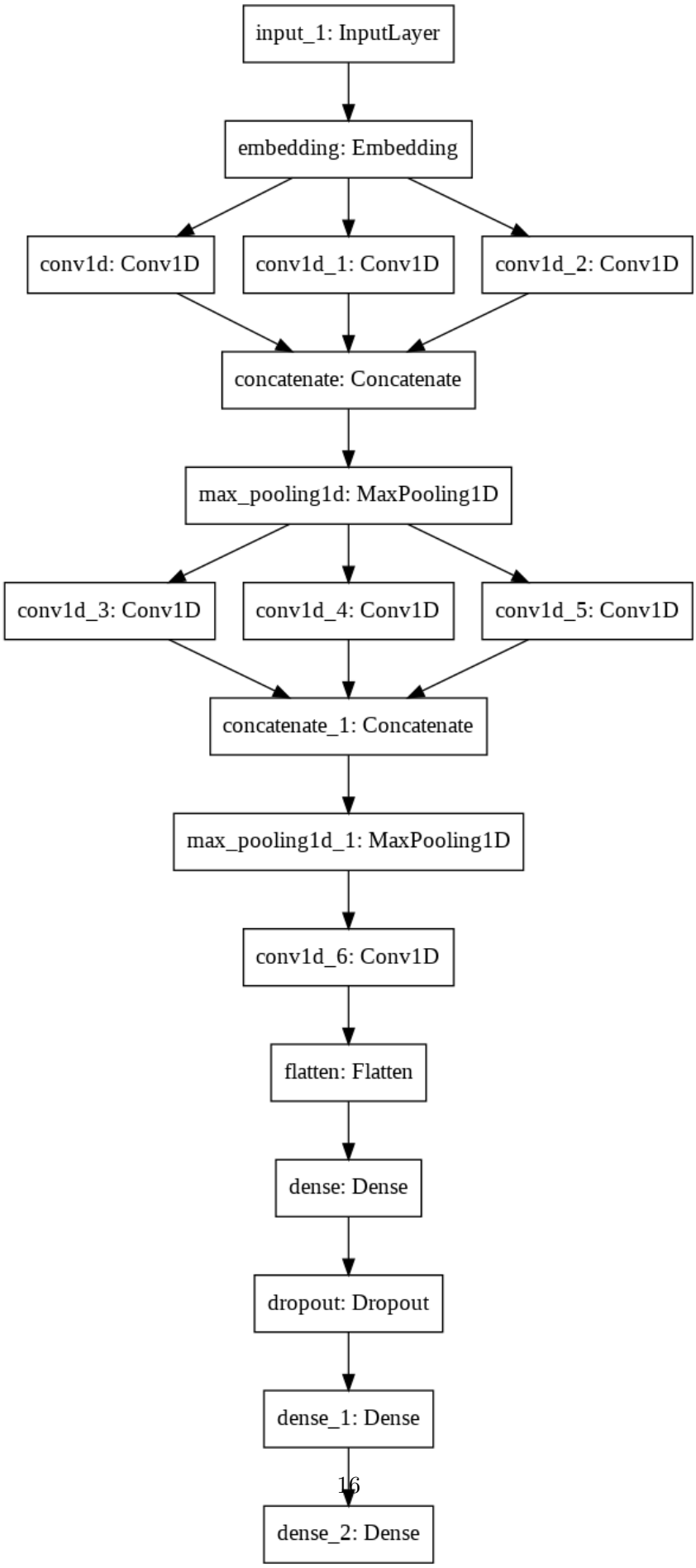
```
  --description "Training results from https://colab.research.google.com/drive/
↪1eD9wkwlZTz8JRIAcFa1fXbyeOi90vISB#scrollTo=BPUvjkh2aMMP" \
  --one_shot
```

```
2020-10-08 14:47:51.081486: I
tensorflow/stream_executor/platform/default/dso_loader.cc:48] Successfully
opened dynamic library libcudart.so.10.1

***** TensorBoard Uploader *****

This will upload your TensorBoard logs to https://tensorboard.dev/ from
the following directory:

/content/logs

This TensorBoard will be visible to everyone. Do not upload sensitive
data.

Your use of this service is subject to Google's Terms of Service
<https://policies.google.com/terms> and Privacy Policy
<https://policies.google.com/privacy>, and TensorBoard.dev's Terms of Service
<https://tensorboard.dev/policy/terms/>.

This notice will not be shown again while you are logged into the uploader.
To log out, run `tensorboard dev auth revoke`.

Continue? (yes/NO) y

Please visit this URL to authorize this application: https://accounts.google.com
/o/oauth2/auth?response_type=code&client_id=373649185512-8v619h5kft38l4456nm2dj4
ubeqsrvh6.apps.googleusercontent.com&redirect_uri=urn%3Aietf%3Awg%3Aoauth%3A2.0%
3Aoob&scope=openid+https%3A%2F%2Fwww.googleapis.com%2Fauth%2Fuserinfo.email&stat
e=VwwdyEXXsJxw8HLgzAliLLhDjsdPTD&prompt=consent&access_type=offline
Enter the authorization code:
4/5AFHHE1h5AJrlRtwsrRSYwoCTf2jl7NgtmJ7AlmahuReJvzlFxIrMvA

Upload started and will continue reading any new data as it's added
to the logdir. To stop uploading, press Ctrl-C.

View your TensorBoard live at:
https://tensorboard.dev/experiment/nKkOE2iVR7Ofgm7sVN5BsQ/

[2020-10-08T14:53:05] Uploader started.
[2020-10-08T14:53:06] Total uploaded: 80 scalars, 0 tensors, 1 binary
objects (20.2 kB)
Listening for new data in logdir…
Done. View your TensorBoard at
```

https://tensorboard.dev/experiment/nKkOE2iVR7Ofgm7sVN5BsQ/

[ ]:
```
tf.keras.utils.plot_model(Model_1, to_file='model.png', show_shapes=False,
                          show_layer_names=True, rankdir='TB',␣
↪expand_nested=False, dpi=96)
```

[ ]:


input_1: InputLayer
embedding: Embedding
conv1d: Conv1D
conv1d_1: Conv1D
conv1d_2: Conv1D
concatenate: Concatenate
max_pooling1d: MaxPooling1D
conv1d_3: Conv1D
conv1d_4: Conv1D
conv1d_5: Conv1D
concatenate_1: Concatenate
max_pooling1d_1: MaxPooling1D
conv1d_6: Conv1D
flatten: Flatten
dense: Dense
dropout: Dropout
dense_1: Dense
dense_2: Dense

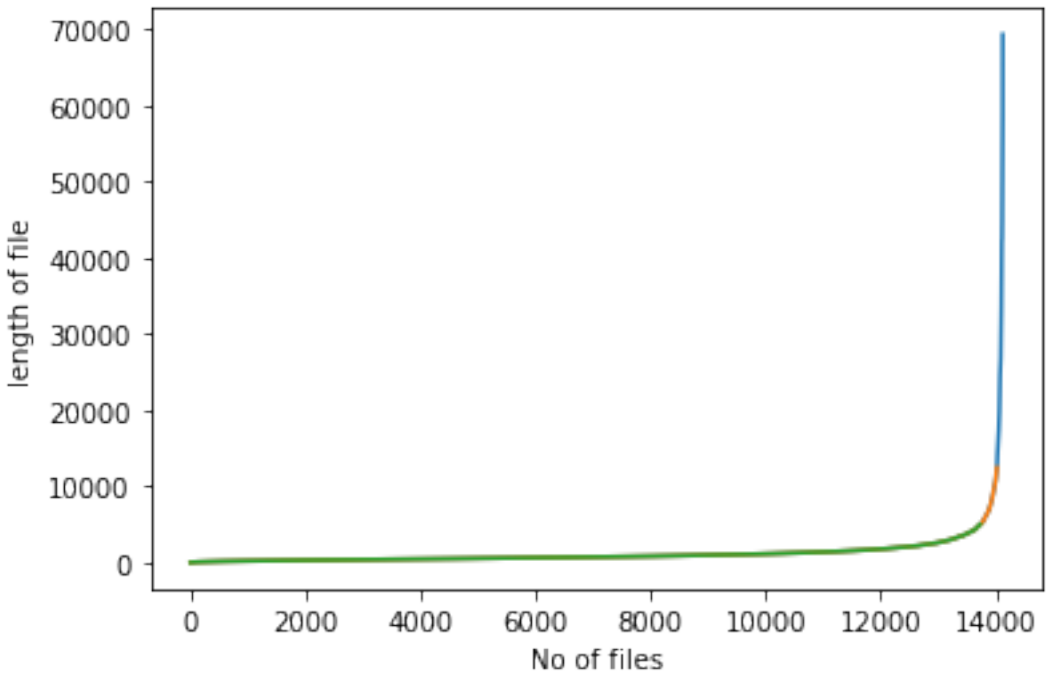
5 Model - 2

Using Character Level Embeddings and Glove Weights

5.1 Tokenizing

[ ]:
```
Lenths = [len(row) for row in X_Train['All_text']]
Sorted_len = np.sort(Lenths)
plt.plot(Sorted_len) ; plt.plot(Sorted_len[:-100]) ; plt.plot(Sorted_len[:-392])
plt.xlabel('No of files')  ; plt.ylabel('length of file')
print(Sorted_len[-140])
print(f"Percentage of lengths above 5000 : {(1-392/14121)*100}")
```

```
10004
Percentage of lengths above 5000 : 97.2239926350825
```



More than 97% of the points have their length under 5000(characters). So taking Max_len =5000 woud be the best trade off between the Retention of maximum data and time and computational limitations. (Based on Elbow theory)

[ ]:
```
def Seq(text_data, Tok):
    lst = list(text_data['All_text'].astype(str))
    sequences = Tok.texts_to_sequences(lst)
    Padded_Seq = tf_pad_sequences(sequences, maxlen=10000)

    return Padded_Seq
```

[ ]:
```
%%time
# Custom filtered Tokenizer to excluse '_' from filtering out.
Tok = tf_Tokenizer(filters='!"#$%&()*+,-./:;<=>?
 ↪@[\\]^`{|}~\t\n',oov_token='<OOV>', char_level=True)
Tokens = Tok.fit_on_texts(X_Train['All_text'].astype(str))
Voc_len = len(Tok.word_index)
print( 'Voc_len: ', Voc_len)

Train = Seq(X_Train, Tok)
Test = Seq(X_Test, Tok)
in_shape = Train.shape[1]
print(Train.shape, Test.shape)
```

```
Voc_len:  55
(14121, 10000) (4707, 10000)
CPU times: user 10.5 s, sys: 225 ms, total: 10.7 s
Wall time: 10.7 s
```

5.2 Embedding matrix

[ ]:
```
EMBD_MX = np.zeros((Voc_len+1, 300))
for Word, i in Tok.word_index.items():
    EMBD_MX[i] = The_Dictionery.get(Word)
EMBD_MX = np.nan_to_num(EMBD_MX)   # making zero vectors for those words absent␣
 ↪in Glove
```

5.3 Model

[ ]:
```
# defining the model
Model_2 = tf.keras.Sequential([
            Input(shape=(in_shape,)),
            Embedding(Voc_len+1, 300, weights = [EMBD_MX],␣
 ↪input_length=in_shape),
            Convol1D(16, 7),
            Convol1D(16, 9),
            MaxPool1D(2, 2),
            Convol1D(16, 11),
            Convol1D(16, 13),
```

```
            MaxPool1D(2, 2),
            Flatten(),
            Dense_(64),
            Dropout(0.4),
            Dense(32, activation='relu'),
            Dense(20, activation='softmax') ])

# summarize the model
print(Model_2.summary())
```

```
Model: "sequential"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
embedding_1 (Embedding)      (None, 10000, 300)        16800
_________________________________________________________________
conv1d_7 (Conv1D)            (None, 10000, 16)         33616
_________________________________________________________________
conv1d_8 (Conv1D)            (None, 10000, 16)         2320
_________________________________________________________________
max_pooling1d_2 (MaxPooling1 (None, 5000, 16)          0
_________________________________________________________________
conv1d_9 (Conv1D)            (None, 5000, 16)          2832
_________________________________________________________________
conv1d_10 (Conv1D)           (None, 5000, 16)          3344
_________________________________________________________________
max_pooling1d_3 (MaxPooling1 (None, 2500, 16)          0
_________________________________________________________________
flatten_1 (Flatten)          (None, 40000)             0
_________________________________________________________________
dense_3 (Dense)              (None, 64)                2560064
_________________________________________________________________
dropout_1 (Dropout)          (None, 64)                0
_________________________________________________________________
dense_4 (Dense)              (None, 32)                2080
_________________________________________________________________
dense_5 (Dense)              (None, 20)                660
=================================================================
Total params: 2,621,716
Trainable params: 2,621,716
Non-trainable params: 0
_________________________________________________________________
None
```

[ ]:
```
CB = [f1_Metrics(Model_2), checkpoint(2), tensorboard_cb, earlystop, reduce_lr]

!rm -rf /content/logs # Clear Logs
```

```
# compile the model
Model_2.compile(tf.keras.optimizers.Adam(), 'categorical_crossentropy', metrics␣
↪= Metrics)

with tf.device('/device:GPU:0'):
    # Execute the model
    Model_2.fit(Train, Y_Train, epochs= 50, batch_size=64, callbacks=CB,
              validation_data = (Test, Y_Test),
              use_multiprocessing=True)
```

```
Epoch 1/50
221/221 [==============================] - ETA: 0s - loss: 2.9692 - acc: 0.0680
- f1_score:  0.0
221/221 [==============================] - 102s 461ms/step - loss: 2.9692 - acc:
0.0680 - val_loss: 2.9336 - val_acc: 0.0809
Epoch 2/50
221/221 [==============================] - ETA: 0s - loss: 2.9301 - acc: 0.0787
- f1_score:  0.0
221/221 [==============================] - 100s 454ms/step - loss: 2.9301 - acc:
0.0787 - val_loss: 2.9126 - val_acc: 0.0884
Epoch 3/50
221/221 [==============================] - ETA: 0s - loss: 2.8174 - acc: 0.0969
- f1_score:  0.0
221/221 [==============================] - 101s 456ms/step - loss: 2.8174 - acc:
0.0969 - val_loss: 2.7088 - val_acc: 0.1277
Epoch 4/50
221/221 [==============================] - ETA: 0s - loss: 2.6617 - acc: 0.1205
- f1_score:  0.0
221/221 [==============================] - 101s 455ms/step - loss: 2.6617 - acc:
0.1205 - val_loss: 2.5766 - val_acc: 0.1470
Epoch 5/50
221/221 [==============================] - ETA: 0s - loss: 2.4939 - acc: 0.1639
- f1_score:  0.0
221/221 [==============================] - 101s 456ms/step - loss: 2.4939 - acc:
0.1639 - val_loss: 2.4568 - val_acc: 0.1776
Epoch 6/50
221/221 [==============================] - ETA: 0s - loss: 2.3561 - acc: 0.1942
- f1_score:  0.0
221/221 [==============================] - 101s 455ms/step - loss: 2.3561 - acc:
0.1942 - val_loss: 2.3546 - val_acc: 0.2165
Epoch 7/50
221/221 [==============================] - ETA: 0s - loss: 2.2327 - acc: 0.2379
- f1_score:  0.0
221/221 [==============================] - 101s 456ms/step - loss: 2.2327 - acc:
0.2379 - val_loss: 2.4173 - val_acc: 0.2025
Epoch 8/50
221/221 [==============================] - ETA: 0s - loss: 2.1095 - acc: 0.2680
```

```
- f1_score:  0.0
221/221 [==============================] - 101s 455ms/step - loss: 2.1095 - acc:
0.2680 - val_loss: 2.2953 - val_acc: 0.2390
Epoch 9/50
221/221 [==============================] - ETA: 0s - loss: 2.0316 - acc: 0.2923
- f1_score:  0.0012738853503184713
221/221 [==============================] - 101s 455ms/step - loss: 2.0316 - acc:
0.2923 - val_loss: 2.2927 - val_acc: 0.2354
Epoch 10/50
221/221 [==============================] - ETA: 0s - loss: 1.9370 - acc: 0.3263
- f1_score:  0.000849437247823317
221/221 [==============================] - 101s 458ms/step - loss: 1.9370 - acc:
0.3263 - val_loss: 2.2948 - val_acc: 0.2481
Epoch 11/50
221/221 [==============================] - ETA: 0s - loss: 1.8844 - acc: 0.3367
- f1_score:  0.0004248088360237893
221/221 [==============================] - 100s 453ms/step - loss: 1.8844 - acc:
0.3367 - val_loss: 2.3169 - val_acc: 0.2513
Epoch 12/50
221/221 [==============================] - ETA: 0s - loss: 1.8434 - acc: 0.3487
- f1_score:  0.0004248088360237893
221/221 [==============================] - 101s 455ms/step - loss: 1.8434 - acc:
0.3487 - val_loss: 2.3291 - val_acc: 0.2447
Epoch 13/50
221/221 [==============================] - ETA: 0s - loss: 1.7925 - acc: 0.3682
- f1_score:  0.000849437247823317
221/221 [==============================] - 101s 455ms/step - loss: 1.7925 - acc:
0.3682 - val_loss: 2.3409 - val_acc: 0.2505
Epoch 00013: early stopping
```

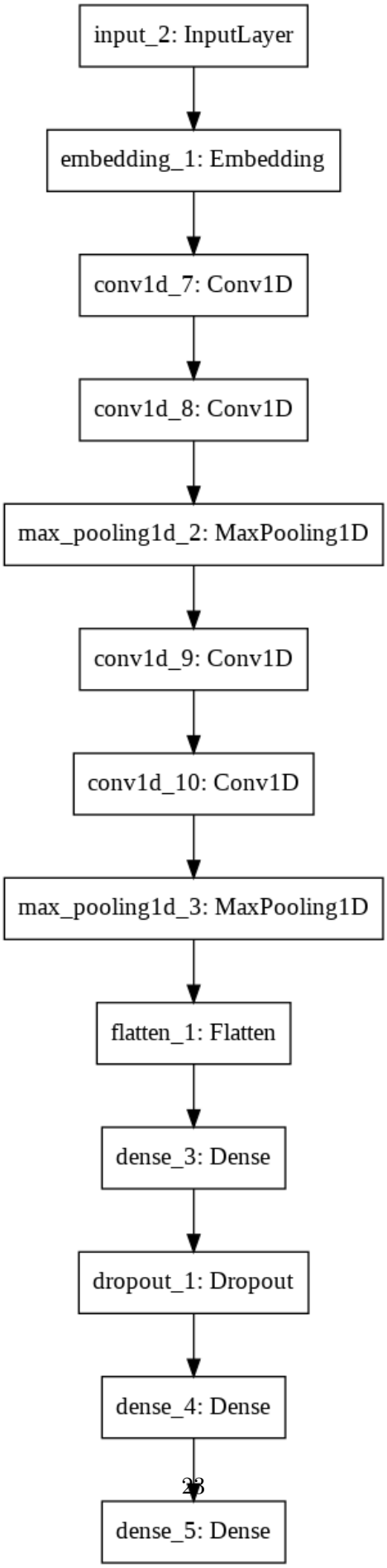
[ ]:
```
!tensorboard dev upload --logdir /content/logs \
  --name "Doc Classification using 1D CNN Model_2" \
  --description "Training results from https://colab.research.google.com/drive/
↪1eD9wkwlZTz8JRIAcFa1fXbyeOi90vISB#scrollTo=BPUvjkh2aMMP" \
  --one_shot
```

```
2020-10-08 15:15:16.617250: I
tensorflow/stream_executor/platform/default/dso_loader.cc:48] Successfully
opened dynamic library libcudart.so.10.1
Upload started and will continue reading any new data as it's added
to the logdir. To stop uploading, press Ctrl-C.

View your TensorBoard live at:
https://tensorboard.dev/experiment/PC5B7VEgSKizxWRdxjLVOA/

[2020-10-08T15:15:18] Uploader started.
[2020-10-08T15:15:19] Total uploaded: 52 scalars, 0 tensors, 1 binary
objects (34.7 kB)
```

```
Listening for new data in logdir…
Done. View your TensorBoard at
https://tensorboard.dev/experiment/PC5B7VEgSKizxWRdxjLV0A/
```

[ ]:
```
tf.keras.utils.plot_model(Model_2, to_file='model.png', show_shapes=False,
                          show_layer_names=True, rankdir='TB',␣
↪expand_nested=False, dpi=96)
```

[ ]:


input_2: InputLayer
embedding_1: Embedding
conv1d_7: Conv1D
conv1d_8: Conv1D
max_pooling1d_2: MaxPooling1D
conv1d_9: Conv1D
conv1d_10: Conv1D
max_pooling1d_3: MaxPooling1D
flatten_1: Flatten
dense_3: Dense
dropout_1: Dropout
dense_4: Dense
dense_5: Dense

6 Observations

We can see the Following results of the same Data from 2 different models

Model - 1: Using Word embedding and Glove Vectors

- Used the Tensorflow Tokenizer with custom filter for excluding the '_' from filtering out.
- The Tokenizer was based on Word Tokens And Decided the max lenghth by trade off as mentioned.
- The results were pretty Good with almost 83% accuracy on validation data

  .

Model - 2: Using Character level embedding and Glove Vectors

- Used the Tensorflow Tokenizer with Character level Tokenizing.
- The Tokenizer was based on Character Tokens And Decided the max lenghth by trade off as mentioned.
- The results were lower side compared to Word Embeddings ending up with 25% accuracy on validation data