Predictor

July 14, 2020

1 Initialization

[ ]:
```
# Simple fork of the original git to fix tqdm progress bar in google collab
!pip install --no-cache-dir git+https://github.com/lowener/sentence-transformers
!pip install ngt
```

[ ]:
```
import numpy as np
import torch
import math
from torch.utils.data import Dataset, DataLoader
from sklearn import datasets, model_selection
from matplotlib import pyplot as plt
import itertools
from sentence_transformers import SentenceTransformer, losses, evaluation
import ngt
from sklearn import metrics
import seaborn as sn
import ngtpy
```

[3]:
```
SEED = 2020
np.random.seed(SEED)
torch.manual_seed(SEED)
torch.backends.cudnn.enabled = True
torch.backends.cudnn.benchmark = True
```

2 Data Loader for Triplet Learning on 20 Newsgroup dataset

[5]:
```
def build_triplets(classid: int, X: np.array, Y: np.array):
  # TODO: Select more often negative from the same 'group' (ex: 'comp' for␣
 ↪'comp.sys.ibm.pc.hardware')
  # OR use negative anchor on two groups that fine-tuning can't separate very␣
 ↪well
  positive_idx = np.where(Y == classid)[0]
  negative_idx = np.where(Y != classid)[0]
  # Those groups have common features. Make sure that they are well fine-tuned
```

```
  focus_negative = {
      0: [15, 19],
      1: [2,3,4,5, 12],
      2: [1,3,4,5, 12],
      3: [1,2,4,5, 12],
      4: [1,2,3,5, 12],
      5: [1,2,3,4, 12],
      7: [8,9,10],
      8: [7,9,10],
      9: [7,8,10],
      10: [7,8,9],
      11: [12,13,14],
      12: [1, 2, 3, 4, 5,11,13,14],
      13: [11,12,14],
      14: [11,12,13],
      15: [0, 19],
      16: [17,18,19],
      17: [16,18,19],
      18: [16,17,19],
      19: [0, 15, 16,17,18],
  }
  combinations = itertools.combinations(positive_idx, 2)
  combinations = list(combinations)
  triplets = []
  np.random.shuffle(negative_idx)
  choose_focus = np.random.random((len(combinations)))
  neg = negative_idx[:len(combinations)]
  for c, n, cf in zip(combinations, neg, choose_focus):
    # Choose random example 60% of the time
    # Choose a focus example 40% of the time
    if classid in focus_negative and cf < 0.4:
      neg_array = focus_negative[classid]
      neg_category = np.random.choice(neg_array)
      n = np.random.choice(np.where(Y == neg_category)[0])
      triplets.append(list(c) + [n])
    else:
      triplets.append(list(c) + [n])
  return triplets
```

[6]:
```
class NewsDataset(Dataset):
  def __init__(self, model, subset='train'):
    if model is None or (subset != 'train' and subset != 'test'):
      raise AttributeError("Model is None or subset is not train/test")
    self.model = model
    self.X, self.y = datasets.fetch_20newsgroups(subset=subset,␣
 ↪remove=('headers', 'footers', 'quotes'), return_X_y=True)
```

```
    if subset == 'test': # Reduce the validation data by 2/3
      self.X = self.X[:len(self.X)//3]
      self.y = self.y[:len(self.y)//3]
    for i in range(len(self.X)):
      self.X[i] = model.tokenize(self.X[i])
    self.triplets = []
    for classid in np.unique(self.y):
      self.triplets += build_triplets(classid, self.X, self.y)
    self.y = torch.tensor(self.y, dtype=torch.long)

  def __len__(self,):
    return len(self.triplets)

  def __getitem__(self, index):
    triplet_idx = self.triplets[index]
    anchor = self.X[triplet_idx[0]]
    pos = self.X[triplet_idx[1]]
    neg = self.X[triplet_idx[2]]
    label = self.y[triplet_idx[0]]
    return [anchor, pos, neg], label
```

[ ]:
```
from google.colab import drive
drive.mount('/content/gdrive')
```

3 Training

[ ]:
```
batch_size = 32
num_epochs = 4
model_save_path = '/content/gdrive/My Drive/Ubisoft/save_model_opti_triplets2'

model = SentenceTransformer('distilbert-base-nli-mean-tokens')
train_data = NewsDataset(model)
train_dataloader = DataLoader(train_data, shuffle=True, batch_size=batch_size,␣
 ↪num_workers=6)
train_loss = losses.TripletLoss(model=model)


test_data = NewsDataset(model, subset='test')
test_dataloader = DataLoader(test_data, shuffle=True,␣
 ↪batch_size=batch_size,num_workers=4)
evaluator = evaluation.TripletEvaluator(test_dataloader)

warmup_steps = math.ceil(len(train_data) * num_epochs / batch_size * 0.1)
```

```
evaluation_steps = math.ceil(len(train_data) * 0.34 / batch_size)
print(len(train_data) // batch_size)
print(evaluation_steps)
print(len(test_data) // batch_size)
```

```
/usr/local/lib/python3.6/dist-packages/transformers/tokenization_utils.py:831:
FutureWarning: Parameter max_len is deprecated and will be removed in a future
release. Use model_max_length instead.
  category=FutureWarning,

6717
2285
1490
```

[ ]:
```
torch.cuda.is_available()
```

[ ]:
```
True
```

[ ]:
```
model.fit(train_objectives=[(train_dataloader, train_loss)],
          evaluator=evaluator,
          epochs=num_epochs,
          evaluation_steps=evaluation_steps,
          warmup_steps=warmup_steps,
          output_path=model_save_path)
```

4 Approximate Nearest Neighbor Classification

4.1 Encode the sentences

[9]:
```
model_save_path = '/content/gdrive/My Drive/Ubisoft/save_model_opti_triplets2'
model = SentenceTransformer(model_save_path)
```

```
/usr/local/lib/python3.6/dist-packages/transformers/tokenization_utils.py:831:
FutureWarning: Parameter max_len is deprecated and will be removed in a future
release. Use model_max_length instead.
  category=FutureWarning,
```

[ ]:
```
X_train, y_train = datasets.fetch_20newsgroups(subset='train',␣
↪remove=('headers', 'footers', 'quotes'), return_X_y=True)
X_train_encoded = model.encode(X_train, batch_size=32, show_progress_bar=True)
X_test, y_test = datasets.fetch_20newsgroups(subset='test', remove=('headers',␣
↪'footers', 'quotes'), return_X_y=True)
X_test_encoded = model.encode(X_test, batch_size=32, show_progress_bar=True)
```

[13]:
```
np.save('/content/gdrive/My Drive/Ubisoft/X_train_encoded', X_train_encoded)
np.save('/content/gdrive/My Drive/Ubisoft/X_test_encoded', X_test_encoded)
np.save('/content/gdrive/My Drive/Ubisoft/y_train', y_train)
```

4.2 Build kNN index

[14]:
```
dim = len(X_train_encoded[0])
ngtpy.create(b"IndexEncoded", dim, distance_type='L1')
index = ngtpy.Index(b"IndexEncoded")
index.batch_insert(X_train_encoded)
index.save()
```

4.3 Query Index

[15]:
```
def classify(query: np.array, index: ngtpy.Index, y_index: np.array, size_k:␣
↪int = 3, weight: bool = True) -> np.array:
  result = np.zeros((len(query)))
  for i in range(len(query)):
    vote_array = np.zeros(20)
    query_res = index.search(query[i], size=size_k)
    for neighbor in query_res:
      if neighbor[1] == 0:
        vote_array[y_index[int(neighbor[0])]] = 1
        break
      if weight:
        vote_array[y_index[int(neighbor[0])]] += 1 / neighbor[1]
      else:
        vote_array[y_index[int(neighbor[0])]] += 1
      #print('Neighbor: ' + str(i) + ', Index: ' + str(o[0]) + ', Class: ' +␣
↪str(y_index[o[0]]) + ', Distance: ' + str(o[1]))
    result[i] = np.argmax(vote_array)
  return result
```

[16]:
```
res = classify(X_test_encoded, index, y_train, size_k=9, weight=True)
```

4.4 Classification report

[17]:
```
print(metrics.classification_report(y_test, res))
```

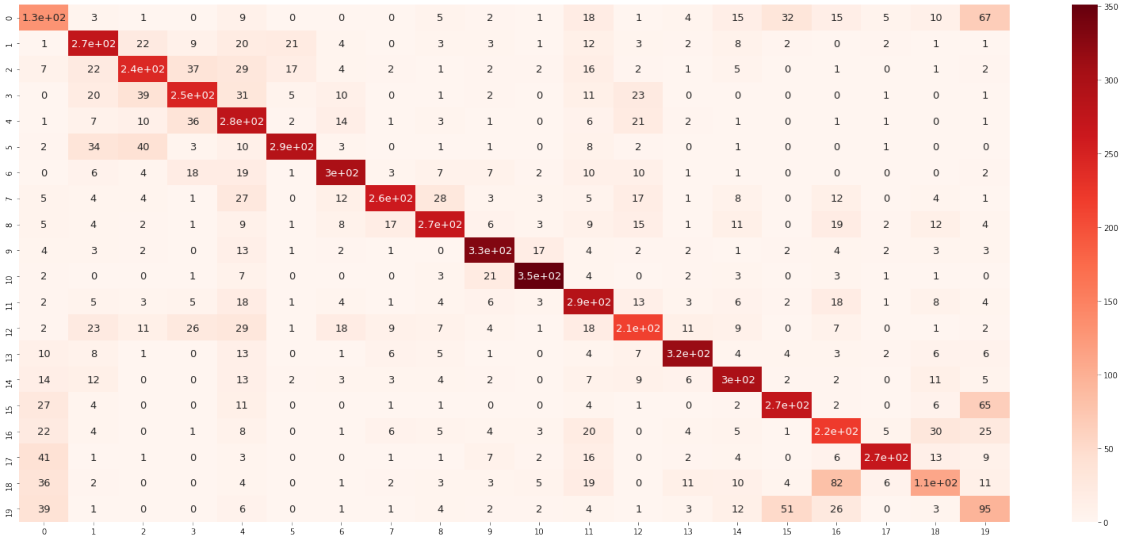
```
              precision    recall  f1-score   support

           0       0.37      0.41      0.39       319
           1       0.63      0.70      0.66       389
```

2	0.63	0.62	0.63	394
3	0.64	0.63	0.64	392
4	0.50	0.72	0.59	385
5	0.85	0.73	0.79	395
6	0.78	0.77	0.77	390
7	0.83	0.66	0.73	396
8	0.76	0.68	0.71	398
9	0.81	0.83	0.82	397
10	0.89	0.88	0.88	399
11	0.60	0.73	0.66	396
12	0.63	0.54	0.58	393
13	0.85	0.80	0.82	396
14	0.74	0.76	0.75	394
15	0.73	0.69	0.71	398
16	0.52	0.60	0.56	364
17	0.90	0.72	0.80	376
18	0.50	0.36	0.42	310
19	0.31	0.38	0.34	251
accuracy			0.67	7532
macro avg	0.67	0.66	0.66	7532
weighted avg	0.69	0.67	0.67	7532

[18]:
```
cfm = metrics.confusion_matrix(y_test, res)
plt.figure(None,(28,12))
sn.heatmap(cfm,annot=True, annot_kws={"size": 13}, cmap=plt.cm.Reds)
```

[18]: <matplotlib.axes._subplots.AxesSubplot at 0x7f4f852ae9e8>



4.5 Compare with base model

```
[ ]: model_base = SentenceTransformer('distilbert-base-nli-mean-tokens')
     #res=model.evaluate(evaluator)
```

```
/usr/local/lib/python3.6/dist-packages/transformers/tokenization_utils.py:831:
FutureWarning: Parameter max_len is deprecated and will be removed in a future
release. Use model_max_length instead.
  category=FutureWarning,
```

```
[ ]: X_train_encoded_base = model_base.encode(X_train, batch_size=64,␣
      ↪show_progress_bar=True)
     X_test_encoded_base = model_base.encode(X_test, batch_size=64,␣
      ↪show_progress_bar=True)
```

```
[ ]: ngtpy.create(b"IndexEncoded_base", dim, distance_type='L1')
     index_base = ngtpy.Index(b"IndexEncoded_base")
     index_base.batch_insert(X_train_encoded_base)
     index_base.save()
```

```
[ ]: res_base = classify(X_test_encoded_base, index_base, y_train, size_k=9,␣
      ↪weight=True)
```

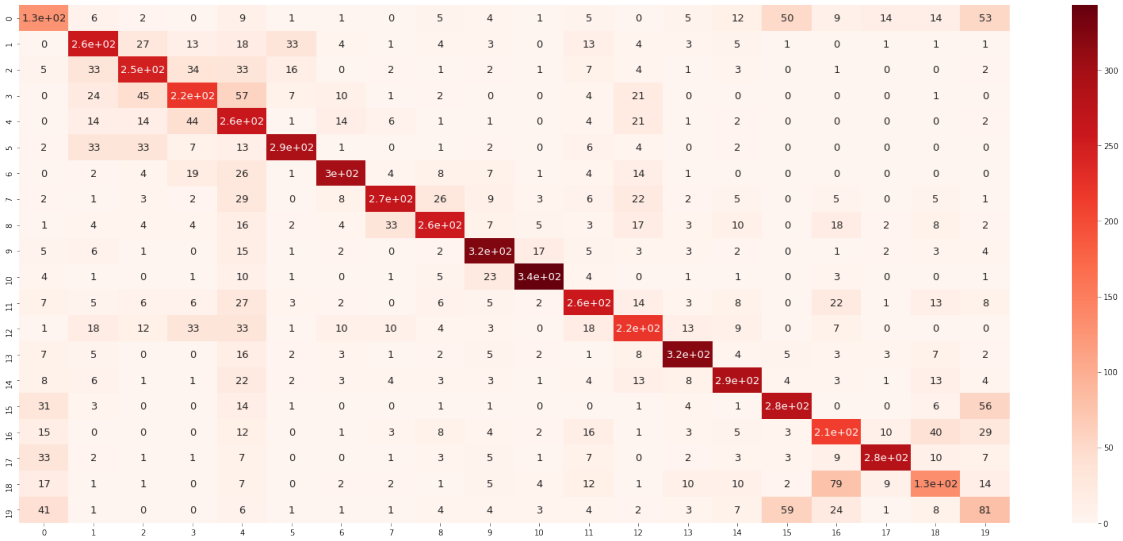
```
[ ]: print(metrics.classification_report(y_test, res_base))
```

	precision	recall	f1-score	support
0	0.33	0.28	0.30	319
1	0.42	0.41	0.42	389
2	0.42	0.47	0.44	394
3	0.37	0.39	0.38	392
4	0.34	0.49	0.40	385
5	0.42	0.49	0.45	395
6	0.63	0.70	0.66	390
7	0.68	0.56	0.61	396
8	0.67	0.50	0.57	398
9	0.82	0.70	0.75	397
10	0.82	0.76	0.79	399
11	0.41	0.52	0.46	396
12	0.45	0.27	0.34	393
13	0.70	0.66	0.68	396
14	0.71	0.66	0.68	394
15	0.52	0.71	0.60	398
16	0.40	0.54	0.46	364
17	0.67	0.61	0.64	376
18	0.43	0.32	0.37	310
19	0.15	0.09	0.11	251

```
    accuracy                           0.52      7532
   macro avg       0.52      0.51      0.51      7532
weighted avg       0.53      0.52      0.52      7532
```

[ ]:
```
cfm_base = metrics.confusion_matrix(y_test, res_base)
plt.figure(None,(28,12))
sn.heatmap(cfm_base,annot=True, annot_kws={"size": 13}, cmap=plt.cm.Reds)
```

[ ]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7f8d937b9978>
```



[ ]:
```
labels
```

[ ]:
```
['alt.atheism',
 'comp.graphics',
 'comp.os.ms-windows.misc',
 'comp.sys.ibm.pc.hardware',
 'comp.sys.mac.hardware',
 'comp.windows.x',
 'misc.forsale',
 'rec.autos',
 'rec.motorcycles',
 'rec.sport.baseball',
 'rec.sport.hockey',
 'sci.crypt',
 'sci.electronics',
 'sci.med',
 'sci.space',
```

```
 'soc.religion.christian',
 'talk.politics.guns',
 'talk.politics.mideast',
 'talk.politics.misc',
 'talk.religion.misc']
```

[20]:
```
X_test[29]
```

[20]:
```
"\n\nI don't know about Canada, but I have heard from people\ndoing translation
work in Papua New Quinea, that they\nlike them and have had good response on
service.\n\nAnother is seriously considering buying one.\n"
```