Sentiment Analysis - AraBERT(Using ArSAS Dataset) -

May 14, 2022

1 Sentiment Analysis - AraBERT(Using ArSAS Dataset) -

1. Dependencies installation

[1]:
```
import torch

# If there's a GPU available...
if torch.cuda.is_available():

    # Tell PyTorch to use the GPU.
    device = torch.device("cuda")

    print('There are %d GPU(s) available.' % torch.cuda.device_count())

    print('We will use the GPU:', torch.cuda.get_device_name(0))
    !nvidia-smi

# If not...
else:
    print('No GPU available, using the CPU instead.')
    device = torch.device("cpu")
```

```
There are 1 GPU(s) available.
We will use the GPU: Tesla T4
Sat May 14 12:36:11 2022
+-----------------------------------------------------------------------------+
| NVIDIA-SMI 460.32.03    Driver Version: 460.32.03    CUDA Version: 11.2     |
|-------------------------------+----------------------+----------------------+
| GPU  Name        Persistence-M| Bus-Id        Disp.A | Volatile Uncorr. ECC |
| Fan  Temp  Perf  Pwr:Usage/Cap|         Memory-Usage | GPU-Util  Compute M. |
|                               |                      |               MIG M. |
|===============================+======================+======================|
|   0  Tesla T4            Off  | 00000000:00:04.0 Off |                    0 |
| N/A   41C    P8    12W /  70W |      3MiB / 15109MiB |      0%      Default |
|                               |                      |                  N/A |
+-------------------------------+----------------------+----------------------+
```

```
+-----------------------------------------------------------------------------+
| Processes:                                                                  |
|  GPU   GI   CI        PID   Type   Process name                  GPU Memory |
|        ID   ID                                                   Usage      |
|=============================================================================|
|  No running processes found                                                 |
+-----------------------------------------------------------------------------+
```

[2]:
```
from google.colab import drive
drive.mount('/content/drive')
```

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

[3]:
```
!pip install transformers==4.12.2
!pip install farasapy==0.0.14
!pip install pyarabic==0.6.14
!git clone https://github.com/aub-mind/arabert
!pip install emoji==1.6.1
!pip install sentencepiece==0.1.96
```

```
Collecting transformers==4.12.2
  Downloading transformers-4.12.2-py3-none-any.whl (3.1 MB)
     |                  | 3.1 MB 8.4 MB/s
Requirement already satisfied: tqdm>=4.27 in
/usr/local/lib/python3.7/dist-packages (from transformers==4.12.2) (4.64.0)
Collecting sacremoses
  Downloading sacremoses-0.0.53.tar.gz (880 kB)
     |                  | 880 kB 54.6 MB/s
Requirement already satisfied: numpy>=1.17 in
/usr/local/lib/python3.7/dist-packages (from transformers==4.12.2) (1.21.6)
Collecting pyyaml>=5.1
  Downloading PyYAML-6.0-cp37-cp37m-manylinux_2_5_x86_64.manylinux1_x86_64.manyl
inux_2_12_x86_64.manylinux2010_x86_64.whl (596 kB)
     |                  | 596 kB 63.3 MB/s
Requirement already satisfied: packaging>=20.0 in
/usr/local/lib/python3.7/dist-packages (from transformers==4.12.2) (21.3)
Collecting huggingface-hub>=0.0.17
  Downloading huggingface_hub-0.6.0-py3-none-any.whl (84 kB)
     |                  | 84 kB 3.9 MB/s
Requirement already satisfied: filelock in /usr/local/lib/python3.7/dist-
packages (from transformers==4.12.2) (3.6.0)
Requirement already satisfied: regex!=2019.12.17 in
/usr/local/lib/python3.7/dist-packages (from transformers==4.12.2) (2019.12.20)
Collecting tokenizers<0.11,>=0.10.1
  Downloading tokenizers-0.10.3-cp37-cp37m-manylinux_2_5_x86_64.manylinux1_x86_6
4.manylinux_2_12_x86_64.manylinux2010_x86_64.whl (3.3 MB)
     |                  | 3.3 MB 46.7 MB/s
```

```
Requirement already satisfied: importlib-metadata in
/usr/local/lib/python3.7/dist-packages (from transformers==4.12.2) (4.11.3)
Requirement already satisfied: requests in /usr/local/lib/python3.7/dist-
packages (from transformers==4.12.2) (2.23.0)
Requirement already satisfied: typing-extensions>=3.7.4.3 in
/usr/local/lib/python3.7/dist-packages (from huggingface-
hub>=0.0.17->transformers==4.12.2) (4.2.0)
Requirement already satisfied: pyparsing!=3.0.5,>=2.0.2 in
/usr/local/lib/python3.7/dist-packages (from
packaging>=20.0->transformers==4.12.2) (3.0.8)
Requirement already satisfied: zipp>=0.5 in /usr/local/lib/python3.7/dist-
packages (from importlib-metadata->transformers==4.12.2) (3.8.0)
Requirement already satisfied: certifi>=2017.4.17 in
/usr/local/lib/python3.7/dist-packages (from requests->transformers==4.12.2)
(2021.10.8)
Requirement already satisfied: chardet<4,>=3.0.2 in
/usr/local/lib/python3.7/dist-packages (from requests->transformers==4.12.2)
(3.0.4)
Requirement already satisfied: idna<3,>=2.5 in /usr/local/lib/python3.7/dist-
packages (from requests->transformers==4.12.2) (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==4.12.2)
(1.24.3)
Requirement already satisfied: six in /usr/local/lib/python3.7/dist-packages
(from sacremoses->transformers==4.12.2) (1.15.0)
Requirement already satisfied: click in /usr/local/lib/python3.7/dist-packages
(from sacremoses->transformers==4.12.2) (7.1.2)
Requirement already satisfied: joblib in /usr/local/lib/python3.7/dist-packages
(from sacremoses->transformers==4.12.2) (1.1.0)
Building wheels for collected packages: sacremoses
  Building wheel for sacremoses (setup.py) … done
  Created wheel for sacremoses: filename=sacremoses-0.0.53-py3-none-any.whl
size=895260
sha256=21a2d3450a70afdc00d99768f1701ecd74929009031f605c3134e56bcfb2c79b
  Stored in directory: /root/.cache/pip/wheels/87/39/dd/a83eeef36d0bf98e7a4d1933
a4ad2d660295a40613079bafc9
Successfully built sacremoses
Installing collected packages: pyyaml, tokenizers, sacremoses, huggingface-hub,
transformers
  Attempting uninstall: pyyaml
    Found existing installation: PyYAML 3.13
    Uninstalling PyYAML-3.13:
      Successfully uninstalled PyYAML-3.13
Successfully installed huggingface-hub-0.6.0 pyyaml-6.0 sacremoses-0.0.53
tokenizers-0.10.3 transformers-4.12.2
Collecting farasapy==0.0.14
  Downloading farasapy-0.0.14-py3-none-any.whl (11 kB)
Requirement already satisfied: tqdm in /usr/local/lib/python3.7/dist-packages
```

```
(from farasapy==0.0.14) (4.64.0)
Requirement already satisfied: requests in /usr/local/lib/python3.7/dist-
packages (from farasapy==0.0.14) (2.23.0)
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->farasapy==0.0.14)
(1.24.3)
Requirement already satisfied: chardet<4,>=3.0.2 in
/usr/local/lib/python3.7/dist-packages (from requests->farasapy==0.0.14) (3.0.4)
Requirement already satisfied: idna<3,>=2.5 in /usr/local/lib/python3.7/dist-
packages (from requests->farasapy==0.0.14) (2.10)
Requirement already satisfied: certifi>=2017.4.17 in
/usr/local/lib/python3.7/dist-packages (from requests->farasapy==0.0.14)
(2021.10.8)
Installing collected packages: farasapy
Successfully installed farasapy-0.0.14
Collecting pyarabic==0.6.14
  Downloading PyArabic-0.6.14-py3-none-any.whl (126 kB)
     |                  | 126 kB 9.0 MB/s
Requirement already satisfied: six>=1.14.0 in
/usr/local/lib/python3.7/dist-packages (from pyarabic==0.6.14) (1.15.0)
Installing collected packages: pyarabic
Successfully installed pyarabic-0.6.14
Cloning into 'arabert'…
remote: Enumerating objects: 564, done.
remote: Counting objects: 100% (29/29), done.
remote: Compressing objects: 100% (7/7), done.
remote: Total 564 (delta 25), reused 22 (delta 22), pack-reused 535
Receiving objects: 100% (564/564), 9.11 MiB | 32.16 MiB/s, done.
Resolving deltas: 100% (326/326), done.
Collecting emoji==1.6.1
  Downloading emoji-1.6.1.tar.gz (170 kB)
     |                  | 170 kB 7.6 MB/s
Building wheels for collected packages: emoji
  Building wheel for emoji (setup.py) … done
  Created wheel for emoji: filename=emoji-1.6.1-py3-none-any.whl size=169313
sha256=44978cca0dbc09720cd3a37dd089fa6c39448f804d8ef550f21b83340b7c9e76
  Stored in directory: /root/.cache/pip/wheels/ea/5f/d3/03d313ddb3c2a1a427bb4690
f1621eea60fe6f2a30cc95940f
Successfully built emoji
Installing collected packages: emoji
Successfully installed emoji-1.6.1
Collecting sentencepiece==0.1.96
  Downloading
sentencepiece-0.1.96-cp37-cp37m-manylinux_2_17_x86_64.manylinux2014_x86_64.whl
(1.2 MB)
     |                  | 1.2 MB 6.9 MB/s
Installing collected packages: sentencepiece
Successfully installed sentencepiece-0.1.96
```

[4]:
```
!git clone https://github.com/mohamedadaly/LABR
!git clone https://github.com/elnagara/HARD-Arabic-Dataset
!wget http://homepages.inf.ed.ac.uk/wmagdy/Resources/ArSAS.zip
!unzip ArSAS.zip
!unzip '/content/HARD-Arabic-Dataset/data/balanced-reviews.zip'
```

```
Cloning into 'LABR'…
remote: Enumerating objects: 37, done.
remote: Total 37 (delta 0), reused 0 (delta 0), pack-reused 37
Unpacking objects: 100% (37/37), done.
Cloning into 'HARD-Arabic-Dataset'…
remote: Enumerating objects: 100, done.
remote: Total 100 (delta 0), reused 0 (delta 0), pack-reused 100
Receiving objects: 100% (100/100), 116.36 MiB | 30.71 MiB/s, done.
Resolving deltas: 100% (35/35), done.
--2022-05-14 12:39:18--
http://homepages.inf.ed.ac.uk/wmagdy/Resources/ArSAS.zip
Resolving homepages.inf.ed.ac.uk (homepages.inf.ed.ac.uk)… 129.215.32.113
Connecting to homepages.inf.ed.ac.uk
(homepages.inf.ed.ac.uk)|129.215.32.113|:80… connected.
HTTP request sent, awaiting response… 301 Moved Permanently
Location: https://homepages.inf.ed.ac.uk/wmagdy/Resources/ArSAS.zip [following]
--2022-05-14 12:39:18--
https://homepages.inf.ed.ac.uk/wmagdy/Resources/ArSAS.zip
Connecting to homepages.inf.ed.ac.uk
(homepages.inf.ed.ac.uk)|129.215.32.113|:443… connected.
HTTP request sent, awaiting response… 200 OK
Length: 1905723 (1.8M) [application/zip]
Saving to: ‘ArSAS.zip’

ArSAS.zip           100%[===================>]   1.82M  1.82MB/s    in 1.0s

2022-05-14 12:39:20 (1.82 MB/s) - ‘ArSAS.zip’ saved [1905723/1905723]

Archive:  ArSAS.zip
  inflating: ArSAS..txt
Archive:  /content/HARD-Arabic-Dataset/data/balanced-reviews.zip
  inflating: balanced-reviews.txt
```

2. Datasets preparation

[5]:
```
import pandas as pd
import numpy as np
from typing import List
from tqdm import tqdm_notebook as tqdm
from sklearn.model_selection import train_test_split
```

[6]:
```
class CustomDataset:
    def __init__(
        self,
        name: str,
        train: List[pd.DataFrame],
        test: List[pd.DataFrame],
        label_list: List[str],
    ):
        self.name = name
        self.train = train
        self.test = test
        self.label_list = label_list
```

[7]:
```
all_datasets= []
DATA_COLUMN = "text"
LABEL_COLUMN = "label"
```

[8]:
```
df_HARD = pd.read_csv("/content/balanced-reviews.txt", sep="\t",␣
 ↪header=0,encoding='utf-16')

df_HARD = df_HARD[["review","rating"]]  # we are interested in rating and␣
 ↪review only
df_HARD.columns = [DATA_COLUMN, LABEL_COLUMN]
print(df_HARD[LABEL_COLUMN].value_counts())
# code rating as +ve if > 3, -ve if less, no 3s in dataset

hard_map = {
    5: 'POS',
    4: 'POS',
    2: 'NEG',
    1: 'NEG'
}

df_HARD[LABEL_COLUMN] = df_HARD[LABEL_COLUMN].apply(lambda x: hard_map[x])
train_HARD, test_HARD = train_test_split(df_HARD, test_size=0.2,␣
 ↪random_state=42)
label_list_HARD = ['NEG', 'POS']

data_Hard = CustomDataset("HARD", train_HARD, test_HARD, label_list_HARD)
all_datasets.append(data_Hard)
```

```
2    38467
4    26450
5    26399
1    14382
Name: label, dtype: int64
```

[9]:
```
#@title
%%writefile labr.py
# -*- coding: utf-8 -*-
"""
Created on Sun Mar 10 16:27:03 2013

@author: Mohamed Aly <mohamed@mohamedaly.info>
"""

import codecs
import numpy as np
import pandas as pd
import re

class LABR:
    def __init__(self):
        self.REVIEWS_PATH = "LABR/data/"
        self.RAW_REVIEWS_FILE = "raw_reviews.tsv"
        self.DELETED_REVIEWS_FILE = "deleted_reviews.tsv"
        self.CLEAN_REVIEWS_FILE = "reviews.tsv"

    # Copied from the PyArabic package.
    def arabicrange(self):
        """return a list of arabic characteres .
        Return a list of characteres between \u060c to \u0652
        @return: list of arabic characteres.
        @rtype: unicode;
        """
        mylist=[];
        for i in range(0x0600, 0x00653):
            try :
                mylist.append(unichr(i));
            except ValueError:
                pass;
        return mylist;

    # cleans a single review
    def clean_raw_review(self, body):
         # patterns to remove first
        pat = [\
            (u'http[s]?://[a-zA-Z0-9_\-./~\?=%&]+', u''),                #␣
 ↪remove links
            (u'www[a-zA-Z0-9_\-?=%&/.~]+', u''),
#            u'\n+': u' ',                       # remove newlines
            (u'<br />', u' '),                    # remove html line breaks
            (u'</?[^>]+>', u' '),                 # remove html markup
#            u'http': u'',
```

```
            (u'[a-zA-Z]+\.org', u''),
            (u'[a-zA-Z]+\.com', u''),
            (u'://', u''),
            (u'&[^;]+;', u' '),
            (u':D', u':)'),
#            (u'[0-9/]+', u''),
#            u'[a-zA-Z.]+': u'',
#            u'[^0-9' + u''.join(self.arabicrange()) + \
#                u"!.,;:$%&*%'#(){}~`\[\]/\\\\\"" + \
#                u'\s^><\-_\u201D\u00AB=\u2026]+': u'',          # remove latin
 ↪characters
            (u'\s+', u' '),                     # remove spaces
            (u'\.+', u'.'),                     # multiple dots
            (u'[\u201C\u201D]', u'"'),          #"
            (u'[\u2665\u2764]', u''),           # heart symbol
            (u'[\u00BB\u00AB]', u'"'),
            (u'\u2013', u'-'),                 # dash
        ]

        # patterns that disqualify a review
        remove_if_there = [\
            (u'[^0-9' + u''.join(self.arabicrange()) + \
                u"!.,;:$%&*%'#(){}~`\[\]/\\\\\"" + \
                u'\s\^><\-_\u201D\u00AB=\u2026+|' + \
                u'\u0660-\u066D\u201C\u201D' + \
                u'\ufefb\ufef7\ufef5\ufef9]+', u''),                    # non
 ↪arabic characters
        ]

        # patterns that disqualify if empty after removing
        remove_if_empty_after = [\
            (u'[0-9a-zA-Z\-_]', u' '),              #alpha-numeric
            (u'[0-9' + u".,!;:$%&*%'#(){}~`\[\]/\\\\\"" + \
                u'\s\^><`\-=_+]+', u''),                   # remove just
 ↪punctuation
            (u'\s+', u' '),                     # remove spaces
        ]

        # remove again
        # patterns to remove
        pat2 = [\
#            u'[^0-9' + u''.join(self.arabicrange()) + \
#                u"!.,;:$%&*%'#(){}~`\[\]/\\\\\"" + \
#                u'\s^><\-_\u201D\u00AB=\u2026]+': u'',          # remove latin
 ↪characters
        ]
```

```
        skip = False

        # if empty body, skip
        if body == u'': skip = True

        # do some subsitutions
        for k,v in pat:
            body = re.sub(k, v, body)

        # remove if exist
        for k,v in remove_if_there:
            if re.search(k, body):
                skip = True

        # remove if empty after replacing
        for k,v in remove_if_empty_after:
            temp = re.sub(k, v, body)
            if temp == u" " or temp == u"":
                skip = True

        # do some more subsitutions
        if not skip:
            for k,v in pat2:
                body = re.sub(k, v, body)

        # if empty string, skip
        if body == u'' or body == u' ':
            skip = True

        if not skip:
            return body
        else:
            return u""

    # Read raw reviews from file and clean and write into clean_reviews
    def clean_raw_reviews(self):
        # input file
        in_file = codecs.open(self.REVIEWS_PATH + self.RAW_REVIEWS_FILE,
                              'r', encoding="utf-8")
        reviews = in_file.readlines()

        # Output file: rating<tab>content
        out_file = open(self.REVIEWS_PATH + self.CLEAN_REVIEWS_FILE,
                        'w', buffering = 100)
        deleted_file = open(self.REVIEWS_PATH + self.DELETED_REVIEWS_FILE,
                            'w', buffering = 100)
```

```
        counter = 1
        for i in xrange(0, len(reviews)):
            review = reviews[i]
            skip = False

#           # If line starts with #, then skip
#            if review[0] == u"#": continue

            # split by <tab>
            parts = review.split(u"\t")

            # rating is first part and body is last part
            rating = parts[0]
            review_id = parts[1]
            user_id = parts[2]
            book_id = parts[3]
            body = parts[4].strip()

            # clean body
            body = self.clean_raw_review(body)
            if body == u"": skip = True

            if i % 5000 == 0:
                print("review %d:" % (i))

            # write output
            line = u"%s\t%s\t%s\t%s\t%s\n" % (rating, review_id, user_id,
                                              book_id, body)
            if not skip:
                out_file.write(line.encode('utf-8'))
                counter += 1
            else:
                deleted_file.write(line.encode('utf-8'))

    # Read the reviews file. Returns a tuple containing these lists:
    #   rating: the rating 1 -> 5
    #   review_id: the id of the review
    #   user_id: the id of the user
    #   book_id: the id of the book
    #   body: the text of the review
    def read_review_file(self, file_name):
        reviews = codecs.open(file_name, 'r', 'utf-8').readlines()

        # remove comment lines and newlines
        reviews = [r.strip() for r in reviews if r[0] != u'#']

        # parse
```

```
        rating = list()
        review_id = list()
        user_id = list()
        book_id = list()
        body = list()
        for review in reviews:
            # split by <tab>
            parts = review.split(u"\t")

            # rating is first part and body is last part
            rating.append(int(parts[0]))
            review_id.append(parts[1])
            user_id.append(parts[2])
            book_id.append(parts[3])
            if len(parts) > 4:
                body.append(parts[4])
            else:
                body.append(u"")

        return (rating, review_id, user_id, book_id, body)

    # Writes reviews to a file
    def write_review_file(self, file_name, rating, review_id, user_id,
                          book_id, body):

        lines = list()
        # loop
        for i in xrange(len(rating)):
            line = u"%s\t%s\t%s\t%s\t%s\n" % (rating[i], review_id[i],
                                              user_id[i], book_id[i],
                                              body[i])
            lines.append(line)

        open(file_name, 'w').write(u''.join(lines).encode('utf-8'))

    def read_clean_reviews(self):
        return self.read_review_file(self.REVIEWS_PATH +
                                     self.CLEAN_REVIEWS_FILE)

    def read_raw_reviews(self):
        return self.read_review_file(self.REVIEWS_PATH + self.RAW_REVIEWS_FILE)

    # Splits the dataset into a training/test sets in the setting of using 5
    # classes (predicting the rating value from 1 to 5)
    def split_train_test_5class(self, rating, percent_test,
                                balanced = "unbalanced"):
        np.random.seed(1234)
```

```
    num_reviews = len(rating)
    review_ids = np.arange(0, num_reviews)

    if balanced == "unbalanced":
        ntest = np.floor(num_reviews * percent_test)
        np.random.shuffle(review_ids)

        test_ids = review_ids[:ntest]
        train_ids = review_ids[ntest:]

    elif balanced == "balanced":
        (sizes, bins) = np.histogram(rating, [1, 2, 3, 4, 5, 6])
        min_size = np.min(sizes)
        print(min_size)

        # sample review ids equally among classes
        test_ids = np.zeros((0,), dtype="int32")
        train_ids = np.zeros((0,), dtype="int32")
        rating = np.array(rating)
        ntest = np.floor(min_size * percent_test)
        for c in range(1, 6):
            cids = review_ids[np.nonzero(rating == c)]
            np.random.shuffle(cids)

            test_ids = np.r_[test_ids, cids[:ntest]]
            train_ids = np.r_[train_ids, cids[ntest:min_size]]

    train_file = self.REVIEWS_PATH + "5class-" + balanced+ "-train.txt"
    test_file = self.REVIEWS_PATH + "5class-" + balanced+ "-test.txt"

    open(train_file, 'w').write('\n'.join(map(str, train_ids)))
    open(test_file, 'w').write('\n'.join(map(str, test_ids)))

    return (train_ids, test_ids)

# Splits the dataset into a training/test sets in the setting of using 2
# classes (predicting the polarity of the review where ratings 1 & 2
# are considered negative, ratings 4 & 5 are positive, and rating 3 is
# ignored)
def split_train_test_2class(self, rating, percent_test,
                            balanced = "unbalanced"):
    np.random.seed(1234)

    rating = np.array(rating, dtype='int32')
    # length
    num_reviews = len(rating)
```

```
        review_ids = np.arange(0, num_reviews)

        # convert to binary, with ratings [1, 2] --> neg and [4, 5] --> pos
        rating[rating == 2] = 1
        rating[rating == 4] = 5

        ids = (rating == 1) + (rating == 5)
        review_ids = review_ids[ids]
        rating = rating[ids]
        rating[rating == 1] = 0
        rating[rating == 5] = 1

        # get length after filtering
        num_reviews = rating.shape[0]

        if balanced == "unbalanced":
            ntest = np.floor(num_reviews * percent_test)
            np.random.shuffle(review_ids)

            test_ids = review_ids[:ntest]
            train_ids = review_ids[ntest:]

        elif balanced == "balanced":
            (sizes, bins) = np.histogram(rating, [0, 1, 2])
            min_size = np.min(sizes)
            print(min_size)

            # sample review ids equally among classes
            test_ids = np.zeros((0,), dtype="int32")
            train_ids = np.zeros((0,), dtype="int32")
            rating = np.array(rating)
            ntest = np.floor(min_size * percent_test)
            for c in [0, 1]:
                cids = review_ids[np.nonzero(rating == c)]
                np.random.shuffle(cids)

                test_ids = np.r_[test_ids, cids[:ntest]]
                train_ids = np.r_[train_ids, cids[ntest:min_size]]

        train_file = self.REVIEWS_PATH + "2class-" + balanced+ "-train.txt"
        test_file = self.REVIEWS_PATH + "2class-" + balanced+ "-test.txt"

        open(train_file, 'w').write('\n'.join(map(str, train_ids)))
        open(test_file, 'w').write('\n'.join(map(str, test_ids)))

        return (train_ids, test_ids)
```

```
    # Reads a training or test file. The file contains the indices of the
    # reviews from the clean reviews file.
    def read_train_test_file(self, file_name):
        ins = open(file_name).readlines()
        ins = [int(i.strip()) for i in ins]

        return ins

    # A helpter function.
    def set_binary_klass(self, ar):
        ar[(ar == 1) + (ar == 2)] = 0
        ar[(ar == 4) + (ar == 5)] = 1

    # Returns (train_x, train_y, test_x, test_y)
    # where x is the review body and y is the rating (1->5 or 0->1)
    def get_train_test(self, klass = "2", balanced = "balanced"):
        (rating, a, b, c, body) = self.read_clean_reviews()
        rating = np.array(rating)
        body = pd.Series(body)

        train_file = (self.REVIEWS_PATH + klass + "class-" +
            balanced+ "-train.txt")
        test_file = (self.REVIEWS_PATH + klass + "class-" +
            balanced+ "-test.txt")

        train_ids = self.read_train_test_file(train_file)
        test_ids = self.read_train_test_file(test_file)

        train_y = rating[train_ids]
        test_y = rating[test_ids]
        train_x = body[train_ids]
        test_x = body[test_ids]

        if klass == "2":
            self.set_binary_klass(train_y)
            self.set_binary_klass(test_y)

        return (train_x, train_y, test_x, test_y)
```

```
Writing labr.py
```

[10]:
```
from labr import LABR

labr_helper = LABR()

(d_train, y_train, d_test, y_test) = labr_helper.get_train_test(
    klass="2", balanced="unbalanced"
```

```
)

train_LABR_B_U = pd.DataFrame({DATA_COLUMN: d_train, LABEL_COLUMN: y_train})
test_LABR_B_U = pd.DataFrame({DATA_COLUMN: d_test, LABEL_COLUMN: y_test})

train_LABR_B_U[LABEL_COLUMN] = train_LABR_B_U[LABEL_COLUMN].apply(lambda x:␣
 ↪'NEG' if (x == 0) else 'POS')
test_LABR_B_U[LABEL_COLUMN] = test_LABR_B_U[LABEL_COLUMN].apply(lambda x: 'NEG'␣
 ↪if (x == 0) else 'POS')

print(train_LABR_B_U[LABEL_COLUMN].value_counts() + test_LABR_B_U[LABEL_COLUMN].
 ↪value_counts())
label_list_LABR_B_U = list(test_LABR_B_U[LABEL_COLUMN].unique())

data_LABR_B_U = CustomDataset(
    "LABR-UN-Binary", train_LABR_B_U, test_LABR_B_U, label_list_LABR_B_U
)
all_datasets.append(data_LABR_B_U)
```

```
POS    42832
NEG     8224
Name: label, dtype: int64
```

[11]:
```
df_ArSAS = pd.read_csv("/content/ArSAS..txt", sep="\t",encoding='utf-8')
df_ArSAS = df_ArSAS[["Tweet_text","Sentiment_label"]]
df_ArSAS.columns = [DATA_COLUMN, LABEL_COLUMN]
print("Total length: ", len(df_ArSAS))
print(df_ArSAS[LABEL_COLUMN].value_counts())

label_list_ArSAS = list(df_ArSAS[LABEL_COLUMN].unique())
print(label_list_ArSAS)

train_ArSAS, test_ArSAS = train_test_split(df_ArSAS, test_size=0.2,␣
 ↪random_state=42)
print("Training length: ", len(train_ArSAS))
print("Testing length: ", len(test_ArSAS))
data_ArSAS = CustomDataset("ArSAS", train_ArSAS, test_ArSAS, label_list_ArSAS)
all_datasets.append(data_ArSAS)
```

```
Total length:  19897
Negative    7384
Neutral     6894
Positive    4400
Mixed       1219
Name: label, dtype: int64
['Positive', 'Negative', 'Neutral', 'Mixed']
Training length:  15917
```

```
Testing length:  3980
```

3. Training procedure

[12]:
```
import numpy as np
import torch
import random
import matplotlib.pyplot as plt
import copy

from arabert.preprocess import ArabertPreprocessor
from sklearn.metrics import (accuracy_score, classification_report,
                             confusion_matrix, f1_score, precision_score,
                             recall_score)
from torch.utils.data import DataLoader, Dataset
from transformers import (AutoConfig, AutoModelForSequenceClassification,
                          AutoTokenizer, BertTokenizer, Trainer,
                          TrainingArguments)
from transformers.data.processors.utils import InputFeatures
```

[13]:
```
for x in all_datasets:
  print(x.name)
```

```
HARD
LABR-UN-Binary
ArSAS
```

[14]:
```
dataset_name = 'ArSAS'
model_name = 'aubmindlab/bert-base-arabertv02-twitter'
```

[15]:
```
for d in all_datasets:
  if d.name==dataset_name:
    selected_dataset = copy.deepcopy(d)
    print('Dataset found')
    break
```

```
Dataset found
```

[16]:
```
arabic_prep = ArabertPreprocessor(model_name)

selected_dataset.train[DATA_COLUMN] = selected_dataset.train[DATA_COLUMN].
 ↪apply(lambda x: arabic_prep.preprocess(x))
selected_dataset.test[DATA_COLUMN] = selected_dataset.test[DATA_COLUMN].
 ↪apply(lambda x: arabic_prep.preprocess(x))
```

[17]:
```
list(selected_dataset.train[DATA_COLUMN][0:10])
```

[17]:
```
['#     - "     " :
[  ]',
 '          [  ]                      ',
 '    #    _
                                    !
                                !
                                   ',
 '
                                ',
 '
                                        #
                    [  ]',
 '#    |              #                          #
   _    _     #    _      # weneedtotalk [  ]',
 '#    _             ',
 '1 -                      2 -
                    3 -

                  ',
 '           . .            . .   #      #       [  ]',
 '        :              2 -


              #   '[
```

[18]:
```
tok = AutoTokenizer.from_pretrained(model_name)
```

```
Downloading:   0%|          | 0.00/476 [00:00<?, ?B/s]

Downloading:   0%|          | 0.00/733k [00:00<?, ?B/s]

Downloading:   0%|          | 0.00/1.19M [00:00<?, ?B/s]

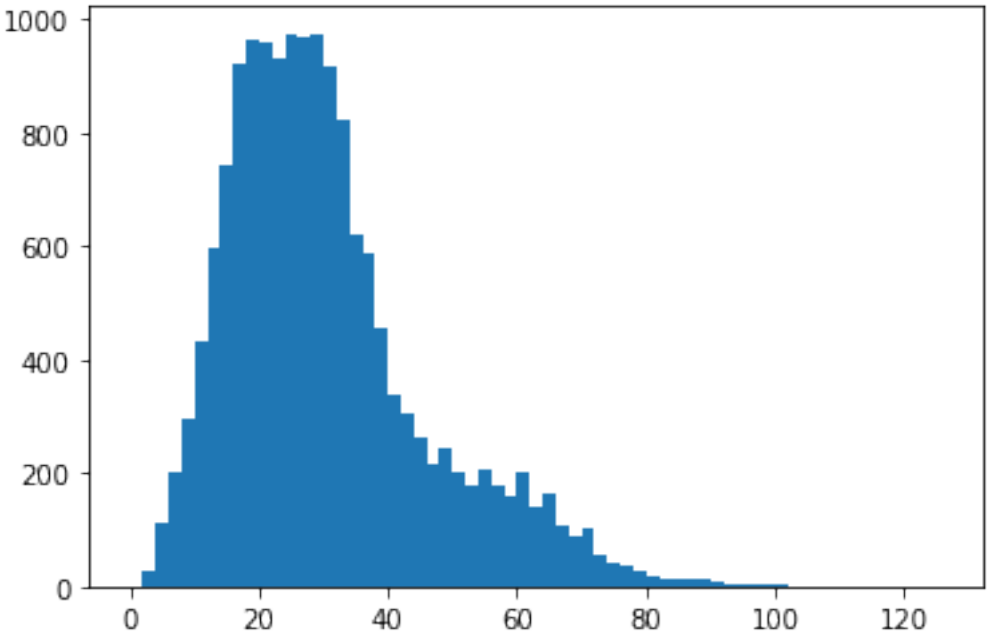
Downloading:   0%|          | 0.00/112 [00:00<?, ?B/s]
```

[19]:
```
print("Training Sentence Lengths: ")
plt.hist([ len(tok.tokenize(sentence)) for sentence in selected_dataset.
 ↪train[DATA_COLUMN].to_list()],bins=range(0,128,2))
plt.show()

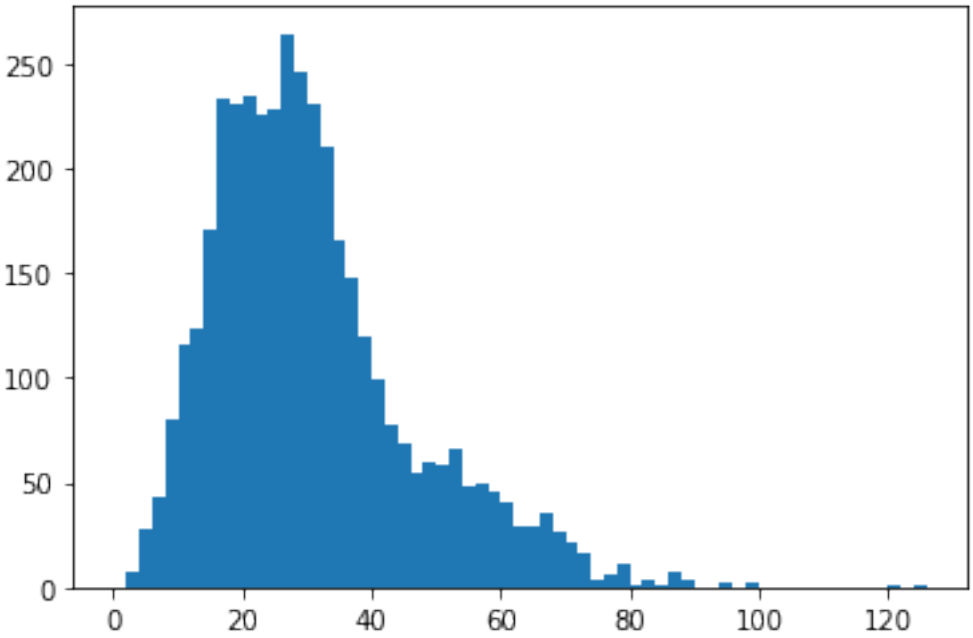
print("Testing Sentence Lengths: ")
plt.hist([ len(tok.tokenize(sentence)) for sentence in selected_dataset.
 ↪test[DATA_COLUMN].to_list()],bins=range(0,128,2))
plt.show()
```

Training Sentence Lengths:

Token indices sequence length is longer than the specified maximum sequence length for this model (521 > 512). Running this sequence through the model will result in indexing errors



Testing Sentence Lengths:



[20]:
```
max_len = 128
```

[21]:
```
print("Truncated training sequences: ", sum([len(tok.tokenize(sentence)) >␣
 ↪max_len for sentence in selected_dataset.test[DATA_COLUMN].to_list()]))

print("Truncated testing sequences: ", sum([len(tok.tokenize(sentence)) >␣
 ↪max_len for sentence in selected_dataset.test[DATA_COLUMN].to_list()]))
```

```
Truncated training sequences:  8
Truncated testing sequences:  8
```

[22]:
```
class ClassificationDataset(Dataset):
    def __init__(self, text, target, model_name, max_len, label_map):
      super(ClassificationDataset).__init__()

      self.text = text
      self.target = target
      self.tokenizer_name = model_name
      self.tokenizer = AutoTokenizer.from_pretrained(model_name)
      self.max_len = max_len
      self.label_map = label_map


    def __len__(self):
      return len(self.text)

    def __getitem__(self,item):
      text = str(self.text[item])
      text = " ".join(text.split())

      inputs = self.tokenizer(
          text,
          max_length=self.max_len,
          padding='max_length',
          truncation=True
      )
      return InputFeatures(**inputs,label=self.label_map[self.target[item]])
```

[23]:
```
label_map = { v:index for index, v in enumerate(selected_dataset.label_list) }
print(label_map)

train_dataset = ClassificationDataset(
    selected_dataset.train[DATA_COLUMN].to_list(),
    selected_dataset.train[LABEL_COLUMN].to_list(),
    model_name,
```

```
    max_len,
    label_map
  )
test_dataset = ClassificationDataset(
    selected_dataset.test[DATA_COLUMN].to_list(),
    selected_dataset.test[LABEL_COLUMN].to_list(),
    model_name,
    max_len,
    label_map
  )
```

```
{'Positive': 0, 'Negative': 1, 'Neutral': 2, 'Mixed': 3}
```

[24]:
```
print(next(iter(train_dataset)))
```

```
InputFeatures(input_ids=[2, 10, 12279, 19, 9, 51185, 9, 31, 582, 3173, 5987,
2095, 27989, 323, 5518, 9435, 420, 1258, 64, 3879, 66, 3, 0, 0, 0, 0, 0, 0, 0,
0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0], attention_mask=[1, 1, 1,
1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0, 0, 0, 0, 0, 0, 0, 0,
0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0], token_type_ids=[0, 0, 0, 0,
0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0], label=2)
```

[25]:
```
def model_init():
    return AutoModelForSequenceClassification.from_pretrained(model_name,␣
 ↪return_dict=True, num_labels=len(label_map))
```

[26]:
```
def compute_metrics(p): #p should be of type EvalPrediction
  preds = np.argmax(p.predictions, axis=1)
  assert len(preds) == len(p.label_ids)
  #print(classification_report(p.label_ids,preds))
  #print(confusion_matrix(p.label_ids,preds))
  macro_f1 = f1_score(p.label_ids,preds,average='macro')
  #macro_precision = precision_score(p.label_ids,preds,average='macro')
  #macro_recall = recall_score(p.label_ids,preds,average='macro')
  acc = accuracy_score(p.label_ids,preds)
  return {
      'macro_f1' : macro_f1,
```

```
      'accuracy': acc
  }
```

[27]:
```
def set_seed(seed=42):
  random.seed(seed)
  np.random.seed(seed)
  torch.manual_seed(seed)
  torch.cuda.manual_seed(seed)
  torch.cuda.manual_seed_all(seed)
  torch.backends.cudnn.deterministic=True
  torch.backends.cudnn.benchmark = False
```

4. Regular Training

[28]:
```
training_args = TrainingArguments(
    output_dir= "./train",
    adam_epsilon = 1e-8,
    learning_rate = 2e-5,
    fp16 = False, # enable this when using V100 or T4 GPU
    per_device_train_batch_size = 16, # up to 64 on 16GB with max len of 128
    per_device_eval_batch_size = 128,
    gradient_accumulation_steps = 2, # use this to scale batch size without␣
 ↪needing more memory
    num_train_epochs= 2,
    warmup_ratio = 0,
    do_eval = True,
    evaluation_strategy = 'epoch',
    save_strategy = 'epoch',
    load_best_model_at_end = True, # this allows to automatically get the best␣
 ↪model at the end based on whatever metric we want
    metric_for_best_model = 'macro_f1',
    greater_is_better = True,
    seed = 25
  )

set_seed(training_args.seed)
```

[29]:
```
trainer = Trainer(
    model = model_init(),
    args = training_args,
    train_dataset = train_dataset,
    eval_dataset=test_dataset,
    compute_metrics=compute_metrics,
)
```

```
Downloading:   0%|          | 0.00/667 [00:00<?, ?B/s]
```

```
Downloading:   0%|          | 0.00/516M [00:00<?, ?B/s]
```

```
Some weights of the model checkpoint at aubmindlab/bert-base-arabertv02-twitter
were not used when initializing BertForSequenceClassification:
['cls.predictions.bias', 'cls.predictions.transform.LayerNorm.bias',
'cls.predictions.decoder.bias', 'cls.predictions.decoder.weight',
'cls.predictions.transform.dense.weight',
'cls.predictions.transform.dense.bias',
'cls.predictions.transform.LayerNorm.weight']
- This IS expected if you are initializing BertForSequenceClassification from
the checkpoint of a model trained on another task or with another architecture
(e.g. initializing a BertForSequenceClassification model from a
BertForPreTraining model).
- This IS NOT expected if you are initializing BertForSequenceClassification
from the checkpoint of a model that you expect to be exactly identical
(initializing a BertForSequenceClassification model from a
BertForSequenceClassification model).
Some weights of BertForSequenceClassification were not initialized from the
model checkpoint at aubmindlab/bert-base-arabertv02-twitter and are newly
initialized: ['classifier.weight', 'bert.pooler.dense.weight',
'bert.pooler.dense.bias', 'classifier.bias']
You should probably TRAIN this model on a down-stream task to be able to use it
for predictions and inference.
```

[30]:
```
trainer.train()
```

```
***** Running training *****
  Num examples = 15917
  Num Epochs = 2
  Instantaneous batch size per device = 16
  Total train batch size (w. parallel, distributed & accumulation) = 32
  Gradient Accumulation steps = 2
  Total optimization steps = 994
```

```
<IPython.core.display.HTML object>
```

```
***** Running Evaluation *****
  Num examples = 3980
  Batch size = 128
Saving model checkpoint to ./train/checkpoint-497
Configuration saved in ./train/checkpoint-497/config.json
Model weights saved in ./train/checkpoint-497/pytorch_model.bin
***** Running Evaluation *****
  Num examples = 3980
  Batch size = 128
Saving model checkpoint to ./train/checkpoint-994
Configuration saved in ./train/checkpoint-994/config.json
```

```
Model weights saved in ./train/checkpoint-994/pytorch_model.bin


Training completed. Do not forget to share your model on huggingface.co/models
=)


Loading best model from ./train/checkpoint-994 (score: 0.657271963641283).
```

[30]:
```
TrainOutput(global_step=994, training_loss=0.5354030616806307,
metrics={'train_runtime': 770.2601, 'train_samples_per_second': 41.329,
'train_steps_per_second': 1.29, 'total_flos': 2093151809608704.0, 'train_loss':
0.5354030616806307, 'epoch': 2.0})
```

[31]:
```
inv_label_map = inv_label_map = { v:k for k, v in label_map.items()}
print(inv_label_map)
trainer.model.config.label2id = label_map
trainer.model.config.id2label = inv_label_map
trainer.save_model("output_dir")
train_dataset.tokenizer.save_pretrained("output_dir")
```

```
Saving model checkpoint to output_dir
Configuration saved in output_dir/config.json
{0: 'Positive', 1: 'Negative', 2: 'Neutral', 3: 'Mixed'}
Model weights saved in output_dir/pytorch_model.bin
tokenizer config file saved in output_dir/tokenizer_config.json
Special tokens file saved in output_dir/special_tokens_map.json
```

[31]:
```
('output_dir/tokenizer_config.json',
 'output_dir/special_tokens_map.json',
 'output_dir/vocab.txt',
 'output_dir/added_tokens.json',
 'output_dir/tokenizer.json')
```

[32]:
```
!cp output_dir /content/drive/MyDrive
```

```
cp: -r not specified; omitting directory 'output_dir'
```

5. Predict Using The Saved Model

[33]:
```
from transformers import pipeline
```

[34]:
```
pipe = pipeline("sentiment-analysis", model="output_dir", device=0,␣
↪return_all_scores=True)
```

```
loading configuration file output_dir/config.json
Model config BertConfig {
  "_name_or_path": "aubmindlab/bert-base-arabertv02-twitter",
```

```
  "architectures": [
    "BertForSequenceClassification"
  ],
  "attention_probs_dropout_prob": 0.1,
  "classifier_dropout": null,
  "gradient_checkpointing": false,
  "hidden_act": "gelu",
  "hidden_dropout_prob": 0.1,
  "hidden_size": 768,
  "id2label": {
    "0": "Positive",
    "1": "Negative",
    "2": "Neutral",
    "3": "Mixed"
  },
  "initializer_range": 0.02,
  "intermediate_size": 3072,
  "label2id": {
    "Mixed": 3,
    "Negative": 1,
    "Neutral": 2,
    "Positive": 0
  },
  "layer_norm_eps": 1e-12,
  "max_position_embeddings": 512,
  "model_type": "bert",
  "num_attention_heads": 12,
  "num_hidden_layers": 12,
  "pad_token_id": 0,
  "position_embedding_type": "absolute",
  "problem_type": "single_label_classification",
  "torch_dtype": "float32",
  "transformers_version": "4.12.2",
  "type_vocab_size": 2,
  "use_cache": true,
  "vocab_size": 64000
}

loading configuration file output_dir/config.json
Model config BertConfig {
  "_name_or_path": "aubmindlab/bert-base-arabertv02-twitter",
  "architectures": [
    "BertForSequenceClassification"
  ],
  "attention_probs_dropout_prob": 0.1,
  "classifier_dropout": null,
  "gradient_checkpointing": false,
  "hidden_act": "gelu",
```

```
  "hidden_dropout_prob": 0.1,
  "hidden_size": 768,
  "id2label": {
    "0": "Positive",
    "1": "Negative",
    "2": "Neutral",
    "3": "Mixed"
  },
  "initializer_range": 0.02,
  "intermediate_size": 3072,
  "label2id": {
    "Mixed": 3,
    "Negative": 1,
    "Neutral": 2,
    "Positive": 0
  },
  "layer_norm_eps": 1e-12,
  "max_position_embeddings": 512,
  "model_type": "bert",
  "num_attention_heads": 12,
  "num_hidden_layers": 12,
  "pad_token_id": 0,
  "position_embedding_type": "absolute",
  "problem_type": "single_label_classification",
  "torch_dtype": "float32",
  "transformers_version": "4.12.2",
  "type_vocab_size": 2,
  "use_cache": true,
  "vocab_size": 64000
}

loading weights file output_dir/pytorch_model.bin
All model checkpoint weights were used when initializing
BertForSequenceClassification.

All the weights of BertForSequenceClassification were initialized from the model
checkpoint at output_dir.
If your task is similar to the task the model of the checkpoint was trained on,
you can already use BertForSequenceClassification for predictions without
further training.
Didn't find file output_dir/added_tokens.json. We won't load it.
loading file output_dir/vocab.txt
loading file output_dir/tokenizer.json
loading file None
loading file output_dir/special_tokens_map.json
loading file output_dir/tokenizer_config.json
```

[35]:
```
pipe("Some Text")
```

[35]:
```
[[{'label': 'Positive', 'score': 0.088777095079422},
  {'label': 'Negative', 'score': 0.06401639431715012},
  {'label': 'Neutral', 'score': 0.8265421986579895},
  {'label': 'Mixed', 'score': 0.02066433243453502 7}]]
```

6. K-fold & Ensemble all the cross validation models

[36]:
```
# do kfold on the training. Check the perfomance on the test set
kfold_dataset = selected_dataset.train
# do kfold on all the dataset. Here we will not have any dataset to checl final␣
 ↪performance on (this is used mainly in competitions)
# kfold_dataset = pd.concat([selected_dataset.train,selected_dataset.test])
kfold_dataset.reset_index(inplace=True,drop=True)
```

[37]:
```
inv_label_map = { v:k for k, v in label_map.items()}
```

[38]:
```
from sklearn.model_selection import StratifiedKFold

kf = StratifiedKFold(
    n_splits=5,
    shuffle=True,
    random_state=123
  )
```

[39]:
```
all_results = []
fold_best_f1 = 0
best_fold = None
for fold_num , (train, dev) in enumerate(kf.
 ↪split(kfold_dataset,kfold_dataset['label'])):
  print("**************************Starting Fold Num: ", fold_num,"␣
 ↪**************************")

  train_dataset = ClassificationDataset(list(kfold_dataset[DATA_COLUMN][train]),
                                list(kfold_dataset[LABEL_COLUMN][train]),
                                model_name,
                                max_len,
                                label_map)

  val_dataset = ClassificationDataset(list(kfold_dataset[DATA_COLUMN][dev]),
                                list(kfold_dataset[LABEL_COLUMN][dev]),
                                model_name,
                                max_len,
                                label_map)

  training_args = TrainingArguments(
```

```
    output_dir= f"./train_{fold_num}",
    adam_epsilon = 1e-8,
    learning_rate = 2e-5,
    fp16 = False,
    per_device_train_batch_size = 64,
    per_device_eval_batch_size = 128,
    gradient_accumulation_steps = 2,
    num_train_epochs= 2,
    warmup_ratio = 0,
    do_eval = True,
    evaluation_strategy = 'epoch',
    save_strategy = 'epoch',
    load_best_model_at_end = True,
    metric_for_best_model = 'macro_f1',
    greater_is_better = True,
    seed = 123
  )

  set_seed(training_args.seed)

  trainer = Trainer(
    model = model_init(),
    args = training_args,
    train_dataset = train_dataset,
    eval_dataset=val_dataset,
    compute_metrics=compute_metrics,
  )
  trainer.model.config.label2id = label_map
  trainer.model.config.id2label = inv_label_map

  trainer.train()

  results = trainer.evaluate()
  all_results.append(results)
  print(results)

  trainer.save_model(f"./train_{fold_num}/best_model")
  val_dataset.tokenizer.save_pretrained(f"./train_{fold_num}/best_model")

  # delete the rest of the checkpoints
  !rm -rf f"./train_{fold_num}/checkpoint-*"

  if results['eval_macro_f1'] > fold_best_f1:
    print('**************************New Best Model Found!
↪**************************')
    fold_best_f1 = results['eval_macro_f1']
    best_fold = fold_num
```

```
**************************Starting Fold Num:  0  **************************
loading file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/vocab.txt from cache at /root/.cache/huggingface
/transformers/dbef00ddc9b64a66ba8057785b166b744cef2a41be973446ad897a56ad317019.a
a4ad61e3b0a52c7bcf5410af86ef01a27cf1147665acd6bfba80731d053f78a
loading file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/tokenizer.json from cache at /root/.cache/huggin
gface/transformers/46fef3ab20b06df535befe0412ab892f9baec0a9f8e64d75a0142a67ce366
959.c7c33ce0611a0a55c52a9ba4c03992b47db6e8b9862113443132ed9af7185a19
loading file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/added_tokens.json from cache at None
loading file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/special_tokens_map.json from cache at /root/.cac
he/huggingface/transformers/7f74425f6809cddb05d5de7967a5af4e325b04245017a7b1917f
e7d5cfb06988.dd8bd9bfd3664b530ea4e645105f557769387b3da9f79bdb55ed556bdd80611d
loading file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/tokenizer_config.json from cache at /root/.cache
/huggingface/transformers/582bc76b2b3acaaf545878170de8fbf8d6d1f65bd0180769ff4ed9
01cd60d3c4.9badb1b6af7f7e89d855c8fbc79dd73ef57ac1c9e573a43862ddaeb2c798a290
loading file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/vocab.txt from cache at /root/.cache/huggingface
/transformers/dbef00ddc9b64a66ba8057785b166b744cef2a41be973446ad897a56ad317019.a
a4ad61e3b0a52c7bcf5410af86ef01a27cf1147665acd6bfba80731d053f78a
loading file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/tokenizer.json from cache at /root/.cache/huggin
gface/transformers/46fef3ab20b06df535befe0412ab892f9baec0a9f8e64d75a0142a67ce366
959.c7c33ce0611a0a55c52a9ba4c03992b47db6e8b9862113443132ed9af7185a19
loading file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/added_tokens.json from cache at None
loading file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/special_tokens_map.json from cache at /root/.cac
he/huggingface/transformers/7f74425f6809cddb05d5de7967a5af4e325b04245017a7b1917f
e7d5cfb06988.dd8bd9bfd3664b530ea4e645105f557769387b3da9f79bdb55ed556bdd80611d
loading file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/tokenizer_config.json from cache at /root/.cache
/huggingface/transformers/582bc76b2b3acaaf545878170de8fbf8d6d1f65bd0180769ff4ed9
01cd60d3c4.9badb1b6af7f7e89d855c8fbc79dd73ef57ac1c9e573a43862ddaeb2c798a290
PyTorch: setting up devices
The default value for the training argument `--report_to` will change in v5
(from all installed integrations to none). In v5, you will need to use
`--report_to all` to get the same behavior as now. You should start updating
your code and make this info disappear :-).
loading configuration file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/config.json from cache at /root/.cache/huggingfa
ce/transformers/1109ac490c1eb90f74960e17c00032f27ea3c4be159567d7ed5d2b5908f9855c
.01294502d101541d98086466d32c6b4f04698a90a573cd06480d05bd0c20b2aa
Model config BertConfig {
```

```
  "_name_or_path": "bert-base-arabertv02",
  "architectures": [
    "BertForMaskedLM"
  ],
  "attention_probs_dropout_prob": 0.1,
  "classifier_dropout": null,
  "gradient_checkpointing": false,
  "hidden_act": "gelu",
  "hidden_dropout_prob": 0.1,
  "hidden_size": 768,
  "id2label": {
    "0": "LABEL_0",
    "1": "LABEL_1",
    "2": "LABEL_2",
    "3": "LABEL_3"
  },
  "initializer_range": 0.02,
  "intermediate_size": 3072,
  "label2id": {
    "LABEL_0": 0,
    "LABEL_1": 1,
    "LABEL_2": 2,
    "LABEL_3": 3
  },
  "layer_norm_eps": 1e-12,
  "max_position_embeddings": 512,
  "model_type": "bert",
  "num_attention_heads": 12,
  "num_hidden_layers": 12,
  "pad_token_id": 0,
  "position_embedding_type": "absolute",
  "torch_dtype": "float32",
  "transformers_version": "4.12.2",
  "type_vocab_size": 2,
  "use_cache": true,
  "vocab_size": 64000
}

loading weights file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/pytorch_model.bin from cache at /root/.cache/hug
gingface/transformers/1f7c10cecf08743620c7e224e2f3c6b072e45aee1e88fa324837fd199c
f24f21.e7b697f3572c7ddd6984e105b6c6cacc07a625d1195f9be544d26d3ad7d0e442
Some weights of the model checkpoint at aubmindlab/bert-base-arabertv02-twitter
were not used when initializing BertForSequenceClassification:
['cls.predictions.bias', 'cls.predictions.transform.LayerNorm.bias',
'cls.predictions.decoder.bias', 'cls.predictions.decoder.weight',
'cls.predictions.transform.dense.weight',
'cls.predictions.transform.dense.bias',
```

```
'cls.predictions.transform.LayerNorm.weight']
- This IS expected if you are initializing BertForSequenceClassification from
the checkpoint of a model trained on another task or with another architecture
(e.g. initializing a BertForSequenceClassification model from a
BertForPreTraining model).
- This IS NOT expected if you are initializing BertForSequenceClassification
from the checkpoint of a model that you expect to be exactly identical
(initializing a BertForSequenceClassification model from a
BertForSequenceClassification model).
Some weights of BertForSequenceClassification were not initialized from the
model checkpoint at aubmindlab/bert-base-arabertv02-twitter and are newly
initialized: ['classifier.weight', 'bert.pooler.dense.weight',
'bert.pooler.dense.bias', 'classifier.bias']
You should probably TRAIN this model on a down-stream task to be able to use it
for predictions and inference.
***** Running training *****
  Num examples = 12733
  Num Epochs = 2
  Instantaneous batch size per device = 64
  Total train batch size (w. parallel, distributed & accumulation) = 128
  Gradient Accumulation steps = 2
  Total optimization steps = 198
```

```
<IPython.core.display.HTML object>
```

```
***** Running Evaluation *****
  Num examples = 3184
  Batch size = 128
Saving model checkpoint to ./train_0/checkpoint-99
Configuration saved in ./train_0/checkpoint-99/config.json
Model weights saved in ./train_0/checkpoint-99/pytorch_model.bin
***** Running Evaluation *****
  Num examples = 3184
  Batch size = 128
Saving model checkpoint to ./train_0/checkpoint-198
Configuration saved in ./train_0/checkpoint-198/config.json
Model weights saved in ./train_0/checkpoint-198/pytorch_model.bin


Training completed. Do not forget to share your model on huggingface.co/models
=)


Loading best model from ./train_0/checkpoint-198 (score: 0.6079539714099805).
***** Running Evaluation *****
  Num examples = 3184
  Batch size = 128
```

```
<IPython.core.display.HTML object>


Saving model checkpoint to ./train_0/best_model
Configuration saved in ./train_0/best_model/config.json

{'eval_loss': 0.5619563460350037, 'eval_macro_f1': 0.6079539714099805,
'eval_accuracy': 0.7889447236180904, 'eval_runtime': 25.8254,
'eval_samples_per_second': 123.29, 'eval_steps_per_second': 0.968, 'epoch':
1.99}

Model weights saved in ./train_0/best_model/pytorch_model.bin
tokenizer config file saved in ./train_0/best_model/tokenizer_config.json
Special tokens file saved in ./train_0/best_model/special_tokens_map.json

**************************New Best Model Found!**************************
**************************Starting Fold Num:  1  **************************

loading file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/vocab.txt from cache at /root/.cache/huggingface
/transformers/dbef00ddc9b64a66ba8057785b166b744cef2a41be973446ad897a56ad317019.a
a4ad61e3b0a52c7bcf5410af86ef01a27cf1147665acd6bfba80731d053f78a
loading file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/tokenizer.json from cache at /root/.cache/huggin
gface/transformers/46fef3ab20b06df535befe0412ab892f9baec0a9f8e64d75a0142a67ce366
959.c7c33ce0611a0a55c52a9ba4c03992b47db6e8b9862113443132ed9af7185a19
loading file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/added_tokens.json from cache at None
loading file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/special_tokens_map.json from cache at /root/.cac
he/huggingface/transformers/7f74425f6809cddb05d5de7967a5af4e325b04245017a7b1917f
e7d5cfb06988.dd8bd9bfd3664b530ea4e645105f557769387b3da9f79bdb55ed556bdd80611d
loading file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/tokenizer_config.json from cache at /root/.cache
/huggingface/transformers/582bc76b2b3acaaf545878170de8fbf8d6d1f65bd0180769ff4ed9
01cd60d3c4.9badb1b6af7f7e89d855c8fbc79dd73ef57ac1c9e573a43862ddaeb2c798a290
loading file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/vocab.txt from cache at /root/.cache/huggingface
/transformers/dbef00ddc9b64a66ba8057785b166b744cef2a41be973446ad897a56ad317019.a
a4ad61e3b0a52c7bcf5410af86ef01a27cf1147665acd6bfba80731d053f78a
loading file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/tokenizer.json from cache at /root/.cache/huggin
gface/transformers/46fef3ab20b06df535befe0412ab892f9baec0a9f8e64d75a0142a67ce366
959.c7c33ce0611a0a55c52a9ba4c03992b47db6e8b9862113443132ed9af7185a19
loading file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/added_tokens.json from cache at None
loading file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/special_tokens_map.json from cache at /root/.cac
he/huggingface/transformers/7f74425f6809cddb05d5de7967a5af4e325b04245017a7b1917f
e7d5cfb06988.dd8bd9bfd3664b530ea4e645105f557769387b3da9f79bdb55ed556bdd80611d
```

```
loading file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/tokenizer_config.json from cache at /root/.cache
/huggingface/transformers/582bc76b2b3acaaf545878170de8fbf8d6d1f65bd0180769ff4ed9
01cd60d3c4.9badb1b6af7f7e89d855c8fbc79dd73ef57ac1c9e573a43862ddaeb2c798a290
PyTorch: setting up devices
The default value for the training argument `--report_to` will change in v5
(from all installed integrations to none). In v5, you will need to use
`--report_to all` to get the same behavior as now. You should start updating
your code and make this info disappear :-).
loading configuration file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/config.json from cache at /root/.cache/huggingfa
ce/transformers/1109ac490c1eb90f74960e17c00032f27ea3c4be159567d7ed5d2b5908f9855c
.01294502d101541d98086466d32c6b4f04698a90a573cd06480d05bd0c20b2aa
Model config BertConfig {
  "_name_or_path": "bert-base-arabertv02",
  "architectures": [
    "BertForMaskedLM"
  ],
  "attention_probs_dropout_prob": 0.1,
  "classifier_dropout": null,
  "gradient_checkpointing": false,
  "hidden_act": "gelu",
  "hidden_dropout_prob": 0.1,
  "hidden_size": 768,
  "id2label": {
    "0": "LABEL_0",
    "1": "LABEL_1",
    "2": "LABEL_2",
    "3": "LABEL_3"
  },
  "initializer_range": 0.02,
  "intermediate_size": 3072,
  "label2id": {
    "LABEL_0": 0,
    "LABEL_1": 1,
    "LABEL_2": 2,
    "LABEL_3": 3
  },
  "layer_norm_eps": 1e-12,
  "max_position_embeddings": 512,
  "model_type": "bert",
  "num_attention_heads": 12,
  "num_hidden_layers": 12,
  "pad_token_id": 0,
  "position_embedding_type": "absolute",
  "torch_dtype": "float32",
  "transformers_version": "4.12.2",
  "type_vocab_size": 2,
```

```
  "use_cache": true,
  "vocab_size": 64000
}

loading weights file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/pytorch_model.bin from cache at /root/.cache/hug
gingface/transformers/1f7c10cecf08743620c7e224e2f3c6b072e45aee1e88fa324837fd199c
f24f21.e7b697f3572c7ddd6984e105b6c6cacc07a625d1195f9be544d26d3ad7d0e442
Some weights of the model checkpoint at aubmindlab/bert-base-arabertv02-twitter
were not used when initializing BertForSequenceClassification:
['cls.predictions.bias', 'cls.predictions.transform.LayerNorm.bias',
'cls.predictions.decoder.bias', 'cls.predictions.decoder.weight',
'cls.predictions.transform.dense.weight',
'cls.predictions.transform.dense.bias',
'cls.predictions.transform.LayerNorm.weight']
- This IS expected if you are initializing BertForSequenceClassification from
the checkpoint of a model trained on another task or with another architecture
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from the checkpoint of a model that you expect to be exactly identical
(initializing a BertForSequenceClassification model from a
BertForSequenceClassification model).
Some weights of BertForSequenceClassification were not initialized from the
model checkpoint at aubmindlab/bert-base-arabertv02-twitter and are newly
initialized: ['classifier.weight', 'bert.pooler.dense.weight',
'bert.pooler.dense.bias', 'classifier.bias']
You should probably TRAIN this model on a down-stream task to be able to use it
for predictions and inference.
***** Running training *****
  Num examples = 12733
  Num Epochs = 2
  Instantaneous batch size per device = 64
  Total train batch size (w. parallel, distributed & accumulation) = 128
  Gradient Accumulation steps = 2
  Total optimization steps = 198
<IPython.core.display.HTML object>


***** Running Evaluation *****
  Num examples = 3184
  Batch size = 128
Saving model checkpoint to ./train_1/checkpoint-99
Configuration saved in ./train_1/checkpoint-99/config.json
Model weights saved in ./train_1/checkpoint-99/pytorch_model.bin
***** Running Evaluation *****
  Num examples = 3184
  Batch size = 128
```

```
Saving model checkpoint to ./train_1/checkpoint-198
Configuration saved in ./train_1/checkpoint-198/config.json
Model weights saved in ./train_1/checkpoint-198/pytorch_model.bin


Training completed. Do not forget to share your model on huggingface.co/models
=)


Loading best model from ./train_1/checkpoint-198 (score: 0.6160311742051623).
***** Running Evaluation *****
  Num examples = 3184
  Batch size = 128
<IPython.core.display.HTML object>


Saving model checkpoint to ./train_1/best_model
Configuration saved in ./train_1/best_model/config.json
{'eval_loss': 0.567663311958313, 'eval_macro_f1': 0.6160311742051623,
'eval_accuracy': 0.780464824120603, 'eval_runtime': 25.6981,
'eval_samples_per_second': 123.9, 'eval_steps_per_second': 0.973, 'epoch': 1.99}
Model weights saved in ./train_1/best_model/pytorch_model.bin
tokenizer config file saved in ./train_1/best_model/tokenizer_config.json
Special tokens file saved in ./train_1/best_model/special_tokens_map.json
**************************New Best Model Found!**************************
**************************Starting Fold Num:  2  **************************
loading file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/vocab.txt from cache at /root/.cache/huggingface
/transformers/dbef00ddc9b64a66ba8057785b166b744cef2a41be973446ad897a56ad317019.a
a4ad61e3b0a52c7bcf5410af86ef01a27cf1147665acd6bfba80731d053f78a
loading file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/tokenizer.json from cache at /root/.cache/huggin
gface/transformers/46fef3ab20b06df535befe0412ab892f9baec0a9f8e64d75a0142a67ce366
959.c7c33ce0611a0a55c52a9ba4c03992b47db6e8b9862113443132ed9af7185a19
loading file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/added_tokens.json from cache at None
loading file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/special_tokens_map.json from cache at /root/.cac
he/huggingface/transformers/7f74425f6809cddb05d5de7967a5af4e325b04245017a7b1917f
e7d5cfb06988.dd8bd9bfd3664b530ea4e645105f557769387b3da9f79bdb55ed556bdd80611d
loading file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/tokenizer_config.json from cache at /root/.cache
/huggingface/transformers/582bc76b2b3acaaf545878170de8fbf8d6d1f65bd0180769ff4ed9
01cd60d3c4.9badb1b6af7f7e89d855c8fbc79dd73ef57ac1c9e573a43862ddaeb2c798a290
loading file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/vocab.txt from cache at /root/.cache/huggingface
```

```
/transformers/dbef00ddc9b64a66ba8057785b166b744cef2a41be973446ad897a56ad317019.a
a4ad61e3b0a52c7bcf5410af86ef01a27cf1147665acd6bfba80731d053f78a
loading file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/tokenizer.json from cache at /root/.cache/huggin
gface/transformers/46fef3ab20b06df535befe0412ab892f9baec0a9f8e64d75a0142a67ce366
959.c7c33ce0611a0a55c52a9ba4c03992b47db6e8b9862113443132ed9af7185a19
loading file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/added_tokens.json from cache at None
loading file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/special_tokens_map.json from cache at /root/.cac
he/huggingface/transformers/7f74425f6809cddb05d5de7967a5af4e325b04245017a7b1917f
e7d5cfb06988.dd8bd9bfd3664b530ea4e645105f557769387b3da9f79bdb55ed556bdd80611d
loading file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/tokenizer_config.json from cache at /root/.cache
/huggingface/transformers/582bc76b2b3acaaf545878170de8fbf8d6d1f65bd0180769ff4ed9
01cd60d3c4.9badb1b6af7f7e89d855c8fbc79dd73ef57ac1c9e573a43862ddaeb2c798a290
PyTorch: setting up devices
The default value for the training argument `--report_to` will change in v5
(from all installed integrations to none). In v5, you will need to use
`--report_to all` to get the same behavior as now. You should start updating
your code and make this info disappear :-).
loading configuration file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/config.json from cache at /root/.cache/huggingfa
ce/transformers/1109ac490c1eb90f74960e17c00032f27ea3c4be159567d7ed5d2b5908f9855c
.01294502d101541d98086466d32c6b4f04698a90a573cd06480d05bd0c20b2aa
Model config BertConfig {
  "_name_or_path": "bert-base-arabertv02",
  "architectures": [
    "BertForMaskedLM"
  ],
  "attention_probs_dropout_prob": 0.1,
  "classifier_dropout": null,
  "gradient_checkpointing": false,
  "hidden_act": "gelu",
  "hidden_dropout_prob": 0.1,
  "hidden_size": 768,
  "id2label": {
    "0": "LABEL_0",
    "1": "LABEL_1",
    "2": "LABEL_2",
    "3": "LABEL_3"
  },
  "initializer_range": 0.02,
  "intermediate_size": 3072,
  "label2id": {
    "LABEL_0": 0,
    "LABEL_1": 1,
    "LABEL_2": 2,
```

```
    "LABEL_3": 3
  },
  "layer_norm_eps": 1e-12,
  "max_position_embeddings": 512,
  "model_type": "bert",
  "num_attention_heads": 12,
  "num_hidden_layers": 12,
  "pad_token_id": 0,
  "position_embedding_type": "absolute",
  "torch_dtype": "float32",
  "transformers_version": "4.12.2",
  "type_vocab_size": 2,
  "use_cache": true,
  "vocab_size": 64000
}

loading weights file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/pytorch_model.bin from cache at /root/.cache/hug
gingface/transformers/1f7c10cecf08743620c7e224e2f3c6b072e45aee1e88fa324837fd199c
f24f21.e7b697f3572c7ddd6984e105b6c6cacc07a625d1195f9be544d26d3ad7d0e442
Some weights of the model checkpoint at aubmindlab/bert-base-arabertv02-twitter
were not used when initializing BertForSequenceClassification:
['cls.predictions.bias', 'cls.predictions.transform.LayerNorm.bias',
'cls.predictions.decoder.bias', 'cls.predictions.decoder.weight',
'cls.predictions.transform.dense.weight',
'cls.predictions.transform.dense.bias',
'cls.predictions.transform.LayerNorm.weight']
- This IS expected if you are initializing BertForSequenceClassification from
the checkpoint of a model trained on another task or with another architecture
(e.g. initializing a BertForSequenceClassification model from a
BertForPreTraining model).
- This IS NOT expected if you are initializing BertForSequenceClassification
from the checkpoint of a model that you expect to be exactly identical
(initializing a BertForSequenceClassification model from a
BertForSequenceClassification model).
Some weights of BertForSequenceClassification were not initialized from the
model checkpoint at aubmindlab/bert-base-arabertv02-twitter and are newly
initialized: ['classifier.weight', 'bert.pooler.dense.weight',
'bert.pooler.dense.bias', 'classifier.bias']
You should probably TRAIN this model on a down-stream task to be able to use it
for predictions and inference.
***** Running training *****
  Num examples = 12734
  Num Epochs = 2
  Instantaneous batch size per device = 64
  Total train batch size (w. parallel, distributed & accumulation) = 128
  Gradient Accumulation steps = 2
  Total optimization steps = 198
```

```
<IPython.core.display.HTML object>


***** Running Evaluation *****
  Num examples = 3183
  Batch size = 128
Saving model checkpoint to ./train_2/checkpoint-99
Configuration saved in ./train_2/checkpoint-99/config.json
Model weights saved in ./train_2/checkpoint-99/pytorch_model.bin
***** Running Evaluation *****
  Num examples = 3183
  Batch size = 128
Saving model checkpoint to ./train_2/checkpoint-198
Configuration saved in ./train_2/checkpoint-198/config.json
Model weights saved in ./train_2/checkpoint-198/pytorch_model.bin


Training completed. Do not forget to share your model on huggingface.co/models
=)


Loading best model from ./train_2/checkpoint-198 (score: 0.6270059820037497).
***** Running Evaluation *****
  Num examples = 3183
  Batch size = 128

<IPython.core.display.HTML object>


Saving model checkpoint to ./train_2/best_model
Configuration saved in ./train_2/best_model/config.json

{'eval_loss': 0.5623705983161926, 'eval_macro_f1': 0.6270059820037497,
'eval_accuracy': 0.7907634307257304, 'eval_runtime': 25.6667,
'eval_samples_per_second': 124.013, 'eval_steps_per_second': 0.974, 'epoch':
1.99}

Model weights saved in ./train_2/best_model/pytorch_model.bin
tokenizer config file saved in ./train_2/best_model/tokenizer_config.json
Special tokens file saved in ./train_2/best_model/special_tokens_map.json

**************************New Best Model Found!**************************
**************************Starting Fold Num:  3  **************************

loading file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/vocab.txt from cache at /root/.cache/huggingface
/transformers/dbef00ddc9b64a66ba8057785b166b744cef2a41be973446ad897a56ad317019.a
a4ad61e3b0a52c7bcf5410af86ef01a27cf1147665acd6bfba80731d053f78a
loading file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/tokenizer.json from cache at /root/.cache/huggin
gface/transformers/46fef3ab20b06df535befe0412ab892f9baec0a9f8e64d75a0142a67ce366
```

```
959.c7c33ce0611a0a55c52a9ba4c03992b47db6e8b9862113443132ed9af7185a19
loading file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/added_tokens.json from cache at None
loading file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/special_tokens_map.json from cache at /root/.cac
he/huggingface/transformers/7f74425f6809cddb05d5de7967a5af4e325b04245017a7b1917f
e7d5cfb06988.dd8bd9bfd3664b530ea4e645105f557769387b3da9f79bdb55ed556bdd80611d
loading file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/tokenizer_config.json from cache at /root/.cache
/huggingface/transformers/582bc76b2b3acaaf545878170de8fbf8d6d1f65bd0180769ff4ed9
01cd60d3c4.9badb1b6af7f7e89d855c8fbc79dd73ef57ac1c9e573a43862ddaeb2c798a290
loading file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/vocab.txt from cache at /root/.cache/huggingface
/transformers/dbef00ddc9b64a66ba8057785b166b744cef2a41be973446ad897a56ad317019.a
a4ad61e3b0a52c7bcf5410af86ef01a27cf1147665acd6bfba80731d053f78a
loading file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/tokenizer.json from cache at /root/.cache/huggin
gface/transformers/46fef3ab20b06df535befe0412ab892f9baec0a9f8e64d75a0142a67ce366
959.c7c33ce0611a0a55c52a9ba4c03992b47db6e8b9862113443132ed9af7185a19
loading file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/added_tokens.json from cache at None
loading file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/special_tokens_map.json from cache at /root/.cac
he/huggingface/transformers/7f74425f6809cddb05d5de7967a5af4e325b04245017a7b1917f
e7d5cfb06988.dd8bd9bfd3664b530ea4e645105f557769387b3da9f79bdb55ed556bdd80611d
loading file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/tokenizer_config.json from cache at /root/.cache
/huggingface/transformers/582bc76b2b3acaaf545878170de8fbf8d6d1f65bd0180769ff4ed9
01cd60d3c4.9badb1b6af7f7e89d855c8fbc79dd73ef57ac1c9e573a43862ddaeb2c798a290
PyTorch: setting up devices
The default value for the training argument `--report_to` will change in v5
(from all installed integrations to none). In v5, you will need to use
`--report_to all` to get the same behavior as now. You should start updating
your code and make this info disappear :-).
loading configuration file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/config.json from cache at /root/.cache/huggingfa
ce/transformers/1109ac490c1eb90f74960e17c00032f27ea3c4be159567d7ed5d2b5908f9855c
.01294502d101541d98086466d32c6b4f04698a90a573cd06480d05bd0c20b2aa
Model config BertConfig {
  "_name_or_path": "bert-base-arabertv02",
  "architectures": [
    "BertForMaskedLM"
  ],
  "attention_probs_dropout_prob": 0.1,
  "classifier_dropout": null,
  "gradient_checkpointing": false,
  "hidden_act": "gelu",
  "hidden_dropout_prob": 0.1,
```

```
  "hidden_size": 768,
  "id2label": {
    "0": "LABEL_0",
    "1": "LABEL_1",
    "2": "LABEL_2",
    "3": "LABEL_3"
  },
  "initializer_range": 0.02,
  "intermediate_size": 3072,
  "label2id": {
    "LABEL_0": 0,
    "LABEL_1": 1,
    "LABEL_2": 2,
    "LABEL_3": 3
  },
  "layer_norm_eps": 1e-12,
  "max_position_embeddings": 512,
  "model_type": "bert",
  "num_attention_heads": 12,
  "num_hidden_layers": 12,
  "pad_token_id": 0,
  "position_embedding_type": "absolute",
  "torch_dtype": "float32",
  "transformers_version": "4.12.2",
  "type_vocab_size": 2,
  "use_cache": true,
  "vocab_size": 64000
}

loading weights file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/pytorch_model.bin from cache at /root/.cache/hug
gingface/transformers/1f7c10cecf08743620c7e224e2f3c6b072e45aee1e88fa324837fd199c
f24f21.e7b697f3572c7ddd6984e105b6c6cacc07a625d1195f9be544d26d3ad7d0e442
Some weights of the model checkpoint at aubmindlab/bert-base-arabertv02-twitter
were not used when initializing BertForSequenceClassification:
['cls.predictions.bias', 'cls.predictions.transform.LayerNorm.bias',
'cls.predictions.decoder.bias', 'cls.predictions.decoder.weight',
'cls.predictions.transform.dense.weight',
'cls.predictions.transform.dense.bias',
'cls.predictions.transform.LayerNorm.weight']
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- This IS NOT expected if you are initializing BertForSequenceClassification
from the checkpoint of a model that you expect to be exactly identical
(initializing a BertForSequenceClassification model from a
BertForSequenceClassification model).
```

```
Some weights of BertForSequenceClassification were not initialized from the
model checkpoint at aubmindlab/bert-base-arabertv02-twitter and are newly
initialized: ['classifier.weight', 'bert.pooler.dense.weight',
'bert.pooler.dense.bias', 'classifier.bias']
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***** Running training *****
  Num examples = 12734
  Num Epochs = 2
  Instantaneous batch size per device = 64
  Total train batch size (w. parallel, distributed & accumulation) = 128
  Gradient Accumulation steps = 2
  Total optimization steps = 198
```

```
<IPython.core.display.HTML object>
```

```
***** Running Evaluation *****
  Num examples = 3183
  Batch size = 128
Saving model checkpoint to ./train_3/checkpoint-99
Configuration saved in ./train_3/checkpoint-99/config.json
Model weights saved in ./train_3/checkpoint-99/pytorch_model.bin
***** Running Evaluation *****
  Num examples = 3183
  Batch size = 128
Saving model checkpoint to ./train_3/checkpoint-198
Configuration saved in ./train_3/checkpoint-198/config.json
Model weights saved in ./train_3/checkpoint-198/pytorch_model.bin


Training completed. Do not forget to share your model on huggingface.co/models
=)


Loading best model from ./train_3/checkpoint-198 (score: 0.6090894312159227).
***** Running Evaluation *****
  Num examples = 3183
  Batch size = 128
```

```
<IPython.core.display.HTML object>
```

```
Saving model checkpoint to ./train_3/best_model
Configuration saved in ./train_3/best_model/config.json
```

```
{'eval_loss': 0.5707730054855347, 'eval_macro_f1': 0.6090894312159227,
'eval_accuracy': 0.7917059377945335, 'eval_runtime': 25.7547,
'eval_samples_per_second': 123.589, 'eval_steps_per_second': 0.971, 'epoch':
1.99}
```

```
Model weights saved in ./train_3/best_model/pytorch_model.bin
tokenizer config file saved in ./train_3/best_model/tokenizer_config.json
Special tokens file saved in ./train_3/best_model/special_tokens_map.json

**************************Starting Fold Num:  4  **************************

loading file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/vocab.txt from cache at /root/.cache/huggingface
/transformers/dbef00ddc9b64a66ba8057785b166b744cef2a41be973446ad897a56ad317019.a
a4ad61e3b0a52c7bcf5410af86ef01a27cf1147665acd6bfba80731d053f78a
loading file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/tokenizer.json from cache at /root/.cache/huggin
gface/transformers/46fef3ab20b06df535befe0412ab892f9baec0a9f8e64d75a0142a67ce366
959.c7c33ce0611a0a55c52a9ba4c03992b47db6e8b9862113443132ed9af7185a19
loading file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/added_tokens.json from cache at None
loading file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/special_tokens_map.json from cache at /root/.cac
he/huggingface/transformers/7f74425f6809cddb05d5de7967a5af4e325b04245017a7b1917f
e7d5cfb06988.dd8bd9bfd3664b530ea4e645105f557769387b3da9f79bdb55ed556bdd80611d
loading file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/tokenizer_config.json from cache at /root/.cache
/huggingface/transformers/582bc76b2b3acaaf545878170de8fbf8d6d1f65bd0180769ff4ed9
01cd60d3c4.9badb1b6af7f7e89d855c8fbc79dd73ef57ac1c9e573a43862ddaeb2c798a290
loading file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/vocab.txt from cache at /root/.cache/huggingface
/transformers/dbef00ddc9b64a66ba8057785b166b744cef2a41be973446ad897a56ad317019.a
a4ad61e3b0a52c7bcf5410af86ef01a27cf1147665acd6bfba80731d053f78a
loading file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/tokenizer.json from cache at /root/.cache/huggin
gface/transformers/46fef3ab20b06df535befe0412ab892f9baec0a9f8e64d75a0142a67ce366
959.c7c33ce0611a0a55c52a9ba4c03992b47db6e8b9862113443132ed9af7185a19
loading file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/added_tokens.json from cache at None
loading file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/special_tokens_map.json from cache at /root/.cac
he/huggingface/transformers/7f74425f6809cddb05d5de7967a5af4e325b04245017a7b1917f
e7d5cfb06988.dd8bd9bfd3664b530ea4e645105f557769387b3da9f79bdb55ed556bdd80611d
loading file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/tokenizer_config.json from cache at /root/.cache
/huggingface/transformers/582bc76b2b3acaaf545878170de8fbf8d6d1f65bd0180769ff4ed9
01cd60d3c4.9badb1b6af7f7e89d855c8fbc79dd73ef57ac1c9e573a43862ddaeb2c798a290
PyTorch: setting up devices
The default value for the training argument `--report_to` will change in v5
(from all installed integrations to none). In v5, you will need to use
`--report_to all` to get the same behavior as now. You should start updating
your code and make this info disappear :-).
loading configuration file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/config.json from cache at /root/.cache/huggingfa
```

```
ce/transformers/1109ac490c1eb90f74960e17c00032f27ea3c4be159567d7ed5d2b5908f9855c
.01294502d101541d98086466d32c6b4f04698a90a573cd06480d05bd0c20b2aa
Model config BertConfig {
  "_name_or_path": "bert-base-arabertv02",
  "architectures": [
    "BertForMaskedLM"
  ],
  "attention_probs_dropout_prob": 0.1,
  "classifier_dropout": null,
  "gradient_checkpointing": false,
  "hidden_act": "gelu",
  "hidden_dropout_prob": 0.1,
  "hidden_size": 768,
  "id2label": {
    "0": "LABEL_0",
    "1": "LABEL_1",
    "2": "LABEL_2",
    "3": "LABEL_3"
  },
  "initializer_range": 0.02,
  "intermediate_size": 3072,
  "label2id": {
    "LABEL_0": 0,
    "LABEL_1": 1,
    "LABEL_2": 2,
    "LABEL_3": 3
  },
  "layer_norm_eps": 1e-12,
  "max_position_embeddings": 512,
  "model_type": "bert",
  "num_attention_heads": 12,
  "num_hidden_layers": 12,
  "pad_token_id": 0,
  "position_embedding_type": "absolute",
  "torch_dtype": "float32",
  "transformers_version": "4.12.2",
  "type_vocab_size": 2,
  "use_cache": true,
  "vocab_size": 64000
}

loading weights file https://huggingface.co/aubmindlab/bert-base-
arabertv02-twitter/resolve/main/pytorch_model.bin from cache at /root/.cache/hug
gingface/transformers/1f7c10cecf08743620c7e224e2f3c6b072e45aee1e88fa324837fd199c
f24f21.e7b697f3572c7ddd6984e105b6c6cacc07a625d1195f9be544d26d3ad7d0e442
Some weights of the model checkpoint at aubmindlab/bert-base-arabertv02-twitter
were not used when initializing BertForSequenceClassification:
['cls.predictions.bias', 'cls.predictions.transform.LayerNorm.bias',
```

```
'cls.predictions.decoder.bias', 'cls.predictions.decoder.weight',
'cls.predictions.transform.dense.weight',
'cls.predictions.transform.dense.bias',
'cls.predictions.transform.LayerNorm.weight']
- This IS expected if you are initializing BertForSequenceClassification from
the checkpoint of a model trained on another task or with another architecture
(e.g. initializing a BertForSequenceClassification model from a
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from the checkpoint of a model that you expect to be exactly identical
(initializing a BertForSequenceClassification model from a
BertForSequenceClassification model).
Some weights of BertForSequenceClassification were not initialized from the
model checkpoint at aubmindlab/bert-base-arabertv02-twitter and are newly
initialized: ['classifier.weight', 'bert.pooler.dense.weight',
'bert.pooler.dense.bias', 'classifier.bias']
You should probably TRAIN this model on a down-stream task to be able to use it
for predictions and inference.
***** Running training *****
  Num examples = 12734
  Num Epochs = 2
  Instantaneous batch size per device = 64
  Total train batch size (w. parallel, distributed & accumulation) = 128
  Gradient Accumulation steps = 2
  Total optimization steps = 198
```

```
<IPython.core.display.HTML object>
```

```
***** Running Evaluation *****
  Num examples = 3183
  Batch size = 128
Saving model checkpoint to ./train_4/checkpoint-99
Configuration saved in ./train_4/checkpoint-99/config.json
Model weights saved in ./train_4/checkpoint-99/pytorch_model.bin
***** Running Evaluation *****
  Num examples = 3183
  Batch size = 128
Saving model checkpoint to ./train_4/checkpoint-198
Configuration saved in ./train_4/checkpoint-198/config.json
Model weights saved in ./train_4/checkpoint-198/pytorch_model.bin


Training completed. Do not forget to share your model on huggingface.co/models
=)


Loading best model from ./train_4/checkpoint-198 (score: 0.6162014099593958).
***** Running Evaluation *****
```

```
  Num examples = 3183
  Batch size = 128
```

```
<IPython.core.display.HTML object>
```

```
Saving model checkpoint to ./train_4/best_model
Configuration saved in ./train_4/best_model/config.json
```

```
{'eval_loss': 0.5519065260887146, 'eval_macro_f1': 0.6162014099593958,
'eval_accuracy': 0.7954759660697456, 'eval_runtime': 25.7138,
'eval_samples_per_second': 123.786, 'eval_steps_per_second': 0.972, 'epoch':
1.99}
```

```
Model weights saved in ./train_4/best_model/pytorch_model.bin
tokenizer config file saved in ./train_4/best_model/tokenizer_config.json
Special tokens file saved in ./train_4/best_model/special_tokens_map.json
```

[40]:
```
all_results
```

[40]:
```
[{'epoch': 1.99,
  'eval_accuracy': 0.7889447236180904,
  'eval_loss': 0.5619563460350037,
  'eval_macro_f1': 0.6079539714099805,
  'eval_runtime': 25.8254,
  'eval_samples_per_second': 123.29,
  'eval_steps_per_second': 0.968},
 {'epoch': 1.99,
  'eval_accuracy': 0.780464824120603,
  'eval_loss': 0.567663311958313,
  'eval_macro_f1': 0.6160311742051623,
  'eval_runtime': 25.6981,
  'eval_samples_per_second': 123.9,
  'eval_steps_per_second': 0.973},
 {'epoch': 1.99,
  'eval_accuracy': 0.7907634307257304,
  'eval_loss': 0.5623705983161926,
  'eval_macro_f1': 0.6270059820037497,
  'eval_runtime': 25.6667,
  'eval_samples_per_second': 124.013,
  'eval_steps_per_second': 0.974},
 {'epoch': 1.99,
  'eval_accuracy': 0.7917059377945335,
  'eval_loss': 0.5707730054855347,
  'eval_macro_f1': 0.6090894312159227,
  'eval_runtime': 25.7547,
  'eval_samples_per_second': 123.589,
  'eval_steps_per_second': 0.971},
 {'epoch': 1.99,
```

```
 'eval_accuracy': 0.7954759660697456,
 'eval_loss': 0.5519065260887146,
 'eval_macro_f1': 0.6162014099593958,
 'eval_runtime': 25.7138,
 'eval_samples_per_second': 123.786,
 'eval_steps_per_second': 0.972}]
```

[41]:
```
from statistics import mean
mean([x['eval_macro_f1'] for x in all_results])
```

[41]:
```
0.6152563937588422
```

[42]:
```
from transformers import pipeline
import more_itertools
```

[43]:
```
inv_label_map = { v:k for k, v in label_map.items()}
```

[44]:
```
pred_df = selected_dataset.test[DATA_COLUMN]
```

[45]:
```
cross_val_df = pd.DataFrame([])
for i in range(0,5):
  pipe = pipeline("sentiment-analysis", model=f"train_{i}/best_model",␣
↪device=0, return_all_scores =True, max_length=max_len, truncation=True)
  preds = []
  for s in tqdm(more_itertools.chunked(list(pred_df), 32)): # batching for␣
↪faster inference
    preds.extend(pipe(s))
  cross_val_df[f'model_{i}'] = preds
```

```
loading configuration file train_0/best_model/config.json
Model config BertConfig {
  "_name_or_path": "aubmindlab/bert-base-arabertv02-twitter",
  "architectures": [
    "BertForSequenceClassification"
  ],
  "attention_probs_dropout_prob": 0.1,
  "classifier_dropout": null,
  "gradient_checkpointing": false,
  "hidden_act": "gelu",
  "hidden_dropout_prob": 0.1,
  "hidden_size": 768,
  "id2label": {
    "0": "Positive",
    "1": "Negative",
    "2": "Neutral",
    "3": "Mixed"
  },
```

```
  "initializer_range": 0.02,
  "intermediate_size": 3072,
  "label2id": {
    "Mixed": 3,
    "Negative": 1,
    "Neutral": 2,
    "Positive": 0
  },
  "layer_norm_eps": 1e-12,
  "max_position_embeddings": 512,
  "model_type": "bert",
  "num_attention_heads": 12,
  "num_hidden_layers": 12,
  "pad_token_id": 0,
  "position_embedding_type": "absolute",
  "problem_type": "single_label_classification",
  "torch_dtype": "float32",
  "transformers_version": "4.12.2",
  "type_vocab_size": 2,
  "use_cache": true,
  "vocab_size": 64000
}

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Model config BertConfig {
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  ],
  "attention_probs_dropout_prob": 0.1,
  "classifier_dropout": null,
  "gradient_checkpointing": false,
  "hidden_act": "gelu",
  "hidden_dropout_prob": 0.1,
  "hidden_size": 768,
  "id2label": {
    "0": "Positive",
    "1": "Negative",
    "2": "Neutral",
    "3": "Mixed"
  },
  "initializer_range": 0.02,
  "intermediate_size": 3072,
  "label2id": {
    "Mixed": 3,
    "Negative": 1,
    "Neutral": 2,
    "Positive": 0
```

```
  },
  "layer_norm_eps": 1e-12,
  "max_position_embeddings": 512,
  "model_type": "bert",
  "num_attention_heads": 12,
  "num_hidden_layers": 12,
  "pad_token_id": 0,
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  "problem_type": "single_label_classification",
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  "transformers_version": "4.12.2",
  "type_vocab_size": 2,
  "use_cache": true,
  "vocab_size": 64000
}

loading weights file train_0/best_model/pytorch_model.bin
All model checkpoint weights were used when initializing
BertForSequenceClassification.

All the weights of BertForSequenceClassification were initialized from the model
checkpoint at train_0/best_model.
If your task is similar to the task the model of the checkpoint was trained on,
you can already use BertForSequenceClassification for predictions without
further training.
Didn't find file train_0/best_model/added_tokens.json. We won't load it.
loading file train_0/best_model/vocab.txt
loading file train_0/best_model/tokenizer.json
loading file None
loading file train_0/best_model/special_tokens_map.json
loading file train_0/best_model/tokenizer_config.json
/usr/local/lib/python3.7/dist-packages/ipykernel_launcher.py:5:
TqdmDeprecationWarning: This function will be removed in tqdm==5.0.0
Please use `tqdm.notebook.tqdm` instead of `tqdm.tqdm_notebook`
  """

0it [00:00, ?it/s]


Disabling tokenizer parallelism, we're using DataLoader multithreading already
/usr/local/lib/python3.7/dist-packages/torch/utils/data/dataloader.py:490:
UserWarning: This DataLoader will create 8 worker processes in total. Our
suggested max number of worker in current system is 2, which is smaller than
what this DataLoader is going to create. Please be aware that excessive worker
creation might get DataLoader running slow or even freeze, lower the worker
number to avoid potential slowness/freeze if necessary.
  cpuset_checked))
/usr/local/lib/python3.7/dist-packages/transformers/pipelines/base.py:910:
UserWarning: You seem to be using the pipelines sequentially on GPU. In order to
```

```
maximize efficiency please use a dataset
  UserWarning,
loading configuration file train_1/best_model/config.json
Model config BertConfig {
  "_name_or_path": "aubmindlab/bert-base-arabertv02-twitter",
  "architectures": [
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  ],
  "attention_probs_dropout_prob": 0.1,
  "classifier_dropout": null,
  "gradient_checkpointing": false,
  "hidden_act": "gelu",
  "hidden_dropout_prob": 0.1,
  "hidden_size": 768,
  "id2label": {
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  },
  "initializer_range": 0.02,
  "intermediate_size": 3072,
  "label2id": {
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    "Negative": 1,
    "Neutral": 2,
    "Positive": 0
  },
  "layer_norm_eps": 1e-12,
  "max_position_embeddings": 512,
  "model_type": "bert",
  "num_attention_heads": 12,
  "num_hidden_layers": 12,
  "pad_token_id": 0,
  "position_embedding_type": "absolute",
  "problem_type": "single_label_classification",
  "torch_dtype": "float32",
  "transformers_version": "4.12.2",
  "type_vocab_size": 2,
  "use_cache": true,
  "vocab_size": 64000
}

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```

```
  ],
  "attention_probs_dropout_prob": 0.1,
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  "initializer_range": 0.02,
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    "Negative": 1,
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  "max_position_embeddings": 512,
  "model_type": "bert",
  "num_attention_heads": 12,
  "num_hidden_layers": 12,
  "pad_token_id": 0,
  "position_embedding_type": "absolute",
  "problem_type": "single_label_classification",
  "torch_dtype": "float32",
  "transformers_version": "4.12.2",
  "type_vocab_size": 2,
  "use_cache": true,
  "vocab_size": 64000
}

loading weights file train_1/best_model/pytorch_model.bin
All model checkpoint weights were used when initializing
BertForSequenceClassification.

All the weights of BertForSequenceClassification were initialized from the model
checkpoint at train_1/best_model.
If your task is similar to the task the model of the checkpoint was trained on,
you can already use BertForSequenceClassification for predictions without
further training.
Didn't find file train_1/best_model/added_tokens.json. We won't load it.
loading file train_1/best_model/vocab.txt
loading file train_1/best_model/tokenizer.json
```

```
loading file None
loading file train_1/best_model/special_tokens_map.json
loading file train_1/best_model/tokenizer_config.json
0it [00:00, ?it/s]


loading configuration file train_2/best_model/config.json
Model config BertConfig {
  "_name_or_path": "aubmindlab/bert-base-arabertv02-twitter",
  "architectures": [
    "BertForSequenceClassification"
  ],
  "attention_probs_dropout_prob": 0.1,
  "classifier_dropout": null,
  "gradient_checkpointing": false,
  "hidden_act": "gelu",
  "hidden_dropout_prob": 0.1,
  "hidden_size": 768,
  "id2label": {
    "0": "Positive",
    "1": "Negative",
    "2": "Neutral",
    "3": "Mixed"
  },
  "initializer_range": 0.02,
  "intermediate_size": 3072,
  "label2id": {
    "Mixed": 3,
    "Negative": 1,
    "Neutral": 2,
    "Positive": 0
  },
  "layer_norm_eps": 1e-12,
  "max_position_embeddings": 512,
  "model_type": "bert",
  "num_attention_heads": 12,
  "num_hidden_layers": 12,
  "pad_token_id": 0,
  "position_embedding_type": "absolute",
  "problem_type": "single_label_classification",
  "torch_dtype": "float32",
  "transformers_version": "4.12.2",
  "type_vocab_size": 2,
  "use_cache": true,
  "vocab_size": 64000
}

loading configuration file train_2/best_model/config.json
```

```
Model config BertConfig {
  "_name_or_path": "aubmindlab/bert-base-arabertv02-twitter",
  "architectures": [
    "BertForSequenceClassification"
  ],
  "attention_probs_dropout_prob": 0.1,
  "classifier_dropout": null,
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  "hidden_act": "gelu",
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    "2": "Neutral",
    "3": "Mixed"
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  "initializer_range": 0.02,
  "intermediate_size": 3072,
  "label2id": {
    "Mixed": 3,
    "Negative": 1,
    "Neutral": 2,
    "Positive": 0
  },
  "layer_norm_eps": 1e-12,
  "max_position_embeddings": 512,
  "model_type": "bert",
  "num_attention_heads": 12,
  "num_hidden_layers": 12,
  "pad_token_id": 0,
  "position_embedding_type": "absolute",
  "problem_type": "single_label_classification",
  "torch_dtype": "float32",
  "transformers_version": "4.12.2",
  "type_vocab_size": 2,
  "use_cache": true,
  "vocab_size": 64000
}

loading weights file train_2/best_model/pytorch_model.bin
All model checkpoint weights were used when initializing
BertForSequenceClassification.

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checkpoint at train_2/best_model.
If your task is similar to the task the model of the checkpoint was trained on,
you can already use BertForSequenceClassification for predictions without
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```
further training.
Didn't find file train_2/best_model/added_tokens.json. We won't load it.
loading file train_2/best_model/vocab.txt
loading file train_2/best_model/tokenizer.json
loading file None
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loading file train_2/best_model/tokenizer_config.json
0it [00:00, ?it/s]


loading configuration file train_3/best_model/config.json
Model config BertConfig {
  "_name_or_path": "aubmindlab/bert-base-arabertv02-twitter",
  "architectures": [
    "BertForSequenceClassification"
  ],
  "attention_probs_dropout_prob": 0.1,
  "classifier_dropout": null,
  "gradient_checkpointing": false,
  "hidden_act": "gelu",
  "hidden_dropout_prob": 0.1,
  "hidden_size": 768,
  "id2label": {
    "0": "Positive",
    "1": "Negative",
    "2": "Neutral",
    "3": "Mixed"
  },
  "initializer_range": 0.02,
  "intermediate_size": 3072,
  "label2id": {
    "Mixed": 3,
    "Negative": 1,
    "Neutral": 2,
    "Positive": 0
  },
  "layer_norm_eps": 1e-12,
  "max_position_embeddings": 512,
  "model_type": "bert",
  "num_attention_heads": 12,
  "num_hidden_layers": 12,
  "pad_token_id": 0,
  "position_embedding_type": "absolute",
  "problem_type": "single_label_classification",
  "torch_dtype": "float32",
  "transformers_version": "4.12.2",
  "type_vocab_size": 2,
  "use_cache": true,
```

```
  "vocab_size": 64000
}

loading configuration file train_3/best_model/config.json
Model config BertConfig {
  "_name_or_path": "aubmindlab/bert-base-arabertv02-twitter",
  "architectures": [
    "BertForSequenceClassification"
  ],
  "attention_probs_dropout_prob": 0.1,
  "classifier_dropout": null,
  "gradient_checkpointing": false,
  "hidden_act": "gelu",
  "hidden_dropout_prob": 0.1,
  "hidden_size": 768,
  "id2label": {
    "0": "Positive",
    "1": "Negative",
    "2": "Neutral",
    "3": "Mixed"
  },
  "initializer_range": 0.02,
  "intermediate_size": 3072,
  "label2id": {
    "Mixed": 3,
    "Negative": 1,
    "Neutral": 2,
    "Positive": 0
  },
  "layer_norm_eps": 1e-12,
  "max_position_embeddings": 512,
  "model_type": "bert",
  "num_attention_heads": 12,
  "num_hidden_layers": 12,
  "pad_token_id": 0,
  "position_embedding_type": "absolute",
  "problem_type": "single_label_classification",
  "torch_dtype": "float32",
  "transformers_version": "4.12.2",
  "type_vocab_size": 2,
  "use_cache": true,
  "vocab_size": 64000
}

loading weights file train_3/best_model/pytorch_model.bin
All model checkpoint weights were used when initializing
BertForSequenceClassification.
```

```
All the weights of BertForSequenceClassification were initialized from the model
checkpoint at train_3/best_model.
If your task is similar to the task the model of the checkpoint was trained on,
you can already use BertForSequenceClassification for predictions without
further training.
Didn't find file train_3/best_model/added_tokens.json. We won't load it.
loading file train_3/best_model/vocab.txt
loading file train_3/best_model/tokenizer.json
loading file None
loading file train_3/best_model/special_tokens_map.json
loading file train_3/best_model/tokenizer_config.json
0it [00:00, ?it/s]


loading configuration file train_4/best_model/config.json
Model config BertConfig {
  "_name_or_path": "aubmindlab/bert-base-arabertv02-twitter",
  "architectures": [
    "BertForSequenceClassification"
  ],
  "attention_probs_dropout_prob": 0.1,
  "classifier_dropout": null,
  "gradient_checkpointing": false,
  "hidden_act": "gelu",
  "hidden_dropout_prob": 0.1,
  "hidden_size": 768,
  "id2label": {
    "0": "Positive",
    "1": "Negative",
    "2": "Neutral",
    "3": "Mixed"
  },
  "initializer_range": 0.02,
  "intermediate_size": 3072,
  "label2id": {
    "Mixed": 3,
    "Negative": 1,
    "Neutral": 2,
    "Positive": 0
  },
  "layer_norm_eps": 1e-12,
  "max_position_embeddings": 512,
  "model_type": "bert",
  "num_attention_heads": 12,
  "num_hidden_layers": 12,
  "pad_token_id": 0,
  "position_embedding_type": "absolute",
  "problem_type": "single_label_classification",
```

```
  "torch_dtype": "float32",
  "transformers_version": "4.12.2",
  "type_vocab_size": 2,
  "use_cache": true,
  "vocab_size": 64000
}

loading configuration file train_4/best_model/config.json
Model config BertConfig {
  "_name_or_path": "aubmindlab/bert-base-arabertv02-twitter",
  "architectures": [
    "BertForSequenceClassification"
  ],
  "attention_probs_dropout_prob": 0.1,
  "classifier_dropout": null,
  "gradient_checkpointing": false,
  "hidden_act": "gelu",
  "hidden_dropout_prob": 0.1,
  "hidden_size": 768,
  "id2label": {
    "0": "Positive",
    "1": "Negative",
    "2": "Neutral",
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  },
  "initializer_range": 0.02,
  "intermediate_size": 3072,
  "label2id": {
    "Mixed": 3,
    "Negative": 1,
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  "layer_norm_eps": 1e-12,
  "max_position_embeddings": 512,
  "model_type": "bert",
  "num_attention_heads": 12,
  "num_hidden_layers": 12,
  "pad_token_id": 0,
  "position_embedding_type": "absolute",
  "problem_type": "single_label_classification",
  "torch_dtype": "float32",
  "transformers_version": "4.12.2",
  "type_vocab_size": 2,
  "use_cache": true,
  "vocab_size": 64000
}
```

```
loading weights file train_4/best_model/pytorch_model.bin
All model checkpoint weights were used when initializing
BertForSequenceClassification.

All the weights of BertForSequenceClassification were initialized from the model
checkpoint at train_4/best_model.
If your task is similar to the task the model of the checkpoint was trained on,
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further training.
Didn't find file train_4/best_model/added_tokens.json. We won't load it.
loading file train_4/best_model/vocab.txt
loading file train_4/best_model/tokenizer.json
loading file None
loading file train_4/best_model/special_tokens_map.json
loading file train_4/best_model/tokenizer_config.json

0it [00:00, ?it/s]
```

[46]:
```
from collections import defaultdict

final_labels = []
final_scores = []
for id, row in cross_val_df.iterrows():
  total_score = defaultdict(lambda: 0)
  for pred in row:
    for cls in pred:
      total_score[cls['label']] += cls['score']

  avg_score = { k: v/ 5 for k, v in total_score.items()}

  final_labels.append(max(avg_score, key=avg_score.get))
  final_scores.append(avg_score[max(avg_score, key=avg_score.get)])
```

[47]:
```
cross_val_df['preds'] = final_labels
cross_val_df['sentiment_score'] = final_scores
```

[48]:
```
cross_val_df['preds'].value_counts()
```

[48]:
```
Negative    1599
Neutral     1425
Positive     943
Mixed         13
Name: preds, dtype: int64
```

[49]:
```
print(classification_report(selected_dataset.
 ↪test[LABEL_COLUMN],cross_val_df['preds']))
```

	precision	recall	f1-score	support
Mixed	0.38	0.02	0.04	226
Negative	0.80	0.88	0.84	1443
Neutral	0.84	0.85	0.84	1408
Positive	0.72	0.76	0.74	903
accuracy			0.79	3980
macro avg	0.69	0.63	0.62	3980
weighted avg	0.77	0.79	0.77	3980