Part 1 : Load Dataset

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

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

```
!pip install transformers
!pip install pytorch_wrapper
!pip install seaborn
!nvidia-smi

from google.colab import drive
drive.mount('/content/drive')
!cp /content/drive/MyDrive/fake.txt fake.txt
!cp /content/drive/MyDrive/non_fake.txt non_fake.txt
!git clone https://github.com/nlpaueb/greek-bert.git
```

```
Requirement already satisfied: filelock in /usr/local/lib/python3.7/dist-packages (from transformers) (3.3.0)
Requirement already satisfied: tokenizers<0.11,>=0.10.1 in /usr/local/lib/python3.7/dist-packages (from transforme
Requirement already satisfied: sacremoses in /usr/local/lib/python3.7/dist-packages (from transformers) (0.0.46)
Requirement already satisfied: typing-extensions in /usr/local/lib/python3.7/dist-packages (from huggingface-hub<1
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Requirement already satisfied: zipp>=0.5 in /usr/local/lib/python3.7/dist-packages (from importlib-metadata->trans
Requirement already satisfied: idna<3,>=2.5 in /usr/local/lib/python3.7/dist-packages (from requests->transformers
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Requirement already satisfied: torch<2,>=1 in /usr/local/lib/python3.7/dist-packages (from pytorch_wrapper) (1.9.0
Requirement already satisfied: scikit-learn<1,>=0.19 in /usr/local/lib/python3.7/dist-packages (from pytorch_wrapp
```

```
Requirement already satisfied: numpy<2,>=1.14 in /usr/local/lib/python3.7/dist-packages (from pytorch_wrapper) (1.
Requirement already satisfied: tqdm<5,>=4.36.1 in /usr/local/lib/python3.7/dist-packages (from pytorch_wrapper) (4
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Requirement already satisfied: future in /usr/local/lib/python3.7/dist-packages (from hyperopt<0.2,>=0.1->pytorch_
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Requirement already satisfied: pymongo in /usr/local/lib/python3.7/dist-packages (from hyperopt<0.2,>=0.1->pytorch
Requirement already satisfied: joblib>=0.11 in /usr/local/lib/python3.7/dist-packages (from scikit-learn<1,>=0.19-
Requirement already satisfied: typing-extensions in /usr/local/lib/python3.7/dist-packages (from torch<2,>=1->pyto
Requirement already satisfied: seaborn in /usr/local/lib/python3.7/dist-packages (0.11.2)
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Requirement already satisfied: scipy>=1.0 in /usr/local/lib/python3.7/dist-packages (from seaborn) (1.4.1)
Requirement already satisfied: numpy>=1.15 in /usr/local/lib/python3.7/dist-packages (from seaborn) (1.19.5)
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Requirement already satisfied: pyparsing!=2.0.4,!=2.1.2,!=2.1.6,>=2.0.1 in /usr/local/lib/python3.7/dist-packages
Requirement already satisfied: cycler>=0.10 in /usr/local/lib/python3.7/dist-packages (from matplotlib>=2.2->seabo
Requirement already satisfied: python-dateutil>=2.1 in /usr/local/lib/python3.7/dist-packages (from matplotlib>=2.
Requirement already satisfied: six in /usr/local/lib/python3.7/dist-packages (from cycler>=0.10->matplotlib>=2.2->
Requirement already satisfied: pytz>=2017.2 in /usr/local/lib/python3.7/dist-packages (from pandas>=0.23->seaborn)
Fri Nov  5 05:17:07 2021
+-----------------------------------------------------------------------------+
| NVIDIA-SMI 495.44       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 K80           Off  | 00000000:00:04.0 Off |                    0 |
| N/A   35C    P8    29W / 149W |      0MiB / 11441MiB |      0%      Default |
|                               |                      |                  N/A |
+-------------------------------+----------------------+----------------------+

+-----------------------------------------------------------------------------+
| Processes:                                                                  |
|  GPU   GI   CI        PID   Type   Process name                  GPU Memory |
|        ID   ID                                                   Usage      |
|=============================================================================|
|  No running processes found                                                 |
+-----------------------------------------------------------------------------+
Drive already mounted at /content/drive; to attempt to forcibly remount, call drive.mount("/content/drive", force_
fatal: destination path 'speech_bert' already exists and is not an empty directory.
```

```
import datetime
import os
import random
import time
import unicodedata

import numpy as np
import pandas as pd
import torch
import matplotlib
import matplotlib.pyplot as plt
import transformers
from transformers import AutoTokenizer, AutoModel, get_linear_schedule_with_warmup
import pytorch_wrapper.functional as pwF
import sklearn
import seaborn


plt.rcParams['figure.figsize'] = [20, 5]

print("Seaborn version: %s" % (seaborn.__version__))
print("Sklearn version: %s" % (sklearn.__version__))
print("Transformers version: %s" % (transformers.__version__))
print("PyTorch version: %s" % (torch.__version__))
print("Matplotlib version: %s" % (matplotlib.__version__))
print("NumPy version: %s" % (np.__version__))
print("Pandas version: %s" % (pd.__version__))
```

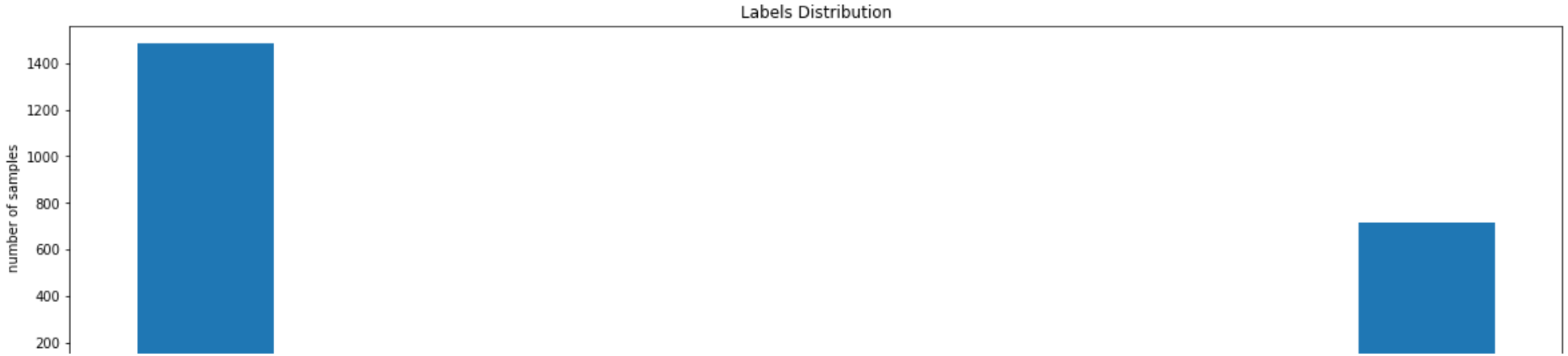
```
Seaborn version: 0.11.2
Sklearn version: 0.22.2.post1
Transformers version: 4.12.3
PyTorch version: 1.9.0+cu111
Matplotlib version: 3.2.2
NumPy version: 1.19.5
Pandas version: 1.1.5
```

```
data = {'text': list(), 'label': list()}
with open('fake.txt') as infile:
  for line in infile:
    data['text'].append(line)
    data['label'].append(1)
with open('non_fake.txt') as infile:
  for line in infile:
    data['text'].append(line)
    data['label'].append(0)

df = pd.DataFrame(data)
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 2201 entries, 0 to 2200
Data columns (total 2 columns):
 #   Column  Non-Null Count  Dtype 
---  ------  --------------  ----- 
 0   text    2201 non-null   object
 1   label   2201 non-null   int64 
dtypes: int64(1), object(1)
memory usage: 34.5+ KB
```

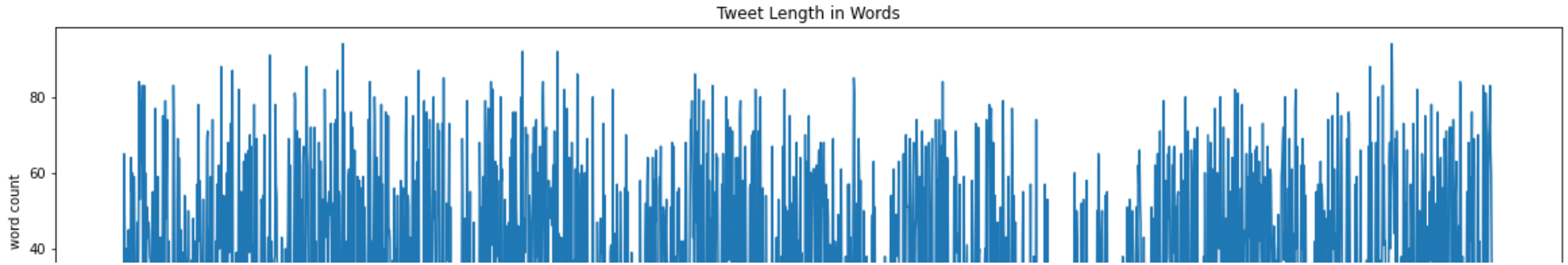
```
#plot labels
labels = df.label
plt.hist(labels)
plt.xlabel("label")
plt.ylabel("number of samples")
plt.title("Labels Distribution")
plt.xticks(np.arange(len(np.unique(labels))))
```

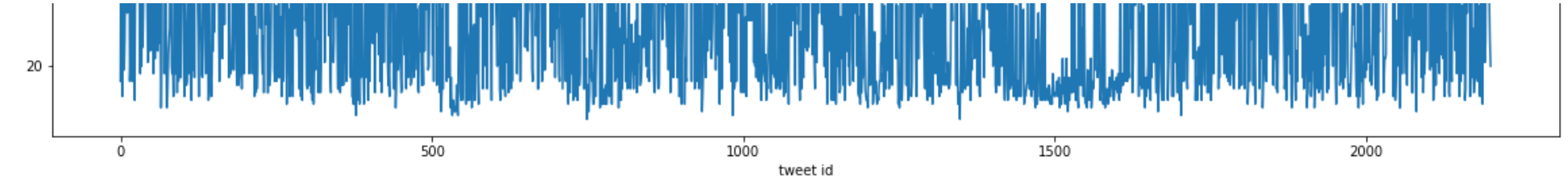
```
([<matplotlib.axis.XTick at 0x7fa5882e0c90>,
  <matplotlib.axis.XTick at 0x7fa5865de5d0>],
 <a list of 2 Text major ticklabel objects>)
```

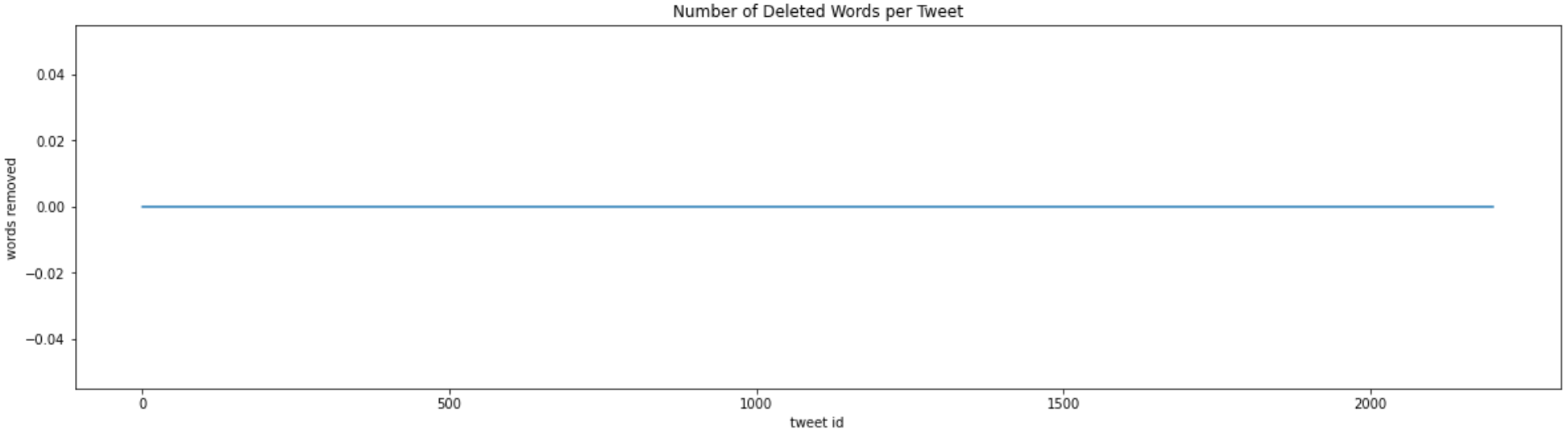


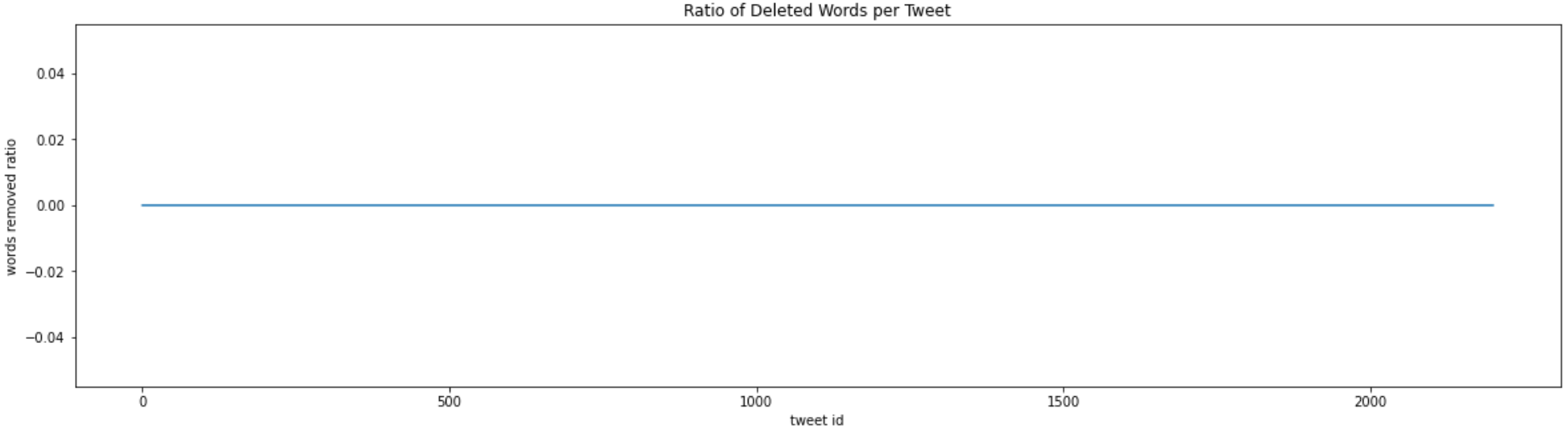

```
# plot article lengths and discarded data length
lengths = pd.DataFrame([len(x.split()) for x in df.text if isinstance(x, str)])
lost_data = pd.DataFrame([max(len(x.split())-512,0) for x in df.text if isinstance(x, str)])
lost_data_ratios = pd.DataFrame([max(len(x.split())-512,0)/float(len(x.split())) for x in df.text if isinstance(x, str)])

print("Tweet lengths description: %s\n" % (lengths.describe()))
lengths.plot(xlabel="tweet id", ylabel="word count", title="Tweet Length in Words", legend=None)
print("Tweet discarded data description: %s\n" % (lost_data.describe()))
lost_data.plot(xlabel="tweet id", ylabel="words removed", title="Number of Deleted Words per Tweet", legend=None)
print("Tweet discarded data ratios description: %s\n" % (lost_data_ratios.describe()))
lost_data_ratios.plot(xlabel="tweet id", ylabel="words removed ratio", title="Ratio of Deleted Words per Tweet", legend=N

s1 = lost_data.sum()
s2 = lengths.sum()
ratio = float(s1) / float(s2)
s3 = (lengths <= 512).astype(int).sum(axis=0)
ratio2 = float(s3) / float(len(lengths))
print("Tweets exceeding 512 word limit: %d out of %d (%.2lf%%)" % (s3, len(lengths), ratio2*100))
print("Total data loss: %d out of %d words (%.2lf%% total, %.2lf%% average)" % (s1, s2, ratio*100, lost_data_ratios.mean(
```

```
Tweet lengths description:                    0
count  2201.000000
mean     35.228987
std      21.252279
min       6.000000
25%      16.000000
50%      30.000000
75%      52.000000
max      94.000000

Tweet discarded data description:              0
count  2201.0
mean      0.0
std       0.0
min       0.0
25%       0.0
50%       0.0
75%       0.0
max       0.0

Tweet discarded data ratios description:              0
count  2201.0
mean      0.0
std       0.0
min       0.0
25%       0.0
50%       0.0
75%       0.0
max       0.0

Tweets exceeding 512 word limit: 2201 out of 2201 (100.00%)
Total data loss: 0 out of 77539 words (0.00% total, 0.00% average)
```




20
0
500
1000
1500
2000
tweet id


Number of Deleted Words per Tweet
words removed
0.04
0.02
0.00
−0.02
−0.04
0
500
1000
1500
2000
tweet id


Ratio of Deleted Words per Tweet
words removed ratio
0.04
0.02
0.00
−0.02
−0.04
0
500
1000
1500
2000
tweet id

Part 2: Tokenization and Input Formatting

```
start = time.time()

def strip_accents_and_lowercase(s):
   return ''.join(c for c in unicodedata.normalize('NFD', s)
                  if unicodedata.category(c) != 'Mn').lower()
################################################################################
class BinaryGreekBERTModel(torch.nn.Module):

    def __init__(self, bert_model, dp):
        super(BinaryGreekBERTModel, self).__init__()
        self._bert_model = bert_model
        self._dp = torch.nn.Dropout(dp)
        self._output_linear = torch.nn.Linear(768, 1)

    def forward(self, text, text_len):
        attention_mask = pwF.create_mask_from_length(text_len, text.shape[1])
        return self._output_linear(self._dp(self._bert_model(text, attention_mask=attention_mask)[0][:, 0, :]))
################################################################################

#from transformers import BertTokenizer
#tokenizer = BertTokenizer.from_pretrained('bert-base-uncased', do_lower_case=True)
tokenizer = AutoTokenizer.from_pretrained("nlpaueb/bert-base-greek-uncased-v1")
greekbert_model = AutoModel.from_pretrained('nlpaueb/bert-base-greek-uncased-v1')
binary_greekbert_model = BinaryGreekBERTModel(greekbert_model, dp=0)

working_set_df = df.head(2200)  # 2201 items don't split nicely, discard one

text_data = working_set_df.text
```

```
text_data.fillna('', inplace=True)

input_ids = []
attention_masks = []
for item in text_data:
    unaccented_string = strip_accents_and_lowercase(item)
    encoded_dict = tokenizer.encode_plus(unaccented_string,
                                         add_special_tokens=True,
                                         max_length=100,
                                         truncation=True,
                                         padding='max_length',
                                         #pad_to_max_length=True,
                                         return_attention_mask=True,
                                         return_tensors="pt")
    input_ids.append(encoded_dict["input_ids"])
    attention_masks.append(encoded_dict["attention_mask"])

input_ids = torch.cat(input_ids, dim=0)
attention_masks = torch.cat(attention_masks, dim=0)
labels = torch.tensor(working_set_df.label.values)

print("Time elapsed: %.1lf seconds." % (time.time() - start))
```

```
Some weights of the model checkpoint at nlpaueb/bert-base-greek-uncased-v1 were not used when initializing BertModel
- This IS expected if you are initializing BertModel from the checkpoint of a model trained on another task or with
- This IS NOT expected if you are initializing BertModel from the checkpoint of a model that you expect to be exactl
/usr/local/lib/python3.7/dist-packages/pandas/core/series.py:4536: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returnir
  downcast=downcast,
Time elapsed: 4.7 seconds.
```

```
# split training and validation sets
from torch.utils.data import TensorDataset, random_split, DataLoader, RandomSampler, SequentialSampler

dataset = TensorDataset(input_ids, attention_masks, labels)
train_size = int(0.8 * len(dataset))
```

```
train_size = int(0.8 * len(dataset))
validation_size = int(0.1 * len(dataset))
test_size = int(0.1 * len(dataset))
train_dataset, validation_dataset, test_dataset = random_split(dataset, [train_size, validation_size, test_size])
print("Training size: %s, Validation size: %s Test size: %s" % (train_size, validation_size, test_size))

batch_size = 8
train_dataloader = DataLoader(train_dataset, sampler=RandomSampler(train_dataset), batch_size=batch_size)
validation_dataloader = DataLoader(validation_dataset, sampler=SequentialSampler(validation_dataset), batch_size=batch_si
test_dataloader = DataLoader(test_dataset, sampler=SequentialSampler(test_dataset), batch_size=batch_size)
```

```
Training size: 1760, Validation size: 220 Test size: 220
```

Part 3: Training

```
start = time.time()

from transformers import BertForSequenceClassification, AdamW, BertConfig

model = BertForSequenceClassification.from_pretrained(
    "nlpaueb/bert-base-greek-uncased-v1",
    num_labels = 2,
    output_attentions = False,
    output_hidden_states = False,
)

device = None
if torch.cuda.is_available():
    device = torch.device("cuda:0")
    model.cuda()
else:
    device = torch.device("cpu")

############################################################
# Batch sizes: 16, 32
```

```
# Learning rate (Adam): 5e-5, 3e-5, 2e-5
# Epochs: 2, 3, 4
##############################################################

optimizer = AdamW(model.parameters(), lr=2e-5, eps=1e-8)
epochs = 4
total_steps = len(train_dataloader) * epochs
scheduler = get_linear_schedule_with_warmup(optimizer,
                                            num_warmup_steps = 0, # Default value in run_glue.py
                                            num_training_steps = total_steps)

print("Time elapsed: %.2lf" % (time.time() - start))
!nvidia-smi
```

```
Some weights of the model checkpoint at nlpaueb/bert-base-greek-uncased-v1 were not used when initializing BertForSe
- This IS expected if you are initializing BertForSequenceClassification from the checkpoint of a model trained on a
- This IS NOT expected if you are initializing BertForSequenceClassification from the checkpoint of a model that you
Some weights of BertForSequenceClassification were not initialized from the model checkpoint at nlpaueb/bert-base-gr
You should probably TRAIN this model on a down-stream task to be able to use it for predictions and inference.
Time elapsed: 21.27
Fri Nov  5 05:24:17 2021
+-----------------------------------------------------------------------------+
| NVIDIA-SMI 495.44       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 K80           Off  | 00000000:00:04.0 Off |                    0 |
| N/A   40C    P0    60W / 149W |   1039MiB / 11441MiB |     27%      Default |
|                               |                      |                  N/A |
+-------------------------------+----------------------+----------------------+

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

Training Loop

```
start = time.time()

def flat_accuracy(preds, labels):
    """Function to calculate the accuracy of our predictions vs labels"""
    pred_flat = np.argmax(preds, axis=1).flatten()
    labels_flat = labels.flatten()
    return np.sum(pred_flat == labels_flat) / len(labels_flat)
#########################################################################

seed_val = 21
random.seed(seed_val)
np.random.seed(seed_val)
torch.manual_seed(seed_val)
torch.cuda.manual_seed_all(seed_val)

training_stats = []
total_t0 = time.time()

for epoch_i in range(0, epochs):
    print('Epoch %s out of %s' % (epoch_i + 1, epochs))
    print('Training...')

    t0 = time.time()
    total_train_loss = 0
    model.train()
    for step, batch in enumerate(train_dataloader):
        if step % 40 == 0 and not step == 0:
            print('  Batch %s out  of  %s, Elapsed %.2lf seconds' % (step, len(train_dataloader), time.time() - t0))

        b_input_ids = batch[0].to(device)
        b_input_mask = batch[1].to(device)
        b_labels = batch[2].to(device)
```

```
    model.zero_grad()
    loss, logits = model(
        b_input_ids,
        token_type_ids=None,
        attention_mask=b_input_mask,
        labels=b_labels,
        return_dict=False
    )

    total_train_loss += loss.item()
    loss.backward()
    torch.nn.utils.clip_grad_norm_(model.parameters(), 1.0)
    optimizer.step()
    scheduler.step()
avg_train_loss = total_train_loss / len(train_dataloader)
training_time = time.time() - t0

print("  Average training loss: %.2lf" % (avg_train_loss))
print("  Epoch %s training time %.2lf seconds" % (epoch_i, training_time))
print("Running Validation...")

t0 = time.time()
model.eval()
total_eval_accuracy = 0
total_eval_loss = 0
nb_eval_steps = 0
for batch in validation_dataloader:
    b_input_ids = batch[0].to(device)
    b_input_mask = batch[1].to(device)
    b_labels = batch[2].to(device)
    with torch.no_grad():
        loss, logits = model(
            b_input_ids,
            token_type_ids=None,
            attention_mask=b_input_mask,
            labels=b_labels,
            return_dict=False
        )
```

```
            ,

        total_eval_loss += loss.item()
        logits = logits.detach().cpu().numpy()
        label_ids = b_labels.to('cpu').numpy()
        total_eval_accuracy += flat_accuracy(logits, label_ids)
    avg_val_accuracy = total_eval_accuracy / len(validation_dataloader)
    avg_val_loss = total_eval_loss / len(validation_dataloader)
    validation_time = time.time() - t0

    print("  Accuracy: %.2lf" % (avg_val_accuracy))
    print("  Validation Loss: %2lf" % (avg_val_loss))
    print("  Validation time %.2lf seconds" % (validation_time))

    training_stats.append(
        {
            'epoch': epoch_i + 1,
            'Training Loss': avg_train_loss,
            'Valid. Loss': avg_val_loss,
            'Valid. Accur.': avg_val_accuracy,
            'Training Time': training_time,
            'Validation Time': validation_time
        }
    )
print("Training complete!")
print("Time elapsed: %.2lf seconds" % (time.time() - start))
```

```
 Epoch 1 out of 4
 Training...
   Batch 40 out  of  220, Elapsed 14.14 seconds
   Batch 80 out  of  220, Elapsed 27.84 seconds
   Batch 120 out  of  220, Elapsed 41.57 seconds
   Batch 160 out  of  220, Elapsed 55.52 seconds
   Batch 200 out  of  220, Elapsed 69.50 seconds
   Average training loss: 0.47
   Epoch 0 training time 76.36 seconds
 Running Validation...
   Accuracy: 0.83
   Validation Loss: 0.352907
```

```
  Validation time 3.01 seconds
Epoch 2 out of 4
Training...
  Batch 40 out  of  220, Elapsed 13.78 seconds
  Batch 80 out  of  220, Elapsed 27.54 seconds
  Batch 120 out  of  220, Elapsed 41.27 seconds
  Batch 160 out  of  220, Elapsed 55.28 seconds
  Batch 200 out  of  220, Elapsed 69.09 seconds
  Average training loss: 0.29
  Epoch 1 training time 75.82 seconds
Running Validation...
  Accuracy: 0.90
  Validation Loss: 0.278729
  Validation time 2.95 seconds
Epoch 3 out of 4
Training...
  Batch 40 out  of  220, Elapsed 13.51 seconds
  Batch 80 out  of  220, Elapsed 27.03 seconds
  Batch 120 out  of  220, Elapsed 40.48 seconds
  Batch 160 out  of  220, Elapsed 53.94 seconds
  Batch 200 out  of  220, Elapsed 67.49 seconds
  Average training loss: 0.21
  Epoch 2 training time 74.28 seconds
Running Validation...
  Accuracy: 0.93
  Validation Loss: 0.308774
  Validation time 2.97 seconds
Epoch 4 out of 4
Training...
  Batch 40 out  of  220, Elapsed 13.51 seconds
  Batch 80 out  of  220, Elapsed 26.92 seconds
  Batch 120 out  of  220, Elapsed 40.33 seconds
  Batch 160 out  of  220, Elapsed 53.72 seconds
  Batch 200 out  of  220, Elapsed 67.19 seconds
  Average training loss: 0.12
  Epoch 3 training time 73.88 seconds
Running Validation...
  Accuracy: 0.92
  Validation Loss: 0.377954
  Validation time 2.98 seconds
Training complete!
Time elapsed: 312.27 seconds
```

```
!nvidia-smi
```

```
Fri Nov  5 05:30:50 2021
+-----------------------------------------------------------------------------+
| NVIDIA-SMI 495.44       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 K80           Off  | 00000000:00:04.0 Off |                    0 |
| N/A   57C    P0    61W / 149W |   3230MiB / 11441MiB |      0%      Default |
|                               |                      |                  N/A |
+-------------------------------+----------------------+----------------------+

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

```
##############################
# View training summary
##############################

pd.set_option('precision', 2)
df_stats = pd.DataFrame(data=training_stats)
df_stats = df_stats.set_index('epoch')
df_stats
```

epoch	Training Loss	Valid. Loss	Valid. Accur.	Training Time	Validation Time
1	0.47	0.35	0.83	76.36	3.01

```
# If validation loss is increasing, it means we are overfitting!
# Plot training and validation loss
import seaborn as sns

# Use plot styling from seaborn.
sns.set(style='darkgrid')

# Increase the plot size and font size.
sns.set(font_scale=1.5)
plt.rcParams["figure.figsize"] = (12,6)

# Plot the learning curve.
plt.plot(df_stats['Training Loss'], 'b-o', label="Training")
plt.plot(df_stats['Valid. Loss'], 'g-o', label="Validation")

# Label the plot.
plt.title("Training & Validation Loss")
plt.xlabel("Epoch")
plt.ylabel("Loss")
plt.legend()
plt.xticks([1, 2, 3, 4])

plt.show()
```


```
####################
# Save model to disk
####################
tstamp = datetime.datetime.now().strftime("%Y-%m-%d_%H%M%S")
output_dir = './greekbert_twitter_model_save/%s/' % (tstamp)
if not os.path.exists(output_dir):
    os.makedirs(output_dir)
print("Saving model to %s" % output_dir)
model_to_save = model.module if hasattr(model, 'module') else model  # Take care of distributed/parallel training
model_to_save.save_pretrained(output_dir)
tokenizer.save_pretrained(output_dir)
torch.save(optimizer.state_dict(), os.path.join(output_dir, 'training_args.bin'))
```

```
    Saving model to ./greekbert_twitter_model_save/2021-11-05_053152/
```

```
!ls -lhatrR greekbert_twitter_model_save/
```

```
    greekbert_twitter_model_save/:
    total 12K
    drwxr-xr-x 1 root root 4.0K Nov  5 05:31 ..
    drwxr-xr-x 3 root root 4.0K Nov  5 05:31 .
    drwxr-xr-x 2 root root 4.0K Nov  5 05:31 2021-11-05_053152
```

```
greekbert_twitter_model_save/2021-11-05_053152:
total 1.3G
drwxr-xr-x 3 root root 4.0K Nov  5 05:31 ..
-rw-r--r-- 1 root root  732 Nov  5 05:31 config.json
-rw-r--r-- 1 root root 431M Nov  5 05:31 pytorch_model.bin
-rw-r--r-- 1 root root  526 Nov  5 05:31 tokenizer_config.json
-rw-r--r-- 1 root root  112 Nov  5 05:31 special_tokens_map.json
-rw-r--r-- 1 root root 518K Nov  5 05:31 vocab.txt
-rw-r--r-- 1 root root 782K Nov  5 05:31 tokenizer.json
drwxr-xr-x 2 root root 4.0K Nov  5 05:31 .
-rw-r--r-- 1 root root 862M Nov  5 05:31 training_args.bin
```

Part 4: Test

```
start = time.time()

epoch_loss = 0
epoch_acc = 0
predicted_labels = []
labels = []
model.eval()
for batch in test_dataloader:
    b_input_ids = batch[0].to(device)
    b_input_mask = batch[1].to(device)
    b_labels = batch[2].to(device)
    with torch.no_grad():
        loss, logits = model(
            b_input_ids,
            token_type_ids=None,
            attention_mask=b_input_mask,
            labels=b_labels,
            return_dict=False
        )
    epoch_loss += loss.item()
    logits = logits.detach().cpu().numpy()
```

```
    label_ids = b_labels.to('cpu').numpy()
    epoch_acc += flat_accuracy(logits, label_ids)
    predicted_labels.extend(np.argmax(logits, axis=1).flatten())
    labels.extend(label_ids)
    test_loss = epoch_loss / len(test_dataloader)
    test_acc = epoch_acc / len(test_dataloader)
    test_labels = labels
    test_predictions = predicted_labels

print(sklearn.metrics.classification_report(test_labels, test_predictions, target_names=["not-fake", "fake"]))
cm = sklearn.metrics.confusion_matrix(test_labels, test_predictions, normalize='true')
df_cm = pd.DataFrame(cm, index=["not-fake", "fake"], columns=["not-fake", "fake"])
seaborn.heatmap(df_cm, annot=True)
fpr, tpr, thresholds = sklearn.metrics.roc_curve(test_labels, predicted_labels)
auc = sklearn.metrics.auc(fpr, tpr)
plt.figure(figsize=(15, 5))
plt.plot(fpr, tpr, lw=3, color='darkorange', label="ROC curve (area = %.2lf)" % (auc))
plt.plot([0, 1], [0, 1], color="blue", label="Random Classifier")
plt.xlabel("False positive rate")
plt.ylabel("True positive rate")
plt.title("ROC Curve")
plt.legend()

print("Time elapsed: %.2lf" % (time.time() - start))
```

	precision	recall	f1-score	support
not-fake	0.93	0.94	0.94	148
fake	0.87	0.86	0.87	72
accuracy			0.91	220
macro avg	0.90	0.90	0.90	220
weighted avg	0.91	0.91	0.91	220

Time elapsed: 3.29