Imports

In [1]:

```
from google.colab import drive
drive.mount('/content/drive')
```

```
Mounted at /content/drive
```

In [2]:

```
import pickle
train_df = pickle.load(open('/content/drive/MyDrive/Copy of train_df_prep.pkl','rb'))
```

In [3]:

```
!pip install transformers
```

```
Collecting transformers
  Downloading transformers-4.15.0-py3-none-any.whl (3.4 MB)
     |████████████████████████████████| 3.4 MB 4.2 MB/s
Requirement already satisfied: requests in /usr/local/lib/python3.7/dist-packages (from t
ransformers) (2.23.0)
Collecting sacremoses
  Downloading sacremoses-0.0.46-py3-none-any.whl (895 kB)
     |████████████████████████████████| 895 kB 55.2 MB/s
Collecting pyyaml>=5.1
  Downloading PyYAML-6.0-cp37-cp37m-manylinux_2_5_x86_64.manylinux1_x86_64.manylinux_2_12
_x86_64.manylinux2010_x86_64.whl (596 kB)
     |████████████████████████████████| 596 kB 60.2 MB/s
Requirement already satisfied: importlib-metadata in /usr/local/lib/python3.7/dist-packag
es (from transformers) (4.8.2)
Requirement already satisfied: filelock in /usr/local/lib/python3.7/dist-packages (from t
ransformers) (3.4.0)
Requirement already satisfied: packaging>=20.0 in /usr/local/lib/python3.7/dist-packages
(from transformers) (21.3)
Collecting tokenizers<0.11,>=0.10.1
  Downloading tokenizers-0.10.3-cp37-cp37m-manylinux_2_5_x86_64.manylinux1_x86_64.manylin
ux_2_12_x86_64.manylinux2010_x86_64.whl (3.3 MB)
     |████████████████████████████████| 3.3 MB 48.7 MB/s
Requirement already satisfied: numpy>=1.17 in /usr/local/lib/python3.7/dist-packages (fro
m transformers) (1.19.5)
Requirement already satisfied: tqdm>=4.27 in /usr/local/lib/python3.7/dist-packages (from
transformers) (4.62.3)
Collecting huggingface-hub<1.0,>=0.1.0
  Downloading huggingface_hub-0.2.1-py3-none-any.whl (61 kB)
     |████████████████████████████████| 61 kB 411 kB/s
Requirement already satisfied: regex!=2019.12.17 in /usr/local/lib/python3.7/dist-package
s (from transformers) (2019.12.20)
Requirement already satisfied: typing-extensions>=3.7.4.3 in /usr/local/lib/python3.7/dis
t-packages (from huggingface-hub<1.0,>=0.1.0->transformers) (3.10.0.2)
Requirement already satisfied: pyparsing!=3.0.5,>=2.0.2 in /usr/local/lib/python3.7/dist-
packages (from packaging>=20.0->transformers) (3.0.6)
Requirement already satisfied: zipp>=0.5 in /usr/local/lib/python3.7/dist-packages (from
importlib-metadata->transformers) (3.6.0)
Requirement already satisfied: chardet<4,>=3.0.2 in /usr/local/lib/python3.7/dist-package
s (from requests->transformers) (3.0.4)
Requirement already satisfied: certifi>=2017.4.17 in /usr/local/lib/python3.7/dist-packag
es (from requests->transformers) (2021.10.8)
Requirement already satisfied: idna<3,>=2.5 in /usr/local/lib/python3.7/dist-packages (fr
om requests->transformers) (2.10)
Requirement already satisfied: urllib3!=1.25.0,!=1.25.1,<1.26,>=1.21.1 in /usr/local/lib/
python3.7/dist-packages (from requests->transformers) (1.24.3)
Requirement already satisfied: click in /usr/local/lib/python3.7/dist-packages (from sacr
emoses->transformers) (7.1.2)
Requirement already satisfied: six in /usr/local/lib/python3.7/dist-packages (from sacrem
oses->transformers) (1.15.0)
Requirement already satisfied: joblib in /usr/local/lib/python3.7/dist-packages (from sac
```

```
Requirement already satisfied: joblib in /usr/local/lib/python3.7/dist-packages (from sac
remoses->transformers) (1.1.0)
Installing collected packages: pyyaml, tokenizers, sacremoses, huggingface-hub, transform
ers
  Attempting uninstall: pyyaml
    Found existing installation: PyYAML 3.13
    Uninstalling PyYAML-3.13:
      Successfully uninstalled PyYAML-3.13
Successfully installed huggingface-hub-0.2.1 pyyaml-6.0 sacremoses-0.0.46 tokenizers-0.10
.3 transformers-4.15.0
```

In [ ]:

```
from transformers import BertTokenizer,DistilBertTokenizer
tokenizer2 = DistilBertTokenizer.from_pretrained('distilbert-base-uncased',add_prefix_spa
ce=True)          # tokenizer for distill bert
```

In [4]:

```
from transformers import BertTokenizer,DistilBertTokenizer
# tokenizer for bert
tokenizer = BertTokenizer.from_pretrained('bert-base-uncased',add_prefix_space=True)
```

In [5]:

```
from transformers import TFBertForQuestionAnswering,TFDistilBertForQuestionAnswering
dbert= TFDistilBertForQuestionAnswering.from_pretrained('distilbert-base-uncased')
bert= TFBertForQuestionAnswering.from_pretrained('bert-base-uncased')
```

```
All model checkpoint layers were used when initializing TFBertForQuestionAnswering.

Some layers of TFBertForQuestionAnswering were not initialized from the model checkpoint
at bert-base-uncased and are newly initialized: ['qa_outputs']
You should probably TRAIN this model on a down-stream task to be able to use it for predi
ctions and inference.
```

In [6]:

```
from tensorflow.keras.models import Model
from tensorflow.keras.layers import Input,Softmax,Dense,Activation,Dropout
from sklearn.model_selection import train_test_split
import numpy as np
import pandas as pd
from tqdm import tqdm
import tensorflow as tf
from tensorflow.keras.callbacks import ModelCheckpoint
from tensorflow.keras.callbacks import CSVLogger,EarlyStopping,ModelCheckpoint, LearningR
ateScheduler
from tensorflow.keras.optimizers import Adam
from tensorflow.keras.models import Sequential,Model
from tensorflow.keras.layers import Activation, Dropout, Flatten, Dense, Conv2D, MaxPool
ing2D,Embedding,LSTM,Embedding,Input,Softmax,Dense,Activation,Dropout
# from fuzzywuzzy import fuzz
from sklearn.preprocessing import LabelEncoder,OneHotEncoder
import time
from time import time
from tensorflow.keras.preprocessing.text import Tokenizer
from tensorflow.keras.preprocessing.sequence import pad_sequences
import matplotlib.pyplot as plt
import seaborn as sns
```

In [7]:

```
x_train, x_val , y_train , y_val = train_test_split(train_df[['text','sentiment']],train
_df['selected_text'],test_size=0.2, random_state=42)
```

```
x_train.shape, x_val.shape , y_train.shape , y_val.shape
```

Out[7]:

```
((21976, 2), (5495, 2), (21976,), (5495,))
```

metric

In [ ]:

```
def jaccard(str1,str2):
  a=set(str1.lower().split())
  b=set(str2.lower().split())
  c=a.intersection(b)
  return float(len(c)) / (len(a) + len(b) - len(c))
```

Models_comparision

pre_processing

text to input_ids

In [9]:

```
def train_prep(MAX_LEN,tokenizer):
                                                                    # train input
_ids and attten_mask  start and end tokens indexes
  count = x_train.shape[0]
  input_ids = np.zeros((count,MAX_LEN),dtype='int32')
  attention_mask = np.zeros((count,MAX_LEN),dtype='int32')
  start_tokens = np.zeros((count,MAX_LEN),dtype='int32')
  end_tokens = np.zeros((count,MAX_LEN),dtype='int32')
  toks_all = []

  count=0
  for i,each in tqdm(enumerate(x_train.values)):
    val = tokenizer.encode_plus(each[0],each[1],add_special_tokens=True,max_length=MAX_L
EN,return_attention_mask=True,pad_to_max_length=True,return_tensors='tf',verbose=False)
    input_ids[i] = val['input_ids']
    attention_mask[i] = val['attention_mask']
    text1 = " "+" ".join(each[0].split())
    text2 = " ".join(y_train.values[i].split())

    idx = text1.find(text2)
    chars = np.zeros((len(text1)))
    chars[idx:idx+len(text2)]=1
    if text1[idx-1]==' ':
      chars[idx-1] = 1


    enc = tokenizer.encode(text1)
    offsets = []; idx=0
    for t in enc:
      w=tokenizer.decode([t])
      offsets.append((idx,idx+len(w)))
      idx += len(w)

    toks = []
    for c,(a,b) in enumerate(offsets):
      sm = np.sum(chars[a:b])
      if sm>0:
        toks.append(c)
    toks_all.append(toks)
    if len(toks)>0:
      count+=1
      start_tokens[i,(toks[0])+1] = 1
      end_tokens[i,(toks[-1])+1] = 1
```

```
  return toks_all,input_ids,attention_mask,start_tokens,end_tokens
```

In [11]:

```
toks_all,input_ids,attention_mask,start_tokens,end_tokens = train_prep(MAX_LEN=92,tokeni
zer=tokenizer)      # train ids
```

In [ ]:

```
def valid_prep(MAX_LEN,tokenizer):

  count = y_val.shape[0]
  input_ids_val = np.zeros((count,MAX_LEN),dtype='int32')
  attention_mask_val = np.zeros((count,MAX_LEN),dtype='int32')
  start_tokens_val = np.zeros((count,MAX_LEN),dtype='int32')
  end_tokens_val = np.zeros((count,MAX_LEN),dtype='int32')

  count=0
  for i,each in tqdm(enumerate(x_val.values)):
    val = tokenizer.encode_plus(each[0],each[1],add_special_tokens=True,max_length=MAX_L
EN,return_attention_mask=True,pad_to_max_length=True,return_tensors='tf',verbose=False)
    input_ids_val[i] = val['input_ids']
    attention_mask_val[i] = val['attention_mask']
    text1 = " "+" ".join(each[0].split())
    text2 = " ".join(y_val.values[i].split())
    #finding the start index
    idx = text1.find(text2)
    chars = np.zeros((len(text1)))
    chars[idx:idx+len(text2)]=1
    if text1[idx-1]==' ':
      chars[idx-1] = 1


    enc = tokenizer.encode(text1)
    offsets = []; idx=0
    for t in enc:
      w=tokenizer.decode([t])
      offsets.append((idx,idx+len(w)))
      idx += len(w)

    toks = []
    for c,(a,b) in enumerate(offsets):
      sm = np.sum(chars[a:b])
      if sm>0:
        toks.append(c)
    toks_all.append(toks)
    if len(toks)>0:
      count+=1
      start_tokens_val[i,(toks[0])+1] = 1
      end_tokens_val[i,(toks[-1])+1] = 1

  return input_ids_val,attention_mask_val,start_tokens_val,end_tokens_val
```

In [ ]:

```
input_ids_val,attention_mask_val,start_tokens_val,end_tokens_val = valid_prep(MAX_LEN=92,
tokenizer=tokenizer)             # valid ids
```

```
5495it [00:09, 586.80it/s]
```

In [15]:

```
input_data = (input_ids,attention_mask)
output_data = (start_tokens,end_tokens)
val = (input_ids_val,attention_mask_val)
output_val = (start_tokens_val,end_tokens_val)
val_data = (val,output_val)

train_dataset = tf.data.Dataset.from_tensor_slices((input_data, output_data)).shuffle(bu
ffer_size=1024).batch(32)
```

```
val_dataset = tf.data.Dataset.from_tensor_slices(val_data).batch(32)
```

DBERT_QA+dense

In [ ]:

```
MAX_LEN=128
# reload
def create_model():
  input1 = Input(shape=(MAX_LEN,),name='input_id',dtype=tf.int32)
  input2 = Input(shape=(MAX_LEN,),name='attention_mask',dtype=tf.int32)
  start_scores,end_scores = dbert(input1,attention_mask = input2).values()
  dense1 = Dense(units=MAX_LEN,activation='relu',name='dense1',kernel_regularizer = tf.k
eras.regularizers.L2(l2=0.00001))(start_scores)
  softmax1 = Activation('softmax')(dense1)
  dense2 = Dense(units=MAX_LEN,activation='relu',name='dense2',kernel_regularizer = tf.k
eras.regularizers.L2(l2=0.00001))(end_scores)
  softmax2 = Activation('softmax')(dense2)
  model = Model(inputs=[input1,input2],outputs=[softmax1,softmax2])
  opt = tf.keras.optimizers.Adam(learning_rate=0.0001, epsilon=1e-08, clipnorm=1.0)
  model.compile(optimizer=opt,loss='categorical_crossentropy')
  return model

model = create_model()

model.load_weights('/content/drive/MyDrive/Copy of DBertQA_model.hdf5')
```

In [ ]:

```
model.summary()
```

```
Model: "model_3"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 input_id (InputLayer)       [(None, 128)]             0

 attention_mask (InputLayer  [(None, 128)]             0
 )

 tf_distil_bert_for_question_an  multiple              66364418
 swering (TFDistilBertForQuesti
 onAnswering)

 dense1 (Dense)              (None, 128)               16512

 dense2 (Dense)              (None, 128)               16512

 activation_6 (Activation)   (None, 128)               0

 activation_7 (Activation)   (None, 128)               0
```

```
activation_7 (Activation)       (None, 128)          0           [ dense2[0][0] ]

==================================================================================================
Total params: 66,397,442
Trainable params: 66,397,442
Non-trainable params: 0
__________________________________________________________________________________________________
```

predictions

In [ ]:

```
val = (input_ids_val,attention_mask_val)
start_val , end_val = model.predict(val)                  # validation predictions

pred_values_val=[]
for i in tqdm(range(start_val.shape[0])):
  a = np.argmax(start_val[i])
  b = np.argmax(end_val[i])
  text1 = " "+" ".join(x_val['text'].values[i].split())                  # pred_answer
  enc = tokenizer2.encode(text1)
  val = tokenizer2.decode(enc[a:b+1])
  pred_values_val.append(val)
for i in range(len(pred_values_val)):
  pred_values_val[i] = pred_values_val[i].replace('[SEP]','')   # removing [sep] token

scores_val=[]
x_val['pred_text'] = pred_values_val
x_val['selected_text'] = y_val.values
scores=[]
for i in tqdm(range(x_val.shape[0])):
  scores_val.append(jaccard(x_val['pred_text'].values[i],x_val['selected_text'].values[i
]))            # jaccard score calculations
x_val['jaccard']=scores_val
```

In [ ]:

```
x_val.head(20)
```

Out[ ]:

	text	sentiment	pred_text	selected_text	jaccard
7917	this is my update	neutral	this is my update	this is my update	1.000000
15845	whaaat i still have next week	neutral	whaaat i still have next week	whaaat i still have next week	1.000000
21278	happy birthday little sister of mine also go...	positive	happy birthday little sister of mine also good...	happy birthday little sister of mine	0.600000
22338	do some research for my article	neutral	do some research for my article	do some research for my article	1.000000
22474	are you okay	neutral	are you okay	are you okay	1.000000
21560	turned my alarm off this morning because i tho...	negative	turned my alarm off this morning because i tho...	fail	0.043478
8870	elaines my online mommy too she gives good a...	positive	she gives good advice	she gives good advice	1.000000
22030	good ABUSE homie hahahahaha thats what im tal...	positive	good abuse ho	good	0.333333
6693	there are days of summervac school comes alo...	neutral	there are days of summervac school comes along...	the annual problem of r generation is finding ...	0.590909
15718	i have tea have just found a picture of the b...	neutral	i have tea have just found a picture of the bi...	i have tea have just found a picture of the b...	1.000000
15279	craving coffee	neutral	craving coffee	craving coffee	1.000000

	text	sentiment	pred_text	selected_text	jaccard
20672	time for tv in bedthen spending all day catchi...	positive	online summer class	i hate online summer class	0.600000
17239	well it almost was a good day guess i just ret...	positive	good day guess	good day	0.666667
26658	the ultimate shirt folding tool i saw using ...	positive	the ultimate shirt folding tool i saw using th...	ultimate	0.066667
6199	no months	neutral	no months	no months	1.000000
10794	the least i can do for you is retweet it when...	neutral	the least i can do for you is retweet it when ...	the least i can do for you is retweet it when ...	1.000000
2899	oh snap kinda nuts right now ive told at lea...	positive	oh snap kinda nuts right now ive told at least...	thanks	0.083333
12789	says gud eve guys lets play poker yeah cant re...	positive	yeah cant read	says gud eve guys	0.000000
5036	awesome im glad you like it fyi platinum no...	positive	awesome im	glad	0.000000
2938	im celebrating my mother and also celebrating...	positive	im celebrating my	celebrating	0.333333

In [ ]:

```
print('Mean training Jaccard score:',np.mean(x_val['jaccard']))
print("="*150)
print('Mean jaccard score for positive sentiment tweets:',np.mean(x_val[x_val['sentiment'
]=='positive']['jaccard']))
print("="*150)
print('Mean jaccard score for negative sentiment tweets',np.mean(x_val[x_val['sentiment']
=='negative']['jaccard']))
print("="*150)
print('Mean jaccard score for neutral sentiment tweets',np.mean(x_val[x_val['sentiment']=
='neutral']['jaccard']))
```

```
Mean training Jaccard score: 0.6101828553749853
==========================================================================================
============================================================
Mean jaccard score for positive sentiment tweets: 0.3745756631390002
==========================================================================================
============================================================
Mean jaccard score for negative sentiment tweets 0.35826182939871276
==========================================================================================
============================================================
Mean jaccard score for neutral sentiment tweets 0.9672193330825384
```

DBERT_QA+conv1d

In [ ]:

```
MAX_LEN =92
def DBERT_CNN():
  input1 = Input(shape=(MAX_LEN,),name='input_id',dtype=tf.int32)
  input2 = Input(shape=(MAX_LEN,),name='attention_mask',dtype=tf.int32)
  start_scores,end_scores = dbert(input1,attention_mask = input2).values()

  drop1 = Dropout(0.1)(start_scores)
  drop1  = tf.expand_dims(drop1,axis=-1)
  layer1 = tf.keras.layers.Conv1D(1,1)(drop1)
# conv1d instead dense
  layer1= Flatten()(layer1)
  softmax1 = Activation('softmax')(layer1)

  drop2 = Dropout(0.1)(end_scores)
  drop2  = tf.expand_dims(drop2,axis=-1)
  layer2 = tf.keras.layers.Conv1D(1,1)(drop2)                                    #
conv1d
  layer2 = Flatten()(layer2)
  softmax2 = Activation('softmax')(layer2)
```

```
  model = Model(inputs=[input1,input2],outputs=[softmax1,softmax2])

  opt = tf.keras.optimizers.Adam(learning_rate=3e-5, epsilon=1e-08, clipnorm=1.0)
  model.compile(optimizer=opt,loss='categorical_crossentropy')

  return model

model = DBERT_CNN()

model.load_weights('/content/drive/MyDrive/DBert_CNN_QA_model.hdf5')
```

predictions

In [ ]:

```
val = (input_ids_val,attention_mask_val)
start_val , end_val = model.predict(val)                  # validation predictions

pred_values_val=[]
for i in tqdm(range(start_val.shape[0])):
  a = np.argmax(start_val[i])
  b = np.argmax(end_val[i])
  text1 = " "+" ".join(x_val['text'].values[i].split())               # pred_answer
  enc = tokenizer2.encode(text1)
  val = tokenizer2.decode(enc[a:b+1])
  pred_values_val.append(val)
for i in range(len(pred_values_val)):
  pred_values_val[i] = pred_values_val[i].replace('[SEP]','')   # removing [sep] token

scores_val=[]
x_val['pred_text'] = pred_values_val
x_val['selected_text'] = y_val.values
scores=[]
for i in tqdm(range(x_val.shape[0])):
  scores_val.append(jaccard(x_val['pred_text'].values[i],x_val['selected_text'].values[i
]))           # jaccard score calculations
x_val['jaccard']=scores_val
```

In [ ]:

```
model.summary()
```

```
Model: "model_2"
__________________________________________________________________________________________
_________
 Layer (type)                   Output Shape         Param #     Connected to

==========================================================================================
=========
 input_id (InputLayer)          [(None, 92)]         0           []


 attention_mask (InputLayer)    [(None, 92)]         0           []


 tf_distil_bert_for_question_an  TFQuestionAnswering  66364418   ['input_id[0][0]',

 swering (TFDistilBertForQuesti  ModelOutput(loss=No              'attention_mask[0][0]']

 onAnswering)                   ne, start_logits=(N

                                one, 92),

                                 end_logits=(None,

                                92),

                                 hidden_states=None
```

```
                                , attentions=None)

 dropout_24 (Dropout)           (None, 92)           0           ['tf_distil_bert_for_qu
estion_ans                                                      wering[2][1]']

 dropout_25 (Dropout)           (None, 92)           0           ['tf_distil_bert_for_qu
estion_ans                                                      wering[2][0]']

 tf.expand_dims_4 (TFOpLambda)  (None, 92, 1)        0           ['dropout_24[0][0]']

 tf.expand_dims_5 (TFOpLambda)  (None, 92, 1)        0           ['dropout_25[0][0]']

 conv1d_4 (Conv1D)              (None, 92, 1)        2           ['tf.expand_dims_4[0][0
]']

 conv1d_5 (Conv1D)              (None, 92, 1)        2           ['tf.expand_dims_5[0][0
]']

 flatten_4 (Flatten)            (None, 92)           0           ['conv1d_4[0][0]']

 flatten_5 (Flatten)            (None, 92)           0           ['conv1d_5[0][0]']

 activation_4 (Activation)      (None, 92)           0           ['flatten_4[0][0]']

 activation_5 (Activation)      (None, 92)           0           ['flatten_5[0][0]']

==================================================================================
=========
Total params: 66,364,422
Trainable params: 66,364,422
Non-trainable params: 0
__________________________________________________________________________________
_________
```

In [ ]:

```
x_val.head(20)
```

Out[ ]:

	text	sentiment	pred_text	selected_text	jaccard
7917	this is my update	neutral	this is my update	this is my update	1.000000
15845	whaaat i still have next week	neutral	whaaat i still have next week	whaaat i still have next week	1.000000
21278	happy birthday little sister of mine also go...	positive	happy birthday little	happy birthday little sister of mine	0.500000
22338	do some research for my article	neutral	do some research for my article	do some research for my article	1.000000

	text	sentiment	pred_text	selected_text	jaccard
22474	are you okay	neutral	are you okay	are you okay	1.000000
21560	turned my alarm off this morning because i tho...	negative	turned my alarm off this morning because i tho...	fail	0.043478
8870	elaines my online mommy too she gives good a...	positive	good advice	she gives good advice	0.500000
22030	good ABUSE homie hahahahaha thats what im tal...	positive	good	good	1.000000
6693	there are days of summervac school comes alo...	neutral	there are days of summervac school comes along...	the annual problem of r generation is finding ...	0.590909
15718	i have tea have just found a picture of the b...	neutral	i have tea have just found a picture of the bi...	i have tea have just found a picture of the b...	1.000000
15279	craving coffee	neutral	craving coffee	craving coffee	1.000000
20672	time for tv in bedthen spending all day catchi...	negative	online summer classes	i hate online summer classes	0.600000
17239	well it almost was a good day guess i just ret...	positive	day guess	good day	0.333333
26658	the ultimate shirt folding tool i saw using ...	positive	the ultimate shirt folding tool i saw using th...	ultimate	0.062500
6199	no months	neutral	no months	no months	1.000000
10794	the least i can do for you is retweet it when...	neutral	the least i can do for you is retweet it when ...	the least i can do for you is retweet it when ...	1.000000
2899	oh snap kinda nuts right now ive told at lea...	positive	kinda nuts right now ive told at least thanks ...	thanks	0.100000
12789	says gud eve guys lets play poker yeah cant re...	positive	##t read my poker face	says gud eve guys	0.000000
5036	awesome im glad you like it fyi platinum no...	positive	awesome im	glad	0.000000
2938	im celebrating my mother and also celebrating...	positive	im celebrating my	celebrating	0.333333

In [ ]:

```
print('Mean training Jaccard score:',np.mean(x_val['jaccard']))
print("="*150)
print('Mean jaccard score for positive sentiment tweets:',np.mean(x_val[x_val['sentiment'
]=='positive']['jaccard']))
print("="*150)
print('Mean jaccard score for negative sentiment tweets',np.mean(x_val[x_val['sentiment']
=='negative']['jaccard']))
print("="*150)
print('Mean jaccard score for neutral sentiment tweets',np.mean(x_val[x_val['sentiment']=
='neutral']['jaccard']))
```

```
Mean training Jaccard score: 0.6107009628532492
==========================================================================================
==========================================================
Mean jaccard score for positive sentiment tweets: 0.36968854032180715
==========================================================================================
==========================================================
Mean jaccard score for negative sentiment tweets 0.35657944122532753
==========================================================================================
==========================================================
Mean jaccard score for neutral sentiment tweets 0.9734503241642162
```

In [ ]:

```
```

BERT_QA+conv1d

In [ ]:

```
def BERT_QA():
  MAX_LEN = 92
  input1 = Input(shape=(MAX_LEN,),name='input_id',dtype=tf.int32)
  input2 = Input(shape=(MAX_LEN,),name='attention_mask',dtype=tf.int32)
  start_scores,end_scores = bert(input1,attention_mask = input2).values()

  drop1 = Dropout(0.5)(start_scores)
  drop1  = tf.expand_dims(drop1,axis=-1)
  layer1 = tf.keras.layers.Conv1D(1,1)(drop1)
# conv1d instead dense
  layer1= Flatten()(layer1)
  softmax1 = Activation('softmax')(layer1)

  drop2 = Dropout(0.5)(end_scores)
  drop2  = tf.expand_dims(drop2,axis=-1)
  layer2 = tf.keras.layers.Conv1D(1,1)(drop2)                                    #
conv1d
  layer2 = Flatten()(layer2)
  softmax2 = Activation('softmax')(layer2)

  model = Model(inputs=[input1,input2],outputs=[softmax1,softmax2])
  opt = tf.keras.optimizers.Adam(learning_rate=2e-5, epsilon=1e-08, clipnorm=1.0)
  model.compile(optimizer=opt,loss='categorical_crossentropy')

  return model

model = BERT_QA()
model.load_weights('/content/drive/MyDrive/Copy of Copy of Bert_CNN_QA_model.hdf5')
```

In [ ]:

```
model.summary()
```

```
Model: "model_5"
__________________________________________________________________________________________
 Layer (type)                   Output Shape         Param #     Connected to
==========================================================================================
 input_id (InputLayer)          [(None, 92)]         0           []


 attention_mask (InputLayer)    [(None, 92)]         0           []


 tf_bert_for_question_answering  TFQuestionAnswering  108893186  ['input_id[0][0]',
  (TFBertForQuestionAnswering)  ModelOutput(loss=No               'attention_mask[0][0]']
                                ne, start_logits=(N
                                one, 92),
                                 end_logits=(None,
                                92),
                                 hidden_states=None
                                , attentions=None)


 dropout_85 (Dropout)           (None, 92)           0           ['tf_bert_for_question_
answering[
                                                                1][1]']
```

```
 dropout_86 (Dropout)           (None, 92)           0           ['tf_bert_for_question_
answering[
                                                                 1][0]']


 tf.expand_dims_8 (TFOpLambda)  (None, 92, 1)        0           ['dropout_85[0][0]']


 tf.expand_dims_9 (TFOpLambda)  (None, 92, 1)        0           ['dropout_86[0][0]']


 conv1d_8 (Conv1D)              (None, 92, 1)        2           ['tf.expand_dims_8[0][0
]']

 conv1d_9 (Conv1D)              (None, 92, 1)        2           ['tf.expand_dims_9[0][0
]']

 flatten_8 (Flatten)            (None, 92)           0           ['conv1d_8[0][0]']


 flatten_9 (Flatten)            (None, 92)           0           ['conv1d_9[0][0]']


 activation_10 (Activation)     (None, 92)           0           ['flatten_8[0][0]']


 activation_11 (Activation)     (None, 92)           0           ['flatten_9[0][0]']


==================================================================================================
=========
Total params: 108,893,190
Trainable params: 108,893,190
Non-trainable params: 0
__________________________________________________________________________________________________
_________
```

train_performance

In [ ]:

```
input_data = (input_ids,attention_mask)
start , end = model.predict(input_data)

pred_values=[]
for i in tqdm(range(start.shape[0])):
  a = np.argmax(start[i])
  b = np.argmax(end[i])
  text1 = " "+" ".join(x_train['text'].values[i].split())
  enc = tokenizer.encode(text1)
  val = tokenizer.decode(enc[a:b+1])
  pred_values.append(val)
for i in range(len(pred_values)):
  pred_values[i] = pred_values[i].replace('[SEP]','')  # removing [sep] token

x_train['pred_text'] = pred_values
x_train['selected_text'] = y_train.values
scores=[]
for i in tqdm(range(x_train.shape[0])):
  scores.append(jaccard(x_train['pred_text'].values[i],x_train['selected_text'].values[i
]))
```

```
x_train['jaccard']=scores
```

```
100%|██████████| 21976/21976 [00:18<00:00, 1181.78it/s]
```

In [ ]:

```
x_train.head(20)
```

Out[ ]:

	text	sentiment	pred_text	selected_text	jaccard
22723	awe thanks	positive	awe thanks	awe thanks	1.000000
1231	on my way to dazzle bar	neutral	on my way to dazzle bar	on my way to dazzle bar	1.000000
531	terrible haha that was new the fact that he c...	neutral	terrible haha that was new the fact that he co...	he couldnt do it should have cost his part	0.428571
22325	fun day with boo short but fun	positive	fun day	fun day	1.000000
18214	of course im almost there and theres traffic	neutral	of course im almost there and theres traffic	of course im almost there and theres traffic	1.000000
15839	im nauseous i need a yogurt or something	negative	im nauseous	nauseous	0.500000
17356	omg my head still hurts i need to get my comic...	negative	hurts i	hurts	0.500000
12502	my body is aching i can barely movebut its wor...	negative	my body is aching i can barely movebu	barely	0.125000
25623	oh no my fan broke noooooooooooo great now i ...	negative	##ooooooooo	noooooooooooo	0.000000
12306	are you tinkn the people on the street in ny ...	neutral	are you tinkn the people on the street in ny w...	are you tinkn the people on the street in ny w...	1.000000
2863	u no that little prob with ur twitter that ha...	positive	this will help u fix it	mayb this will help u fix it	0.857143
7457	to my pretty lady happy mothers day shes the ...	positive	happy mothers	happy	0.500000
21656	its a an mk mentalityi think	neutral	its a an mk mentalityi think	its a an mk mentalityi think	1.000000
15772	going to shibuya meet my mom get my contact le...	neutral	going to shibuya meet my mom get my contact le...	going to shibuya meet my mom get my contact le...	1.000000
14740	thanks i love the word crikey its like my sayin	positive	thanks i	thanks	0.500000
7376	getting bored of walking up and down the stairs	negative	getting bored of	getting bored of walking up and down the stairs	0.333333
18461	feeling pretty tired and lonely	negative	feeling pretty tired and lonely	feeling pretty tired and lonely	1.000000
5976	ohhh how lovely im glad that you had a grea...	positive	ohhh how lovely im glad that you had a great t...	ohhh how lovely im glad that you had a great t...	1.000000
12647	i made roomi dont have a bed from how much ro...	negative	i made roomi dont have a bed from how much roo...	outta space	0.095238
15760	ABUSEpoints at facebook messageABUSE	neutral	abusepoints at facebook messageabuse	ABUSEpoints at facebook messageABUSE	1.000000

In [ ]:

```
print('Mean training Jaccard score:',np.mean(x_train['jaccard']))
print("="*150)
print('Mean jaccard score for positive sentiment tweets:',np.mean(x_train[x_train['sentiment']=='positive']['jaccard']))
print("="*150)
print('Mean jaccard score for negative sentiment tweets',np.mean(x_train[x_train['sentiment']=='negative']['jaccard']))
print("="*150)
print('Mean jaccard score for neutral sentiment tweets',np.mean(x_train[x_train['sentiment']=='neutral']['jaccard']))
```

```
Mean training jaccard score: 0.6923385846931966
================================================================================================
============================================================
Mean jaccard score for positive sentiment tweets: 0.4911920594886255
================================================================================================
============================================================
Mean jaccard score for negative sentiment tweets 0.5105602910554877
================================================================================================
============================================================
Mean jaccard score for neutral sentiment tweets 0.9748906057382648
```

Validation_performance

In [ ]:

```
val = (input_ids_val,attention_mask_val)
start_val , end_val = model.predict(val)                # validation predictions

pred_values_val=[]
for i in tqdm(range(start_val.shape[0])):
  a = np.argmax(start_val[i])
  b = np.argmax(end_val[i])
  text1 = " "+" ".join(x_val['text'].values[i].split())              # pred_answer
  enc = tokenizer2.encode(text1)
  val = tokenizer2.decode(enc[a:b+1])
  pred_values_val.append(val)
for i in range(len(pred_values_val)):
  pred_values_val[i] = pred_values_val[i].replace('[SEP]','')  # removing [sep] token

scores_val=[]
x_val['pred_text'] = pred_values_val
x_val['selected_text'] = y_val.values
scores=[]
for i in tqdm(range(x_val.shape[0])):
  scores_val.append(jaccard(x_val['pred_text'].values[i],x_val['selected_text'].values[i
]))           # jaccard score calculations
x_val['jaccard']=scores_val
```

In [ ]:

```
x_val.head(20)
```

Out[ ]:

	text	sentiment	pred_text	selected_text	jaccard
7917	this is my update	neutral	this is my update	this is my update	1.000000
15845	whaaat i still have next week	neutral	whaaat i still have next week	whaaat i still have next week	1.000000
21278	happy birthday little sister of mine also go...	positive	happy birthday	happy birthday little sister of mine	0.333333
22338	do some research for my article	neutral	do some research for my article	do some research for my article	1.000000
22474	are you okay	neutral	are you okay	are you okay	1.000000
21560	turned my alarm off this morning because i tho...	negative		fail	0.000000
8870	elaines my online mommy too she gives good a...	positive	good advice	she gives good advice	0.500000
22030	good ABUSE homie hahahahaha thats what im tal...	positive	good	good	1.000000
6693	there are days of summervac school comes alo...	neutral	there are days of summervac school comes along...	the annual problem of r generation is finding ...	0.590909
15718	i have tea have just found a picture of the b...	neutral	i have tea have just found a picture of the bi...	i have tea have just found a picture of the b...	1.000000
15279	craving coffee	neutral	craving coffee	craving coffee	1.000000
20672	time for tv in bedthen spending all	negative	online summer	i hate online summer classes	0.400000

	text	sentiment	pred_text	selected_text	jaccard
17239	well it almost was a good day guess i just ret...	positive	day guess	good day	0.333333
26658	the ultimate shirt folding tool i saw using ...	positive	the ultimate shirt folding tool i saw using th...	ultimate	0.062500
6199	no months	neutral	no months	no months	1.000000
10794	the least i can do for you is retweet it when...	neutral	the least i can do for you is retweet it when ...	the least i can do for you is retweet it when ...	1.000000
2899	oh snap kinda nuts right now ive told at lea...	positive	babes	thanks	0.000000
12789	says gud eve guys lets play poker yeah cant re...	positive	cant read my poker face	says gud eve guys	0.000000
5036	awesome im glad you like it fyi platinum no...	positive	awesome im	glad	0.000000
2938	im celebrating my mother and also celebrating...	positive	im celebrating my mother and also celebrating ...	celebrating	0.083333

In [ ]:

```
print('Mean training Jaccard score:',np.mean(x_val['jaccard']))
print("="*150)
print('Mean jaccard score for positive sentiment tweets:',np.mean(x_val[x_val['sentiment'
]=='positive']['jaccard']))
print("="*150)
print('Mean jaccard score for negative sentiment tweets',np.mean(x_val[x_val['sentiment']
=='negative']['jaccard']))
print("="*150)
print('Mean jaccard score for neutral sentiment tweets',np.mean(x_val[x_val['sentiment']=
='neutral']['jaccard']))
```

```
Mean training Jaccard score: 0.6125855286682741
======================================================================================================================================================
Mean jaccard score for positive sentiment tweets: 0.3721725002502277
======================================================================================================================================================
Mean jaccard score for negative sentiment tweets 0.36163770200012707
======================================================================================================================================================
Mean jaccard score for neutral sentiment tweets 0.972672837052568
```

observations

1. **bertQA performing slight better than distill bertQA**
2. **bertQA have train jaccard 0.69233 and validation jaccard 0.6125 . so there isn't much over fitting .**

Quantization

In [ ]:

```
!pip install -q tensorflow
!pip install -q tensorflow-model-optimization
```

```
     |████████████████████████████████| 213 kB 5.2 MB/s
```

In [ ]:

```
import tensorflow as tf
import numpy as np
import tensorflow_model_optimization as tfmot
import tempfile
```

In [ ]:

```
def BERT_QA():
  MAX_LEN = 92
  input1 = Input(shape=(MAX_LEN,),name='input_id',dtype=tf.int32)
  input2 = Input(shape=(MAX_LEN,),name='attention_mask',dtype=tf.int32)
  start_scores,end_scores = bert(input1,attention_mask = input2).values()

  drop1 = Dropout(0.5)(start_scores)
  drop1  = tf.expand_dims(drop1,axis=-1)
  layer1 = tf.keras.layers.Conv1D(1,1)(drop1)
# conv1d instead dense
  layer1= Flatten()(layer1)
  softmax1 = Activation('softmax')(layer1)

  drop2 = Dropout(0.5)(end_scores)
  drop2  = tf.expand_dims(drop2,axis=-1)
  layer2 = tf.keras.layers.Conv1D(1,1)(drop2)                                    #
conv1d
  layer2 = Flatten()(layer2)
  softmax2 = Activation('softmax')(layer2)

  model = Model(inputs=[input1,input2],outputs=[softmax1,softmax2])
  opt = tf.keras.optimizers.Adam(learning_rate=2e-5, epsilon=1e-08, clipnorm=1.0)
  model.compile(optimizer=opt,loss='categorical_crossentropy')

  return model
model = BERT_QA()
model.load_weights('/content/drive/MyDrive/Copy of Copy of Bert_CNN_QA_model.hdf5')
```

In [ ]:

```

```

In [ ]:

```

```

In [ ]:

```
# model = tf.keras.models.load_model('model.h5')
converter = tf.lite.TFLiteConverter.from_keras_model(model)
converter.target_spec.supported_ops = [tf.lite.OpsSet.TFLITE_BUILTINS, tf.lite.OpsSet.SE
LECT_TF_OPS]
tflite_model = converter.convert()
#saving converted model in "converted_model.tflite" file
open("converted_model.tflite", "wb").write(tflite_model)
```

```
WARNING:absl:Found untraced functions such as embeddings_layer_call_fn, embeddings_layer_
call_and_return_conditional_losses, encoder_layer_call_fn, encoder_layer_call_and_return_
conditional_losses, LayerNorm_layer_call_fn while saving (showing 5 of 1040). These funct
ions will not be directly callable after loading.
```

```
INFO:tensorflow:Assets written to: /tmp/tmpgw8ct29s/assets
```

```
INFO:tensorflow:Assets written to: /tmp/tmpgw8ct29s/assets
INFO:absl:Using new converter: If you encounter a problem please file a bug. You can opt-
out by setting experimental_new_converter=False
WARNING:absl:Buffer deduplication procedure will be skipped when flatbuffer library is no
t properly loaded
```

Out[ ]:

```
434567104
```

In [ ]:

```
# model = tf.keras.models.load_model('model.h5')
converter = tf.lite.TFLiteConverter.from_keras_model(model)
converter.optimizations = [tf.lite.Optimize.DEFAULT]
converter.target_spec.supported_ops = [tf.lite.OpsSet.TFLITE_BUILTINS, tf.lite.OpsSet.SE
LECT_TF_OPS]

tflite_quant_model = converter.convert()
```

```
#saving converted model in "converted_quant_model.tflite" file
open("converted_quant_model.tflite", "wb").write(tflite_quant_model)
```

```
WARNING:absl:Found untraced functions such as embeddings_layer_call_fn, embeddings_layer_
call_and_return_conditional_losses, encoder_layer_call_fn, encoder_layer_call_and_return_
conditional_losses, LayerNorm_layer_call_fn while saving (showing 5 of 1040). These funct
ions will not be directly callable after loading.
```

```
INFO:tensorflow:Assets written to: /tmp/tmpiz72wso1/assets
```

```
INFO:tensorflow:Assets written to: /tmp/tmpiz72wso1/assets
INFO:absl:Using new converter: If you encounter a problem please file a bug. You can opt-
out by setting experimental_new_converter=False
WARNING:absl:Buffer deduplication procedure will be skipped when flatbuffer library is no
t properly loaded
```

Out[ ]:

```
109450336
```

In [ ]:

```
import os
print("Float model in Mb:", os.path.getsize('converted_model.tflite') / float(2**20))
print("Quantized model in Mb:", os.path.getsize('converted_quant_model.tflite') / float(
2**20))
print("Compression ratio:", os.path.getsize('converted_model.tflite')/os.path.getsize('c
onverted_quant_model.tflite'))
```

```
Float model in Mb: 414.43548583984375
Quantized model in Mb: 104.38265991210938
Compression ratio: 3.970348007885602
```

In [ ]:

```
import tensorflow as tf
import pickle
# val = pickle.load(open('/content/drive/MyDrive/quantization/val.pkl','rb'))
# Load TFLite model and allocate tensors.
interpreter = tf.lite.Interpreter(model_path="/content/drive/MyDrive/quantization/convert
ed_quant_model.tflite")
interpreter.allocate_tensors()
# Get input and output tensors.
input_details = interpreter.get_input_details()
output_details = interpreter.get_output_details()
# Test model on some input data.
input_shape = input_details[0]['shape']
start_output =  np.zeros(shape=(len(val[0]),92))
end_output = np.zeros(shape=(len(val[0]),92))
for i in range(len(val[0])):

  input_data0 = val[0][i].reshape(input_shape)
  input_data1 = val[1][i].reshape(input_shape)
  interpreter.set_tensor(input_details[1]['index'], input_data0)
  interpreter.set_tensor(input_details[0]['index'], input_data1)
  interpreter.invoke()
  start_output[i,:] = interpreter.get_tensor(output_details[0]['index'])
  end_output[i,:]  = interpreter.get_tensor(output_details[1]['index'])
```

In [ ]:

```
pred_values_val=[]
from tqdm import tqdm
for i in tqdm(range(start_output.shape[0])):
  a = np.argmax(start_output[i])
  b = np.argmax(end_output[i])
  text1 = " "+" ".join(x_val['text'].values[i].split())                # pred_answer
  enc = tokenizer.encode(text1)
  val = tokenizer.decode(enc[a:b+1])
  pred_values_val.append(val)
```

```
100%|██████████| 5495/5495 [00:03<00:00, 1584.55it/s]
```

In [ ]:

```
for i in range(len(pred_values_val)):
  pred_values_val[i] = pred_values_val[i].replace('[SEP]','')  # removing [sep] token
```

In [ ]:

```
scores_val=[]
x_val['pred_text'] = pred_values_val
x_val['selected_text'] = y_val.values
scores=[]
for i in tqdm(range(x_val.shape[0])):
  scores_val.append(jaccard(x_val['pred_text'].values[i],x_val['selected_text'].values[i
]))           # jaccard score calculations

x_val['jaccard']=scores_val
```

```
100%|██████████| 5495/5495 [00:00<00:00, 77530.68it/s]
```

In [ ]:

```
x_val
```

Out[ ]:

	text	sentiment	pred_text	selected_text	jaccard
7917	this is my update	neutral	this is my update	this is my update	1.000000
15845	whaaat i still have next week	neutral	whaaat i still have next week	whaaat i still have next week	1.000000
21278	happy birthday little sister of mine also go...	positive	happy birthday	happy birthday little sister of mine	0.333333
22338	do some research for my article	neutral	do some research for my article	do some research for my article	1.000000
22474	are you okay	neutral	are you okay	are you okay	1.000000
...	...	...	...	...	...
6816	has a gym day and is hoping to enjoy the last ...	positive	to enjoy the	enjoy	0.333333
8829	pappadeux has some yummy strawberry lemonade	positive	##ux has some yu	yummy strawberry lemonade	0.000000
24019	omg i saw ur update nd it said david archulet...	positive		awsome	0.000000
14448	starting tm alex and i are doing a whole week ...	neutral	starting tm alex and i are doing a whole week ...	starting tm alex and i are doing a whole week ...	1.000000
12569	people r weird	negative	r weird	people r weird	0.666667

5495 rows × 5 columns

In [ ]:

```
print('Mean training Jaccard score:',np.mean(x_val['jaccard']))
print("="*150)
print('Mean jaccard score for positive sentiment tweets:',np.mean(x_val[x_val['sentiment'
]=='positive']['jaccard']))
print("="*150)
print('Mean jaccard score for negative sentiment tweets',np.mean(x_val[x_val['sentiment']
=='negative']['jaccard']))
print("="*150)
print('Mean jaccard score for neutral sentiment tweets',np.mean(x_val[x_val['sentiment']=
='neutral']['jaccard']))
```

```
Mean training Jaccard score: 0.6195375047976922
==========================================================================================
==========================================================
Mean jaccard score for positive sentiment tweets: 0.3849089228986509
==========================================================================================
==========================================================
```

```
Mean jaccard score for negative sentiment tweets 0.37089788790476835
================================================================================================
============================================================
Mean jaccard score for neutral sentiment tweets 0.9735434417562145
```

post training analysis

In [ ]:

```
import pickle
pickle.dump(x_val,open('/content/drive/MyDrive/quantization/x_val.pkl','wb'))
```

In [12]:

```
import pickle
x_val = pickle.load(open('/content/drive/MyDrive/quantization/x_val.pkl','rb'))
```

In [13]:

```
x_val['Num_words_ST'] = x_val['selected_text'].apply(lambda x:len(str(x).split()))
# Number Of words in Selected Text
x_val['Num_word_text'] = x_val['text'].apply(lambda x:len(str(x).split()))
# Number Of words in main text
x_val['difference_in_words'] = x_val['Num_word_text'] - x_val['Num_words_ST']
# difference in number of words
x_val['Num_words_PT'] = x_val['pred_text'].apply(lambda x:len(str(x).split()))
# Number Of words in Predicted Text
x_val['difference_words_ST&PT'] = x_val['Num_words_ST'] - x_val['Num_words_PT']
#difference number of words btw selected text &pred_text
```

In [ ]:

```
x_val
```

Out[ ]:

	text	sentiment	pred_text	selected_text	jaccard	Num_words_PT	Num_words_ST	Num_word_text	difference_
7917	this is my update	neutral	this is my update	this is my update	1.000000	4	4	4	
15845	whaaat i still have next week	neutral	whaaat i still have next week	whaaat i still have next week	1.000000	6	6	6	
21278	happy birthday little sister of mine also go...	positive	happy birthday	happy birthday little sister of mine	0.333333	2	6	10	
22338	do some research for my article	neutral	do some research for my article	do some research for my article	1.000000	6	6	6	
22474	are you okay	neutral	are you okay	are you okay	1.000000	3	3	3	
...	...	...	...	...	...	...	...	...	
6816	has a gym day and is hoping to enjoy the last ...	positive	to enjoy the	enjoy	0.333333	3	1	15	
8829	pappadeux has some yummy strawberry	positive	##ux has some yu	yummy strawberry lemonade	0.000000	4	3	6	

	text	sentiment	pred_text	selected_text	jaccard	Num_words_PT	Num_words_ST	Num_word_text	difference_
	lemonade								
24019	omg i saw ur update nd it said david archulet...	positive		awsome	0.000000	0	1	20	
14448	starting tm alex and i are doing a whole week ...	neutral	starting tm alex and i are doing a whole week ...	starting tm alex and i are doing a whole week ...	1.000000	21	21	21	
12569	people r weird	negative	r weird	people r weird	0.666667	2	3	3	

5495 rows × 10 columns

bad

In [ ]:

```
bad = x_val[x_val.jaccard <= 1/3]
bad
```

Out[ ]:

	text	sentiment	pred_text	selected_text	jaccard	Num_words_PT	Num_words_ST	Num_word_text	difference_
21278	happy birthday little sister of mine also go...	positive	happy birthday	happy birthday little sister of mine	0.333333	2	6	10	
21560	turned my alarm off this morning because i tho...	negative	turned my alarm off this morning because i tho...	fail	0.043478	26	1	26	
17239	well it almost was a good day guess i just ret...	positive	day guess	good day	0.333333	2	2	12	
26658	the ultimate shirt folding tool i saw using ...	positive	the ultimate shirt folding tool i saw using th...	ultimate	0.062500	16	1	16	
2899	oh snap kinda nuts right now ive told at lea...	positive	oh snap kinda nuts right now ive told at least...	thanks	0.083333	12	1	12	
...	...	...	...	...	...	...	...	...	
7554	nice i wish twitter would tile mine	positive	nice i wish twitter	nice	0.250000	4	1	7	
	awww boo i ABUSE		awww boo i						

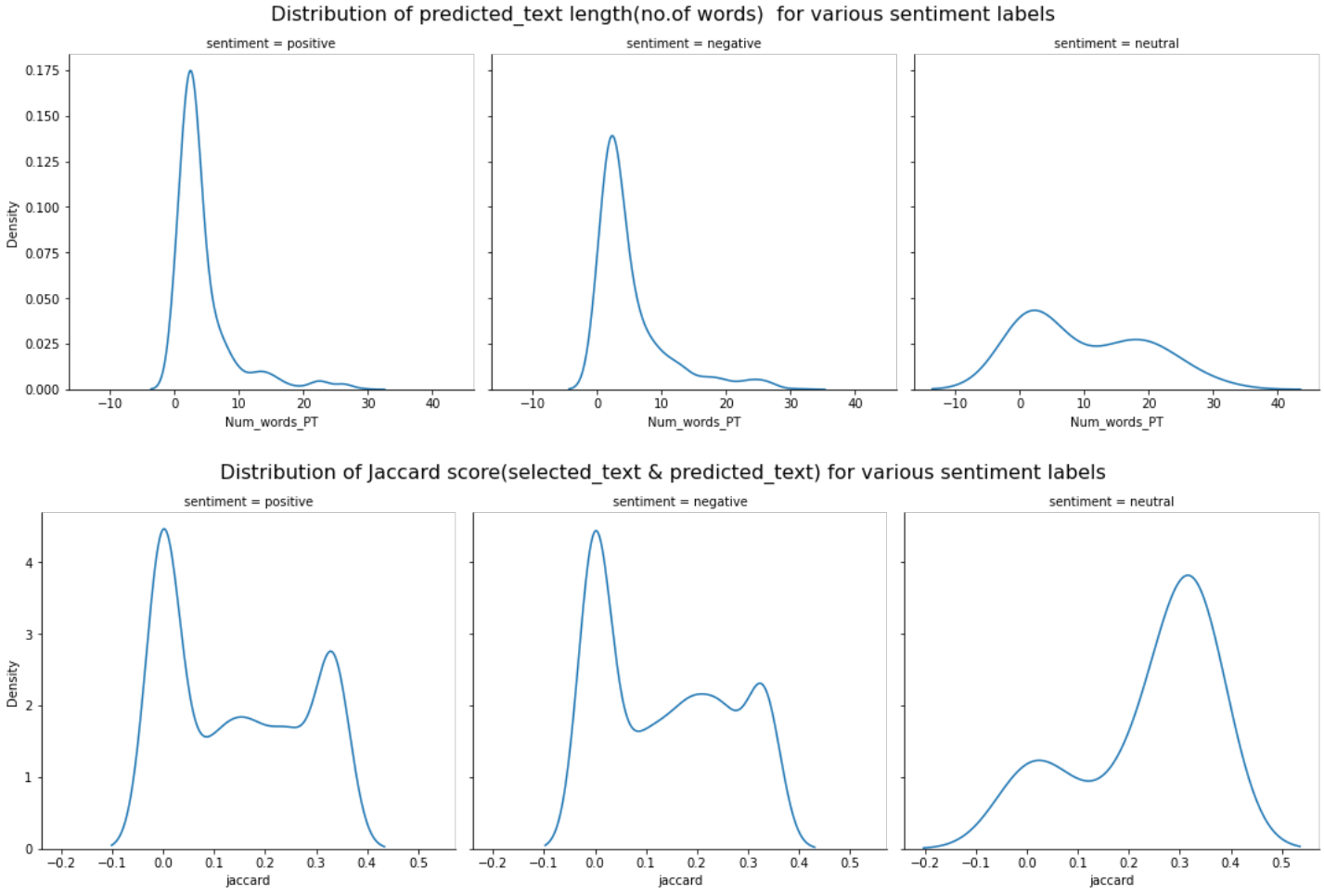
	text	sentiment	pred_text	selected_text	jaccard	Num_words_PT	Num_words_ST	Num_word_text	difference_
6135	loves doing all the girly th...	positive	abuse lovee doing all the girly thi...	ABUSE lovee	0.200000	10	2	10	
6816	has a gym day and is hoping to enjoy the last ...	positive	to enjoy the	enjoy	0.333333	3	1	15	
8829	pappadeux has some yummy strawberry lemonade	positive	##ux has some yu	yummy strawberry lemonade	0.000000	4	3	6	
24019	omg i saw ur updated nd it said david archulet...	positive		awsome	0.000000	0	1	20	

1875 rows × 10 columns

In [ ]:

```
g=sns.FacetGrid(data=bad,col='sentiment',height=5);
g.map(sns.kdeplot,'Num_words_PT');
plt.subplots_adjust(top=0.87,)
g.fig.suptitle('Distribution of predicted_text length(no.of words)  for various sentiment labels',fontsize=16);

g=sns.FacetGrid(data=bad,col='sentiment',height=5);
g.map(sns.kdeplot,'jaccard');
plt.subplots_adjust(top=0.87,)
g.fig.suptitle('Distribution of Jaccard score(selected_text & predicted_text) for various sentiment labels',fontsize=16);
```



observations

from the predicted text length curves.we can see that positive and negative texts number of words are more likely between 0 to 20 words unlike neutral text.

from distributions of jaccard scores of selected_text&predicted_text.here also we can see both positive and negative texts have mostly zero densed values unlike netral text

conclusion

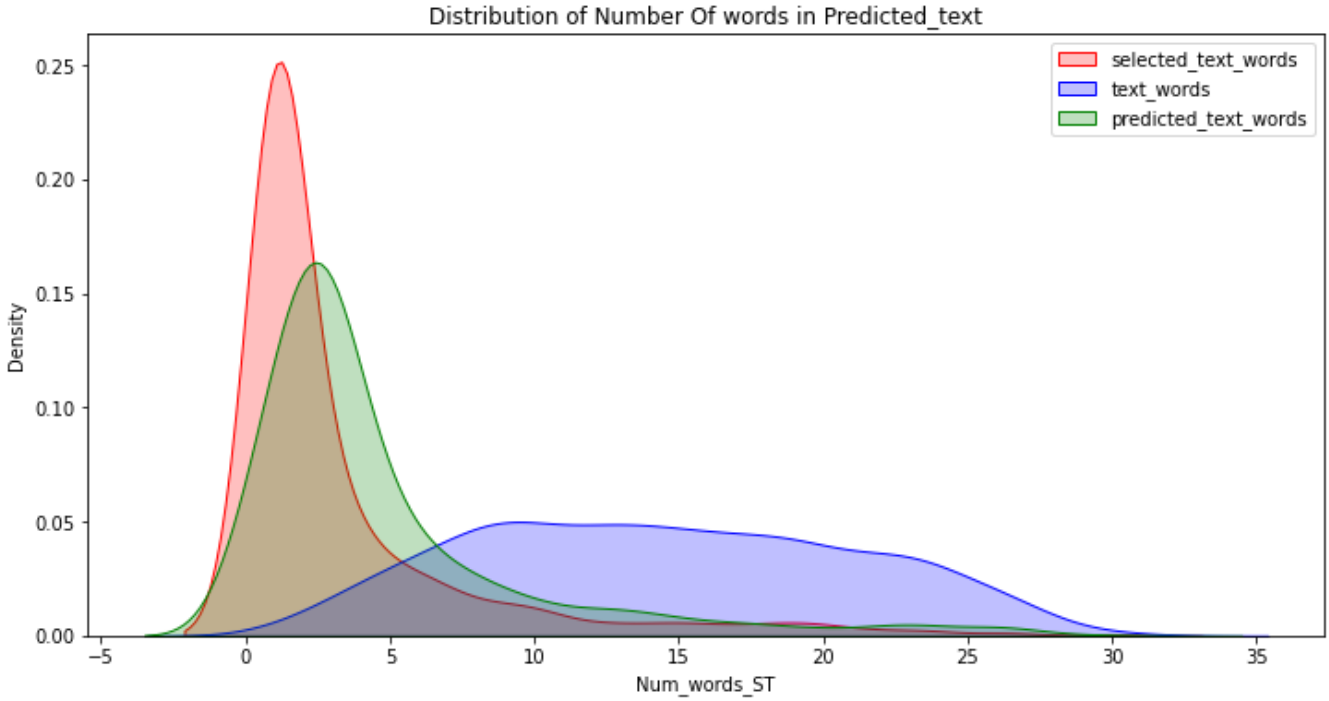
positive and negative texts have zero neared jaccard scores unlike neutral texts

In [ ]:

```
plt.figure(figsize=(12,6))
p1=sns.kdeplot(bad['Num_words_ST'], shade=True, color="r").set_title('Distribution of Num
ber Of words in Predicted_text')
p1=sns.kdeplot(bad['Num_word_text'], shade=True, color="b")
p1=sns.kdeplot(bad['Num_words_PT'], shade=True, color="g")
plt.legend(labels=['selected_text_words','text_words','predicted_text_words'])
```

Out[ ]:

```
<matplotlib.legend.Legend at 0x7fb7f06b2510>
```

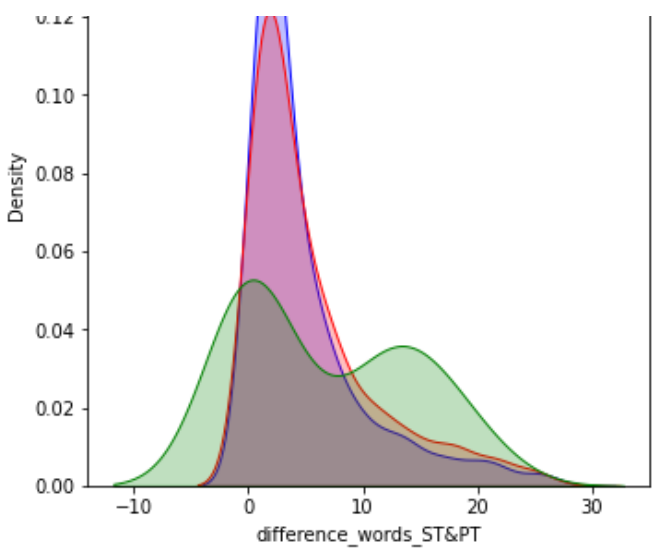


observation

predicted text and selected text are some what similar distributions

In [ ]:

```
plt.figure(figsize=(12,6))
plt.subplot(1,2,1)
p1=sns.kdeplot(bad[bad['sentiment']=='positive']['difference_words_ST&PT'], shade=True,
color="b").set_title('Distribution of Differences btw Selected_text and Predicted_text')
p2=sns.kdeplot(bad[bad['sentiment']=='negative']['difference_words_ST&PT'], shade=True,
color="r")
p2=sns.kdeplot(bad[bad['sentiment']=='neutral']['difference_words_ST&PT'], shade=True, c
olor="g")
plt.legend(labels=['difference in positive_words','difference in negative_words','differe
nce in neutral_words']) ;
```



observations

here difference represents predicted_text length > selected_text length

distributions of differences(length) of positive and negative texts are right skewed ranging from 0 to 30 words but for neutral text is different

conclusion

difference words distribution for positive and negative are very overlapping and right skewed

medium

In [ ]:

```
medium = x_val[(x_val.jaccard > 1/3)&(x_val.jaccard <= 2/3)]
medium
```

Out[ ]:

	text	sentiment	pred_text	selected_text	jaccard	Num_words_PT	Num_words_ST	Num_word_text	differen
8870	elaines my online mommy too she gives good a...	positive	good advice	she gives good advice	0.500000	2	4	9	
6693	there are days of summervac school comes alo...	neutral	there are days of summervac school comes along...	the annual problem of r generation is finding ...	0.590909	24	13	24	
20672	time for tv in bedthen spending all day catchi...	negative	online summer	i hate online summer classes	0.400000	2	5	17	
2859	soooo happy your back	positive	soooo happy	soooo happy your back	0.500000	2	4	4	
7956	lol its not the army its starfleet rules are ...	negative	lol its not the army its starfleet rules are m...	rules are meant to be broken to get the job done	0.500000	24	11	24	
...	...	...	...	...	...	...	...	...	
	extremly			extremly					

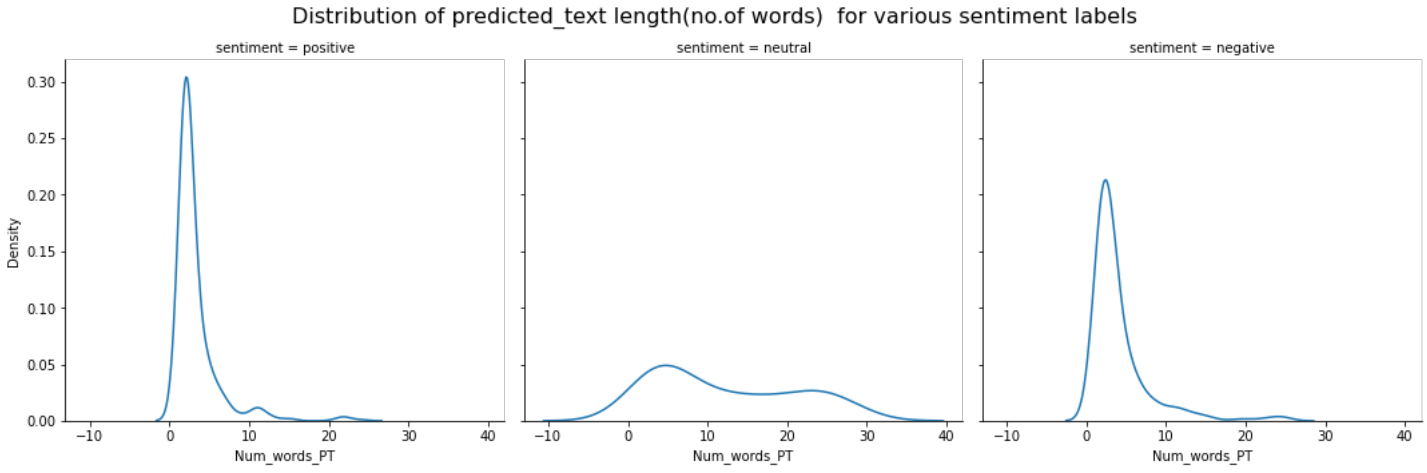
	text	sentiment	pred_text	selected_text	jaccard	Num_words_PT	Num_words_ST	Num_word_text	differen
17773	dean	neutral	extremly	dean	0.500000	1	2	2	
1892	missing mrs mcfox	negative	missing mrs	missing	0.500000	2	1	3	
25589	my brain is gonna explode a minute from now i...	negative	my brain is gonna explode a minute from now it...	my brain is gonna explode a minute from now	0.409091	25	9	25	
21533	good one	positive	good	good one	0.500000	1	2	2	
12569	people r weird	negative	r weird	people r weird	0.666667	2	3	3	

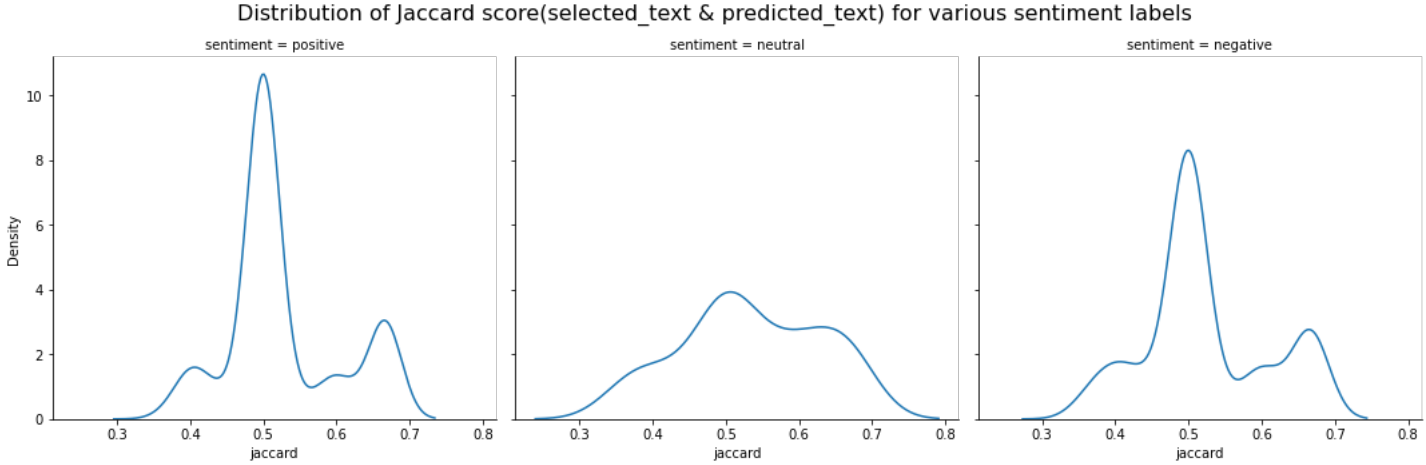
917 rows × 10 columns

In [ ]:

```
g=sns.FacetGrid(data=medium,col='sentiment',height=5);
g.map(sns.kdeplot,'Num_words_PT');
plt.subplots_adjust(top=0.87,)
g.fig.suptitle('Distribution of predicted_text length(no.of words)  for various sentiment labels',fontsize=16);

g=sns.FacetGrid(data=medium,col='sentiment',height=5);
g.map(sns.kdeplot,'jaccard');
plt.subplots_adjust(top=0.87,)
g.fig.suptitle('Distribution of Jaccard score(selected_text & predicted_text) for various sentiment labels',fontsize=16);
```





observations

from the predicted text length curves.we can see that positive and negative texts number of words are more likely between 0 to 10 words unlike neutral text.

from distributions of jaccard scores of selected_text&predicted_text.here we can see jaccard scores for each

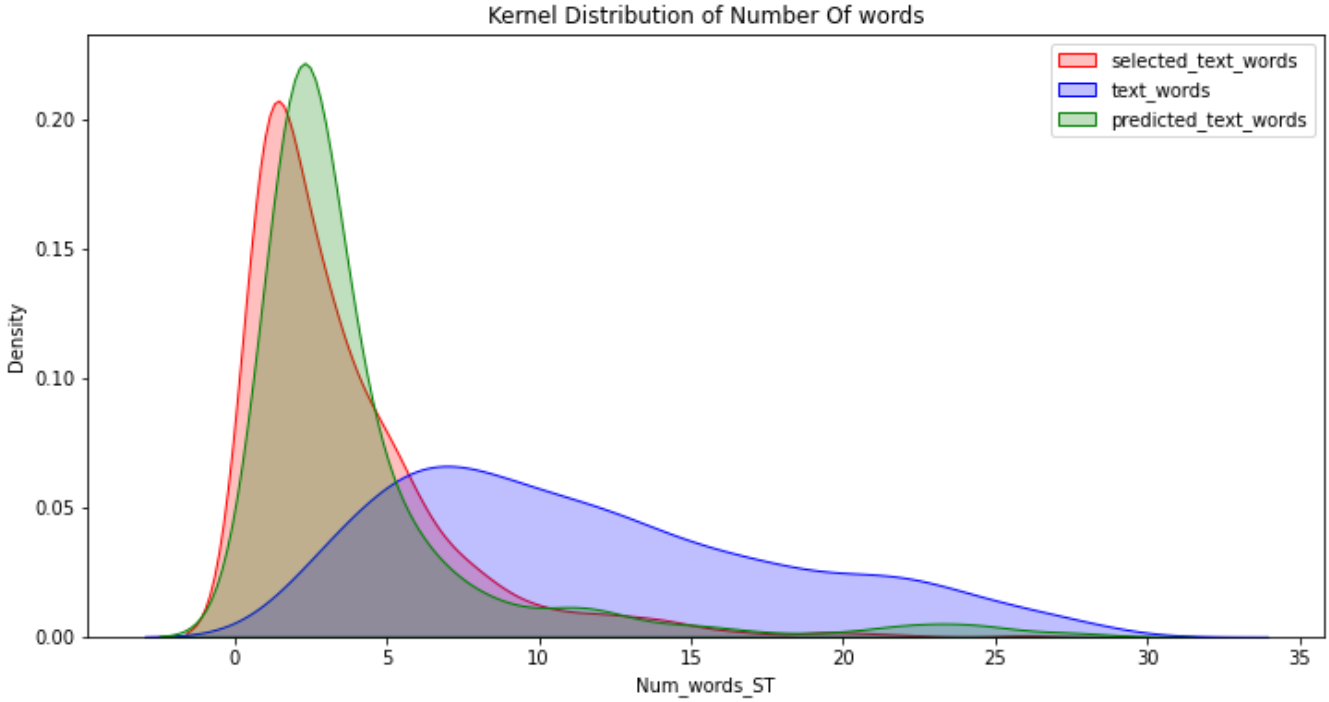
sentiment have mostly 0.5 centered values

In [ ]:

```
plt.figure(figsize=(12,6))
p1=sns.kdeplot(medium['Num_words_ST'], shade=True, color="r").set_title('Kernel Distribu
tion of Number Of words')
p1=sns.kdeplot(medium['Num_word_text'], shade=True, color="b")
p1=sns.kdeplot(medium['Num_words_PT'], shade=True, color="g")
plt.legend(labels=['selected_text_words','text_words','predicted_text_words'])
```

Out[ ]:

```
<matplotlib.legend.Legend at 0x7fb6e583e250>
```

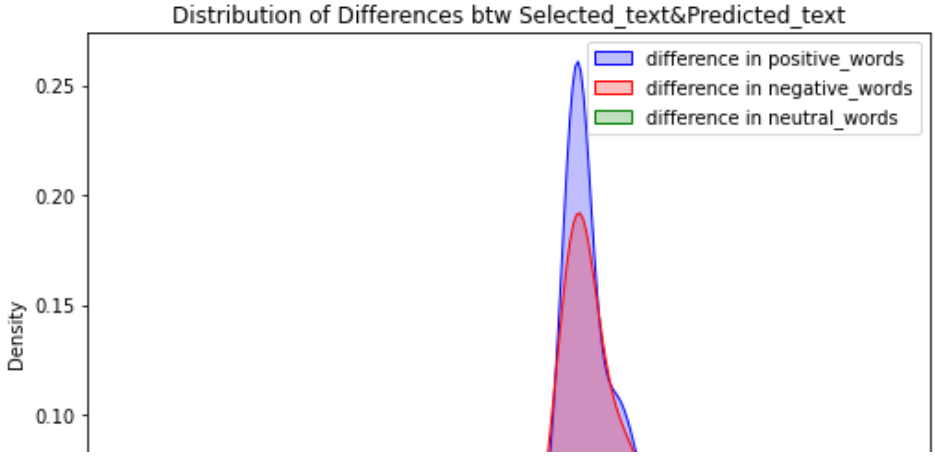


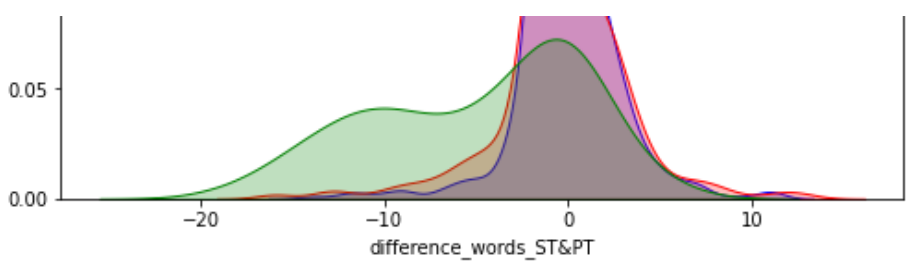
observation

selected text and predicted text have almost similar distributions of lenghts

In [ ]:

```
plt.figure(figsize=(18,6))
plt.subplot(1,2,1)
p1=sns.kdeplot(medium[medium['sentiment']=='positive']['difference_words_ST&PT'], shade=
True, color="b").set_title('Distribution of Differences btw Selected_text&Predicted_text'
)
p2=sns.kdeplot(medium[medium['sentiment']=='negative']['difference_words_ST&PT'], shade=
True, color="r")
p2=sns.kdeplot(medium[medium['sentiment']=='neutral']['difference_words_ST&PT'], shade=T
rue, color="g")
plt.legend(labels=['difference in positive_words','difference in negative_words','differe
nce in neutral_words']) ;
```





observations

we see more negative values in neutral text which implies predicted_text of neutral text length > selected_text length

difference words lies between -10 to 10 mostly which is better than bad performed data where it was 0 to 30(wide)

good

In [ ]:

```
good = x_val[x_val.jaccard > 2/3]
good
```

Out[ ]:

	text	sentiment	pred_text	selected_text	jaccard	Num_words_PT	Num_words_ST	Num_word_text	difference
7917	this is my update	neutral	this is my update	this is my update	1.0	4	4	4	
15845	whaaat i still have next week	neutral	whaaat i still have next week	whaaat i still have next week	1.0	6	6	6	
22338	do some research for my article	neutral	do some research for my article	do some research for my article	1.0	6	6	6	
22474	are you okay	neutral	are you okay	are you okay	1.0	3	3	3	
22030	good ABUSE homie hahahahaha thats what im tal...	positive	good	good	1.0	1	1	9	
...	...	...	...	...	...	...	...	...	
27309	the only thing is im not a chocolate fan but...	neutral	the only thing is im not a chocolate fan but t...	the only thing is im not a chocolate fan but ...	1.0	14	14	14	
616	either way you always tend to make my followf...	positive	you do rock that much	you do rock that much	1.0	5	5	16	
4505	awww whered you get that hugh is so thin no ...	neutral	awww whered you get that hugh is so thin no tr...	awww whered you get that hugh is so thin no t...	1.0	22	22	22	
	gone to the shiggity		gone to the shiggity	gone to the shiggity					

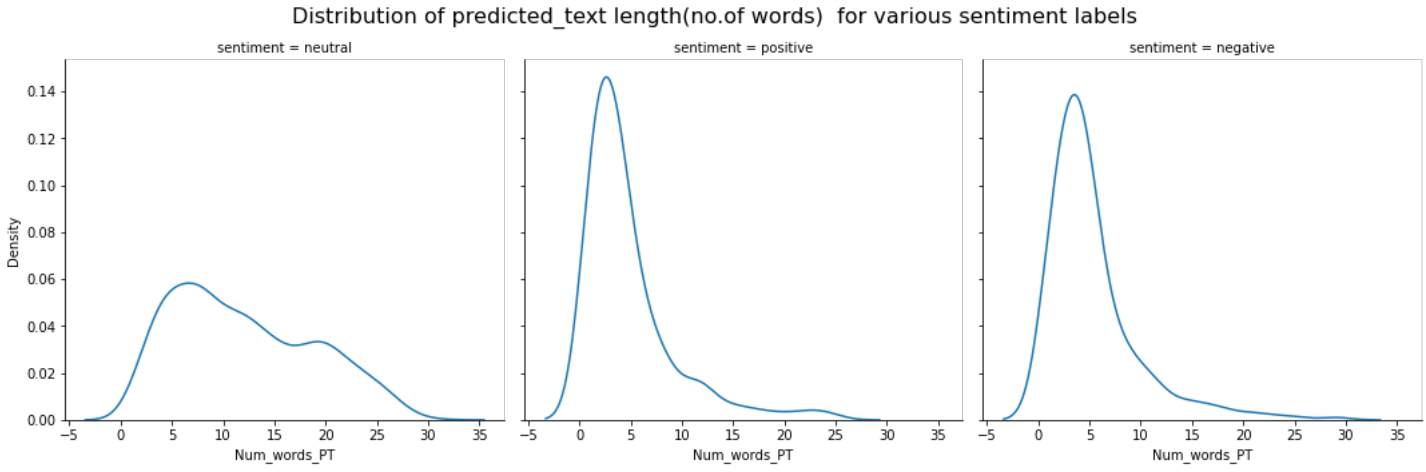
15107	shwa b... sunday	neutral	...back sunday	... sunday	1.0	7	7	7	
14448	starting tm alex and i are doing a whole week ...	neutral	starting tm alex and i are doing a whole week ...	starting tm alex and i are doing a whole week ...	1.0	21	21	21	

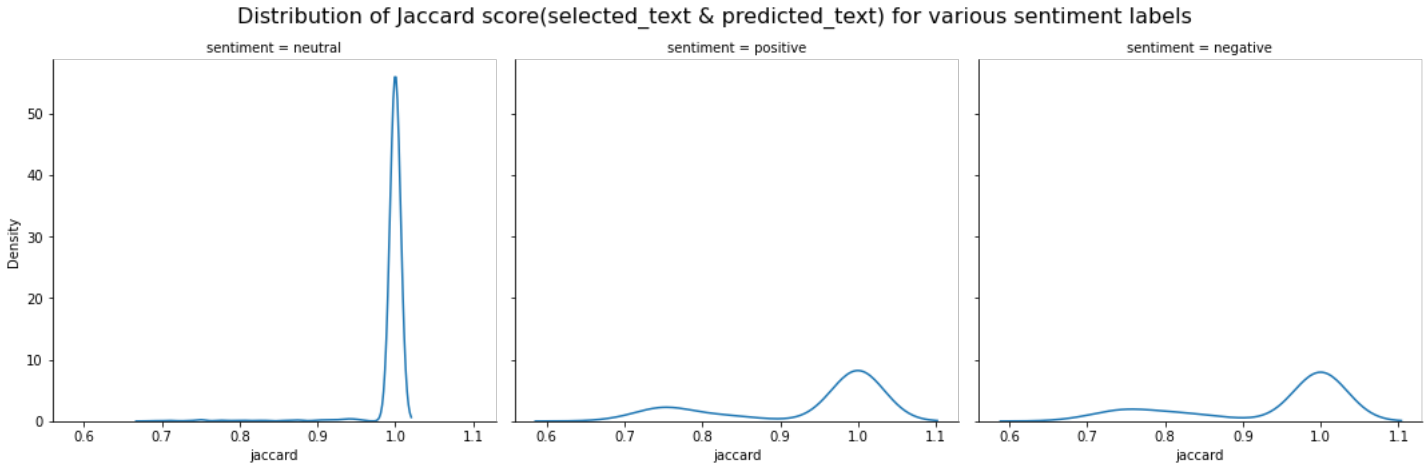
2703 rows × 10 columns

In [ ]:

```
g=sns.FacetGrid(data=good,col='sentiment',height=5);
g.map(sns.kdeplot,'Num_words_PT');
plt.subplots_adjust(top=0.87,)
g.fig.suptitle('Distribution of predicted_text length(no.of words)  for various sentiment labels',fontsize=16);

g=sns.FacetGrid(data=good,col='sentiment',height=5);
g.map(sns.kdeplot,'jaccard');
plt.subplots_adjust(top=0.87,)
g.fig.suptitle('Distribution of Jaccard score(selected_text & predicted_text) for various sentiment labels',fontsize=16);
```





observations

from the predicted text length curves.we can see that positive and negative texts number of words are more likely between 0 to 10 words unlike neutral text.

from distributions of jaccard scores of selected_text&predicted_text.here we can see jaccard scores for each sentiment have mostly 1.0 centered values

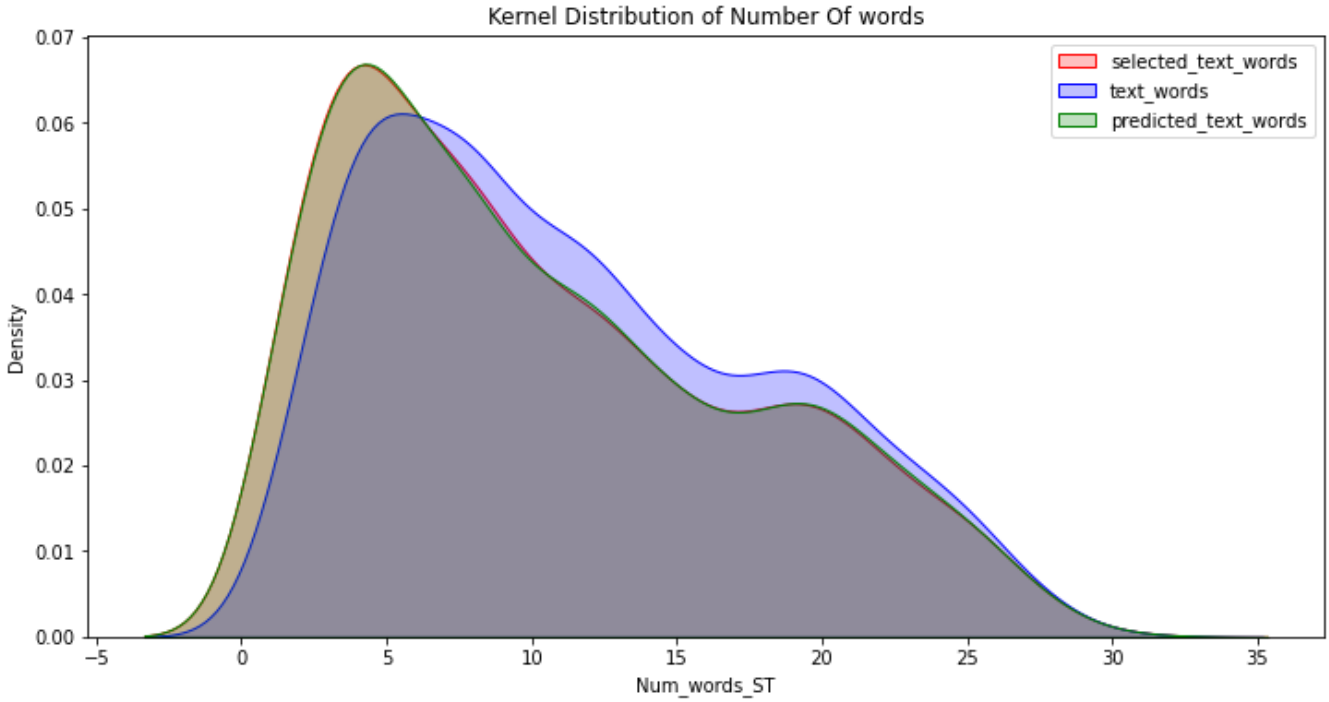
In [ ]:

```
plt.figure(figsize=(12,6))
```

```
p1=sns.kdeplot(good['Num_words_ST'], shade=True, color="r").set_title('Distribution of Number Of words')
p1=sns.kdeplot(good['Num_word_text'], shade=True, color="b")
p1=sns.kdeplot(good['Num_words_PT'], shade=True, color="g")
plt.legend(labels=['selected_text_words','text_words','predicted_text_words'])
```

Out[ ]:

```
<matplotlib.legend.Legend at 0x7fb6e57b9d50>
```

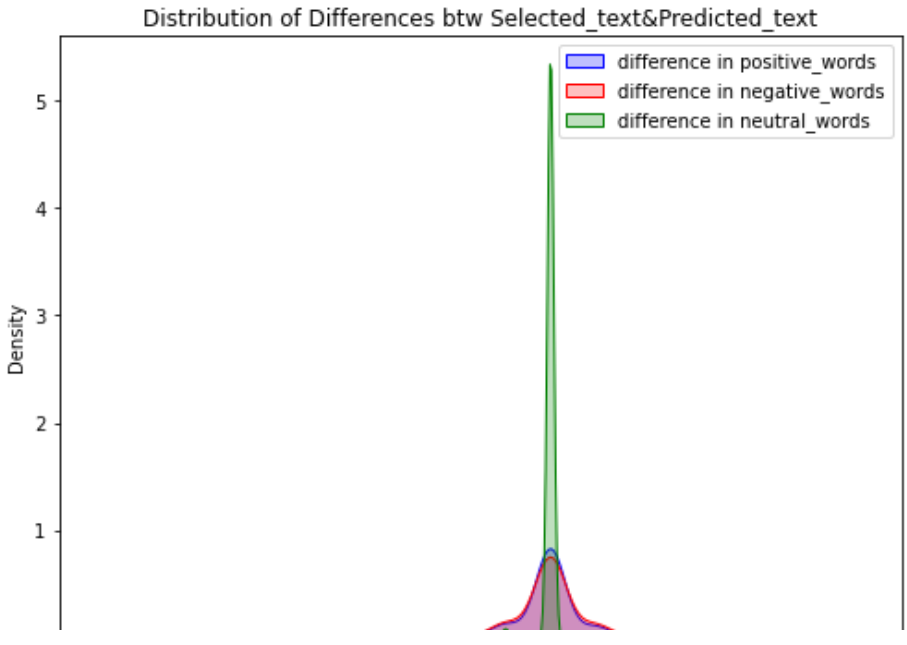


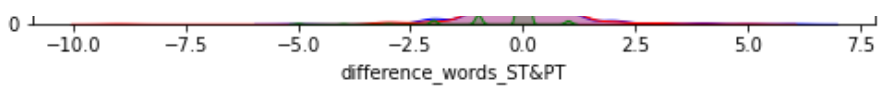
observation

selected text and predicted text have exact same distribution of lenghts

In [ ]:

```
plt.figure(figsize=(18,6))
plt.subplot(1,2,1)
p1=sns.kdeplot(good[good['sentiment']=='positive']['difference_words_ST&PT'], shade=True, color="b").set_title('Distribution of Differences btw Selected_text&Predicted_text')
p2=sns.kdeplot(good[good['sentiment']=='negative']['difference_words_ST&PT'], shade=True, color="r")
p2=sns.kdeplot(good[good['sentiment']=='neutral']['difference_words_ST&PT'], shade=True, color="g")
plt.legend(labels=['difference in positive_words','difference in negative_words','difference in neutral_words']) ;
```





observations

difference in words is zero centered for all sentiments

positive and negative sentiments have same kind of distribution and lies between -2 to 2 words

by densities of each sentiment. we can say that neutral texts are more

conclusion

difference words are few so jaccard performance is good

this data is good because of presence of neutral text

final conclusion

we can not say lenght of text decides jaccard performance because same selected_text length of 0-20words we are getting 0 to 1 jaccard scores for bad,medium,good data respectively.