Fake News Detection

Phase5 - Documentation

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Detect and Tackle Concept Drift

```
import pandas as pd
from sklearn.feature_extraction.text import CountVectorizer
import matplotlib.pyplot as plt import spacy #tokenizer
from spacy.util import minibatch, compounding import random

import os, glob
import pandas as pd
import sklearn import
itertools import
numpy as np import
seaborn as sb import
re import nltk import
pickle
from sklearn.model_selection import train_test_split from
sklearn.feature_extraction.text import TfidfVectorizer from sklearn
import metrics
from sklearn.metrics import auc, accuracy_score, confusion_matrix,
mean_squared_error, balanced_accuracy_score from matplotlib import
pyplot as plt from sklearn.linear_model import
PassiveAggressiveClassifier from nltk.stem import
WordNetLemmatizer from nltk.corpus import stopwords
```

```
df=pd.read_csv("combined_labeled_csv.csv") #combined csv for politfact
datasets which were not labeled from
https://github.com/KaiDMML/FakeNewsNet/tree/master/dataset
df
```

```
                         id  \
0     gossipcop-2493749932
1     gossipcop-4580247171
2     gossipcop-941805037
3     gossipcop-2547891536
4     gossipcop-547663122   6
...                     ...
23191       politifact14731
```

```
23192          politifact329
23193          politifact1576
23194          politifact4720
23195          politifact52

news_url  \
0    www.dailymail.co.uk/tvshowbiz/article-5874213/...
1    hollywoodlife.com/2018/05/05/paris-jacksoncar...2
variety.com/2017/biz/news/tax-marchdonald-tru...


4      variety.com/2018/film/news/list-2018-oscarnom...
...                                                      ...
23191 https://www.flake.senate.gov/public/index.cfm/...
23192 https://web.archive.org/web/20080131000131/htt...
23193 http://www.youtube.com/watch?v=4O8CxZ1OD58 23194
http://www.youtube.com/watch?v=EhyMplwY6HY23195
https://web.archive.org/web/20071102131244/htt...


title  \
0      Did Miley Cyrus and Liam Hemsworth secretly ge...
1      Paris Jackson & Cara Delevingne Enjoy Night Ou...
2      Celebrities Join Tax March in Protest of Donal...
3     Cindy Crawford's daughter Kaia Gerber wears a...
4     Full List of 2018 Oscar Nominations – Variety ...
...
23191 Flake: “Religious tests should have no place i...
23192 Change We Can BelieveIn 23193  deputy director of
national health statistics ...
23194                              Romneys   ProLife
                              Conversion Myth or Reality
                                                    Jun...
23195                              Interest  Group
                                   Ratings
```

```
                                                 tweet_ids label  0
             284329075902926848\t284332744559968256\t284335...
                                                      FAKE        1
992895508267130880\t992897935418503169\t992899...
FAKE
2    853359353532829696\t853359576543920128\t853359...
FAKE
3    988821905196158981\t988824206556172288\t988825...
FAKE
4    955792793632432131\t955795063925301249\t955798...
FAKE  ...                                                ...   ...
23191                                                NaN
REAL                                               23192
634287923135909888\t946743411100536832\t946816...  REAL 23193
NaN REAL  23194
188871706637647874 REAL
23195
1002208963239337984\t1024651239697666048  REAL
                                                                -or-real-news
[23196 rows x 5 columns]
```

```
fr=pd.read_csv(                al_news.csv') # fake_or_real_news
                               asets/jillanisofttech/fake
fr
```

```
      Unnamed: 0                                              title  \
0           8476                       You Can Smell Hillary’s Fear
1          10294  Watch The Exact Moment Paul Ryan Committed Pol...
2           3608        Kerry to go to Paris in gesture of sympathy
3          10142  Bernie supporters on Twitter erupt in anger ag...
4            875   The Battle of New York: Why This Primary Matters
...          ...                                                ...
6330        4490  State Department says it can't find emails fro...
6331        8062  The ‘P’ in PBS Should Stand for ‘Plutocratic’ ..
6332        8622  Anti-Trump Protesters Are Tools of the Oligarc..
6333        4021  In Ethiopia, Obama seeks progress on peace, se...
6334        4330  Jeb Bush Is Suddenly Attacking Trump. Here's W..
```

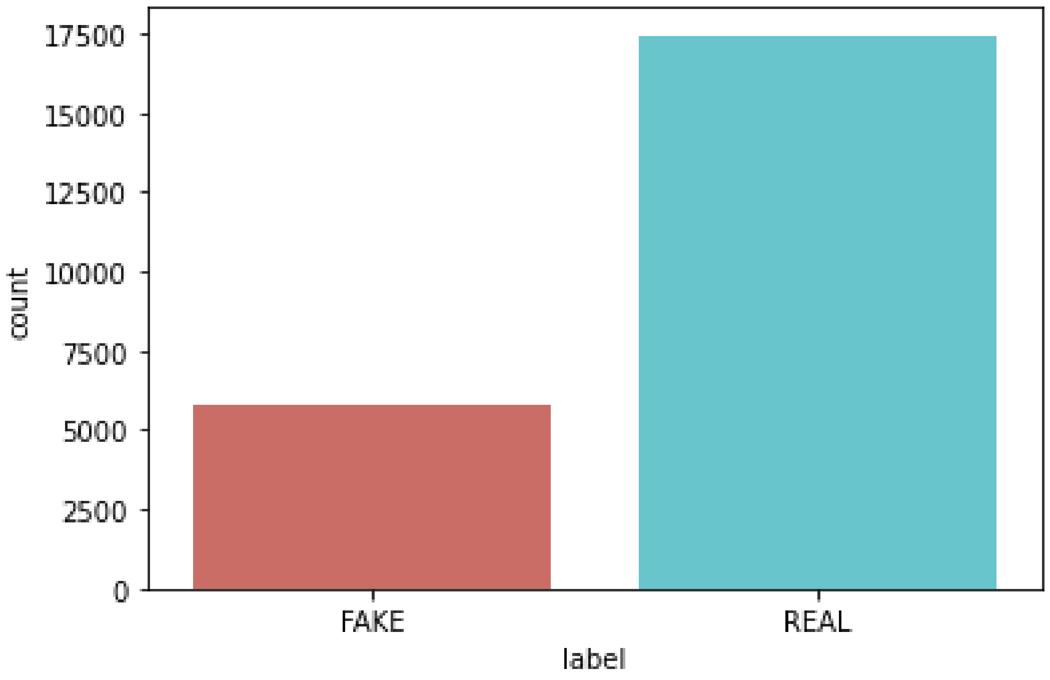
```
                                                    text label
0     Daniel Greenfield, a Shillman Journalism Fello...  FAKE 1     Google
Pinterest Digg Linkedin Reddit Stumbleu...  FAKE 2     U.S. Secretary of
State John F. Kerry said Mon...  REAL 3     — Kaydee King (@KaydeeKing)
November 9, 2016 T...  FAKE 4     It's primary day in New York and front-
runners...  REA ...                                                  ...
...
6330  The State Department told the Republican Natio...  REAL
6331  The ‘P’ in PBS Should Stand for ‘Plutocratic’ ...  FAKE
6332  Anti-Trump Protesters Are Tools of the Oligar...  FAKE
6333  ADDIS ABABA, Ethiopia —President Obama convene...  REAL 6334  Jeb
Bush Is Suddenly Attacking Trump. Here's W...  REAL
[6335 rows x 4 columns]
```

We create 2 separate dataframes for politifact, one contains the title of the article while the other the text

Feature Selection and Preprocess

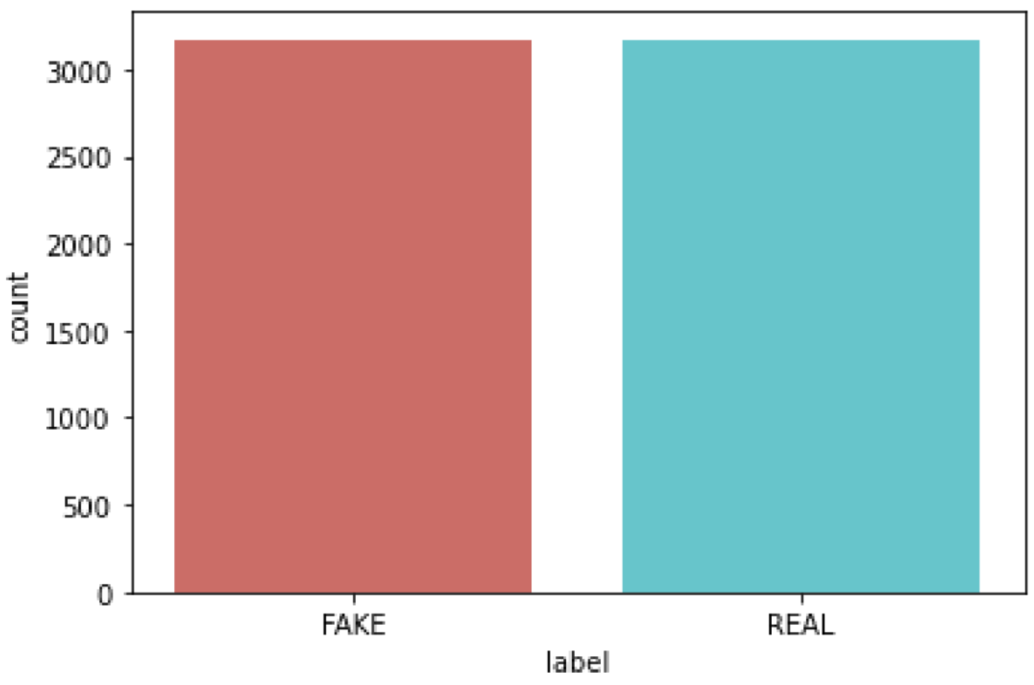
```
df=df.drop('id',axis=1) df=df.drop('tweet_ids',axis=1)
df=df.drop('news_url',axis=1)
df.shape
(23196, 2)
fr_text=fr.drop('title',axis=1)
fr_text.drop(fr.filter(regex="Unname"),axis=1, inplace=True) fr_text
                                                    text label
0     Daniel Greenfield, a Shillman Journalism Fello...  FAKE
```

```
1     Google Pinterest Digg Linkedin Reddit Stumbleu...  FAKE
2     U.S. Secretary of State John F. Kerry said Mon...  REAL
3     — Kaydee King (@KaydeeKing) November 9, 2016 T...  FAKE
4     It's primary day in New York and front-runners...  REAL
...                                                ...    ...
6330  The State Department told the Republican Natio...  REAL
6331 The ‘P’ in PBS Should Stand for ‘Plutocratic’ ...  FAKE
6332 Anti-Trump Protesters Are Tools of the Oligar... FAKE6333
ADDIS ABABA, Ethiopia —President Obama convene... REAL 6334
Jeb Bush Is Suddenly Attacking Trump. Here's W... REAL

[6335 rows x 2 columns]
# function to check if the dataset is balanced def
create_distribution(dataFile):     return
sb.countplot(x='label', data=dataFile, palette='hls')

# by calling below we can see that training, test and valid data seems
to be failry evenly distributed between the classes


# check politifact
create_distribution(df)
<AxesSubplot:xlabel='label', ylabel='count'>
```



```
# check fr with text as feature create_distribution(fr_text)
```

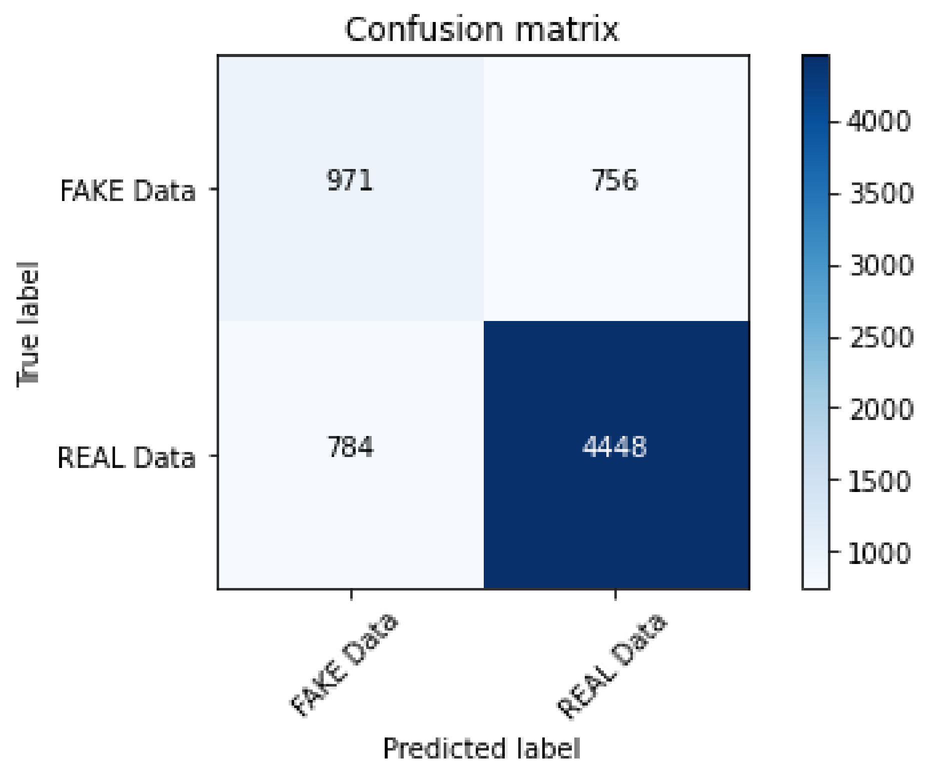
```
<AxesSubplot:xlabel='label', ylabel='count'>
```



```
def data_qualityCheck(data):
    print("Checking data qualitites...")
    data.isnull().sum()
    data.info()
    print("check finished.")

data_qualityCheck(df)

Checking data qualitites...
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 23196 entries, 0 to 23195
Data columns (total 2 columns):
 #   Column  Non-Null Count  Dtype
---  ------  --------------  -----
 0   title   23196 non-null  object
 1   label   23196 non-null  object
dtypes: object(2)
memory usage: 362.6+ KB
check finished.

data_qualityCheck(fr_text)

Checking data qualitites...
<class 'pandas.core.frame.DataFrame'>
```

```
:angeIndex: 6335 entries, 0 to 6334
)ata columns (total 2 columns):
 #   Column  Non-Null Count  Dtype
---  ------  --------------  -----
0   text    6335 non-null   object  1
label   6335 non-null   object
dtypes: object(2) memory usage:
99.1+ KB check finished.

lemmatizer = WordNetLemmatizer() stpwrds =
list(stopwords.words('english'))

for x in range(len(df)) :     corpus
= []
    review = df['title'][x]
    review = re.sub(r'[^a-zA-Z\s]', '', review)     review
= review.lower()
    review = nltk.word_tokenize(review)     for y
in review :          if y not in stpwrds :
corpus.append(lemmatizer.lemmatize(y))     review =
' '.join(corpus)     df['title'][x] = review

innltk_data] Downloading package punkt to

 nltk_data]   Package punkt is already up-to-date!
                                                     [nltk_data]

C:\Users\Christos\AppData\Roaming\nltk_data...
[
True
label_train=df['label']
X_train, X_test, Y_train, Y_test = train_test_split(df['title'],
label_train, test_size=0.3, random_state=1)

tfidf_v = TfidfVectorizer()
tfidf_X_train = tfidf_v.fit_transform(X_train) tfidf_X_test
= tfidf_v.transform(X_test)

def plot_confusion_matrix(cm, classes,
normalize=False,                           title='Confusion
matrix',                           cmap=plt.cm.Blues):

    plt.imshow(cm, interpolation='nearest', cmap=cmap)
plt.title(title)      plt.colorbar()      tick_marks  =
np.arange(len(classes))
```

```
    plt.xticks(tick_marks, classes, rotation=45)
plt.yticks(tick_marks, classes)

    if  normalize:                cm  =  cm.astype('float')  /
cm.sum(axis=1)[:,  np.newaxis]              print("Normalized
confusion matrix")     else:         print('Confusion matrix,
without normalization')

    thresh = cm.max() / 2.     for i, j in
itertools.product(range(cm.shape[0]), range(cm.shape[1])):
plt.text(j, i, cm[i, j],
horizontalalignment="center",                 color="white" if
cm[i, j] > thresh else "black")

    plt.tight_layout()     plt.ylabel('True
label')     plt.xlabel('Predicted label')

classifier = PassiveAggressiveClassifier()
classifier.fit(tfidf_X_train,Y_train)
PassiveAggressiveClassifier()
Y_pred = classifier.predict(tfidf_X_test)
score = metrics.balanced_accuracy_score(Y_test, Y_pred)
print(f'Accuracy: {round(score*100,2)}%') cm =
metrics.confusion_matrix(Y_test, Y_pred) plot_confusion_matrix(cm,
classes=['FAKE Data', 'REAL Data'])
Accuracy: 70.62%

Confusion matrix, without normalization
```

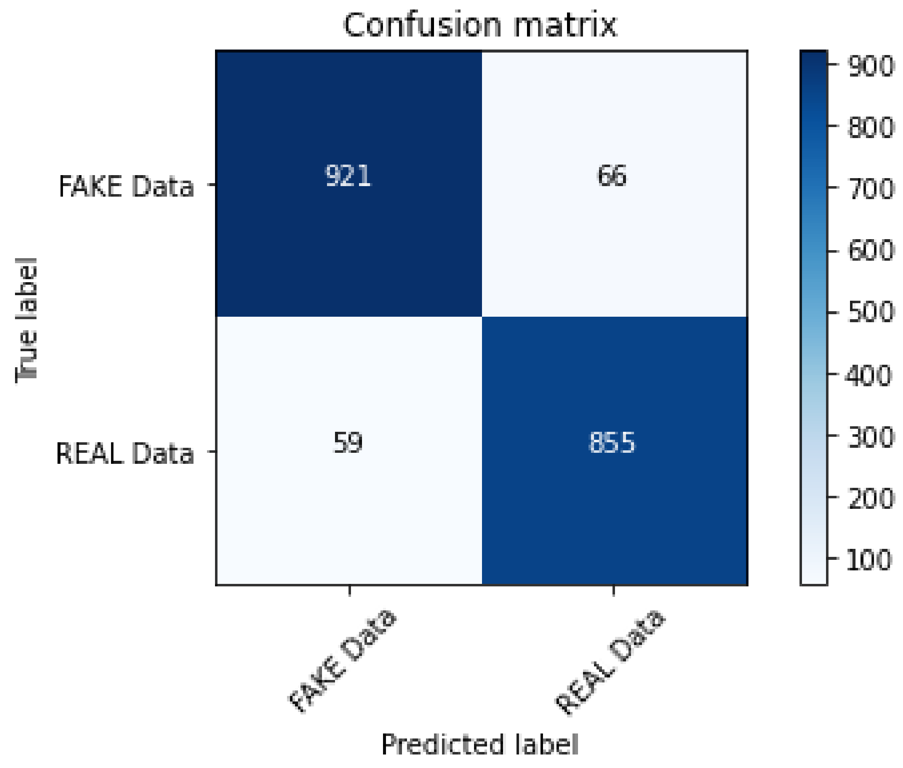


The accuracy isn't good at all, but it's logical since we didn't do almost any preprocessing and the classifier itself is pretty basic. Also the title doesn't really give out a lot of information for our model to train on.

FOR fr dataset when title is dropped

```
for x in range(len(fr_text)) :
corpus = []
    review = fr_text['text'][x]
    review = re.sub(r'[^a-zA-Z\s]', '', review)      review
= review.lower()
    review = nltk.word_tokenize(review)      for y
in review :          if y not in stpwrds :
corpus.append(lemmatizer.lemmatize(y))      review
= ' '.join(corpus)      fr_text['text'][x] = review

label_train1=fr_text['label']
X_train1, X_test1, Y_train1, Y_test1 =
train_test_split(fr_text['text'], label_train1, test_size=0.3,
random_state=1)

tfidf_v1 = TfidfVectorizer()
tfidf_X_train1         =         tfidf_v1.fit_transform(X_train1)
tfidf_X_test1= tfidf_v1.transform(X_test1)
```

```
def plot_confusion_matrix(cm, classes,
normalize=False,
title='Confusion matrix',
cmap=plt.cm.Blues):

    plt.imshow(cm, interpolation='nearest', cmap=cmap)
plt.title(title)      plt.colorbar()      tick_marks =
np.arange(len(classes))         plt.xticks(tick_marks,
classes,  rotation=45)          plt.yticks(tick_marks,
classes)

    if  normalize:                cm  =  cm.astype('float')  /
cm.sum(axis=1)[:,  np.newaxis]                print("Normalized
confusion matrix")     else:         print('Confusion matrix,
without normalization')

    thresh = cm.max() / 2.     for i, j in
itertools.product(range(cm.shape[0]), range(cm.shape[1])):
plt.text(j, i, cm[i, j],
horizontalalignment="center",
                 color="white" if cm[i, j] > thresh else "black")

    plt.tight_layout()     plt.ylabel('True
label')     plt.xlabel('Predicted label')

classifier1 = PassiveAggressiveClassifier()
classifier1.fit(tfidf_X_train1,Y_train1)
PassiveAggressiveClassifier()
Y_pred1 = classifier1.predict(tfidf_X_test1)
score1 = metrics.balanced_accuracy_score(Y_test1, Y_pred1)
print(f'Accuracy: {round(score1*100,2)}%') cm1 =
metrics.confusion_matrix(Y_test1, Y_pred1)
plot_confusion_matrix(cm1, classes=['FAKE Data', 'REAL Data'])
Accuracy: 93.43%

Confusion matrix, without normalization
```

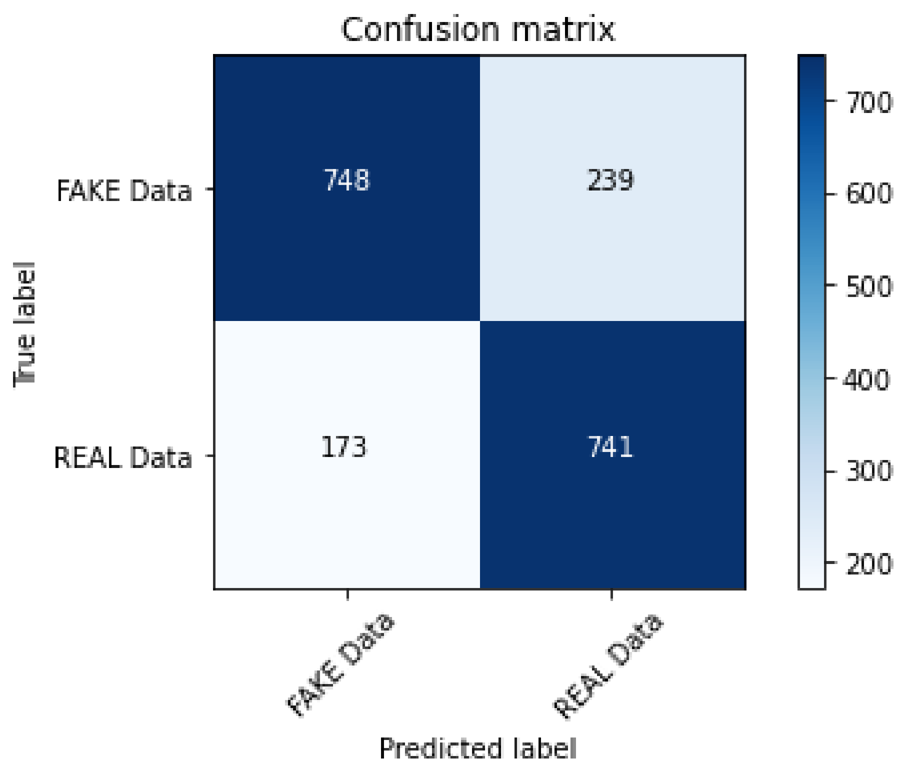


We can see that training on text instead of the title is way better, but this is not the purpose of this notebook.

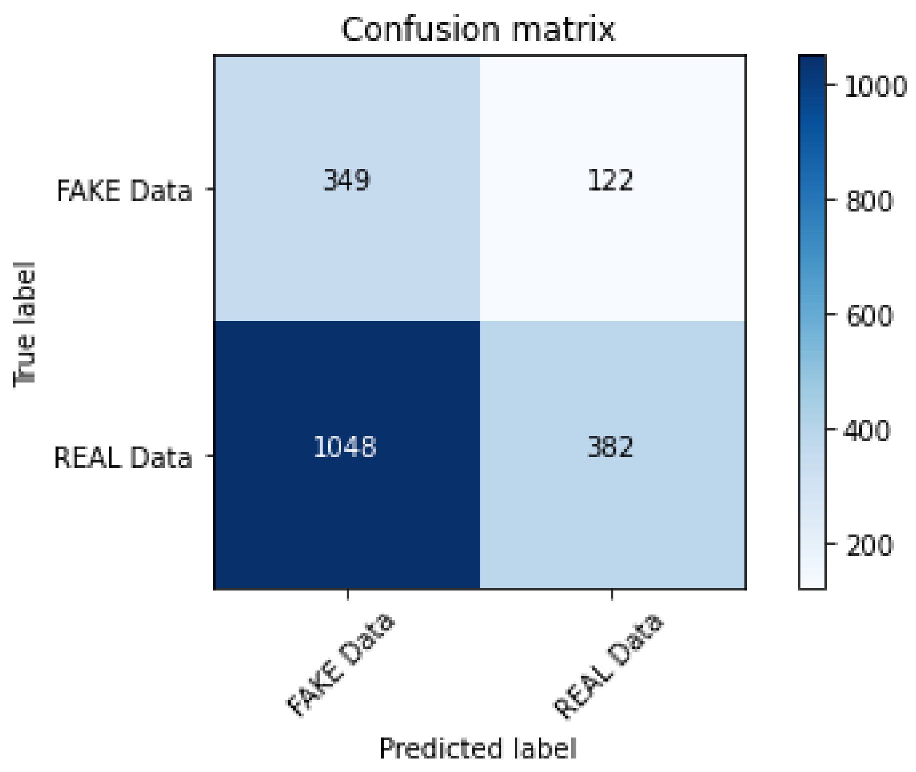
FR dataset with titles

```
fr_title=pd.read_csv('fake_or_real_news.csv') fr_title
      Unnamed: 0                                                 title  \
0           8476                              You Can Smell Hillary’s Fear
1          10294  Watch The Exact Moment Paul Ryan Committed Pol...
2           3608        Kerry to go to Paris in gesture of sympathy
3          10142  Bernie supporters on Twitter erupt in anger ag...
4            875   The Battle of New York: Why This Primary Matters
...          ...                                                ...
6330        4490  State Department says it can't find emails fro...
6331        8062  The ‘P’ in PBS Should Stand for ‘Plutocratic’ ..

6332        8622  Anti-Trump Protesters Are Tools of the Oligarc..
6333        4021  In Ethiopia, Obama seeks progress on peace, se...
6334        4330  Jeb Bush Is Suddenly Attacking Trump. Here's W..
                                                    text label
0     Daniel Greenfield, a Shillman Journalism Fello...  FAKE
1    Google Pinterest Digg Linkedin Reddit Stumbleu...  FAKE
2    U.S. Secretary of State John F. Kerry said Mon...  REAL3
— Kaydee King (@KaydeeKing) November 9, 2016 T...  FAKE
4     It's primary day in New York and front-runners...  REAL
```

```
...                                                            ...    ...
6330  The State Department told the Republican Natio...   REAL
6331  The ‘P’ in PBS Should Stand for ‘Plutocratic’ ...   FAKE
6332 Anti-Trump Protesters Are Tools of the Oligar...   FAKE
6333  ADDIS ABABA, Ethiopia —President Obama convene...   REAL
6334  Jeb Bush Is Suddenly Attacking Trump. Here's W...   REAL
[6335 rows x 4 columns]
fr_title=fr_title.drop('text',axis=1)
fr_title.drop(fr.filter(regex="Unname"),axis=1, inplace=True)
fr_title
                                                          title label
0                            You Can Smell Hillary’s Fear   FAKE
1     Watch The Exact Moment Paul Ryan Committed Pol...   FAKE
2     Kerry to go to Paris in gesture of sympathy   REAL  3
Bernie supporters on Twitter erupt in anger ag...   FAKE  4
The Battle of New York: Why This Primary Matters   REAL ...
...   ...
6330  State Department says it can't find emails fro...  REAL
6331  The ‘P’ in PBS Should Stand for ‘Plutocratic’ ...  FAKE
6332  Anti-Trump Protesters Are Tools of the Oligarc...  FAKE
6333  In Ethiopia, Obama seeks progress on peace, se...  REAL
6334  Jeb Bush Is Suddenly Attacking Trump. Here's W...  REAL
[6335 rows x 2 columns]
for x in range(len(fr_title)) :     corpus
= []
    review = fr_title['title'][x]
    review = re.sub(r'[^a-zA-Z\s]', '', review)     review
= review.lower()
    review = nltk.word_tokenize(review)     for y in
review :         if y not in stpwrds :
corpus.append(lemmatizer.lemmatize(y))     review =
' '.join(corpus)     fr_title['title'][x] = review

label_train2=fr_title['label']
X_train2, X_test2, Y_train2, Y_test2 =
train_test_split(fr_title['title'], label_train2, test_size=0.3,
random_state=1)

tfidf_v2 = TfidfVectorizer()
tfidf_X_train2 = tfidf_v2.fit_transform(X_train2) tfidf_X_test2
= tfidf_v2.transform(X_test2)

def plot_confusion_matrix(cm, classes,
normalize=False,
                          title='Confusion matrix',
cmap=plt.cm.Blues):

    plt.imshow(cm, interpolation='nearest', cmap=cmap)
plt.title(title)      plt.colorbar()      tick_marks =
np.arange(len(classes))         plt.xticks(tick_marks,
classes,  rotation=45)          plt.yticks(tick_marks,
classes)

    if  normalize:                 cm  =  cm.astype('float')  /
cm.sum(axis=1)[:,  np.newaxis]               print("Normalized
confusion matrix")     else:         print('Confusion matrix,
without normalization')

    thresh = cm.max() / 2.     for i, j in
itertools.product(range(cm.shape[0]), range(cm.shape[1])):
plt.text(j, i, cm[i, j],
horizontalalignment="center",
                 color="white" if cm[i, j] > thresh else "black")

    plt.tight_layout()     plt.ylabel('True
label')     plt.xlabel('Predicted label')

classifier2 = PassiveAggressiveClassifier()
classifier2.fit(tfidf_X_train2,Y_train2)
PassiveAggressiveClassifier()
Y_pred2 = classifier2.predict(tfidf_X_test2) score2 =
metrics.accuracy_score(Y_test2, Y_pred2) print(f'Accuracy:
{round(score2*100,2)}%') cm1 =
metrics.confusion_matrix(Y_test2, Y_pred2)
plot_confusion_matrix(cm1, classes=['FAKE Data', 'REAL Data'])
Accuracy: 78.33%

Confusion matrix, without normalization
```



```
np.shape(tfidf_X_test[:6334])
(6334, 14474)
np.shape(Y_test)
(6959,)
np.shape(Y_pred_df_fr)
(1901,)
np.shape(tfidf_X_test2)
(1901, 7492)
Y_pred_df_fr = classifier2.predict(tfidf_X_test[:1901, :7492]) score2
= metrics.accuracy_score(Y_test[:1901], Y_pred_df_fr)
print(f'Accuracy: {round(score2*100,2)}%')
cm1 = metrics.confusion_matrix(Y_test[:1901], Y_pred_df_fr)
plot_confusion_matrix(cm1, classes=['FAKE Data', 'REAL Data'])
Accuracy: 38.45%

Confusion matrix, without normalization
```



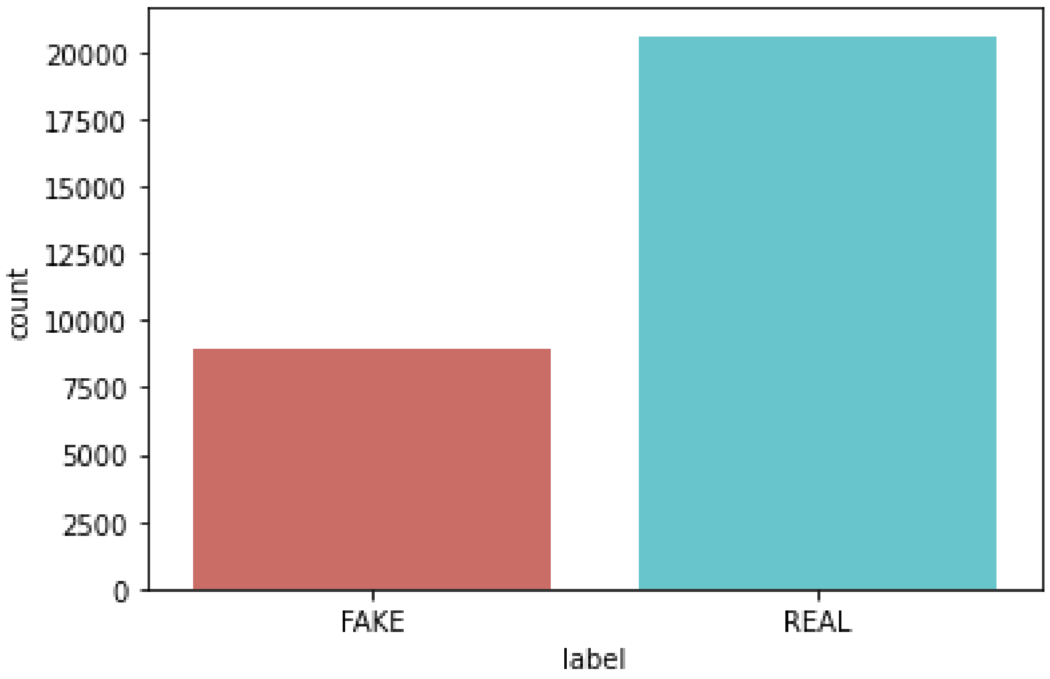
```
Y_pred_df_fr
array(['FAKE', 'REAL', 'FAKE', ..., 'REAL', 'FAKE', 'FAKE'],
dtype='<U4')
r(1901,)e(tfidf_X_test)
(6959, 14474)
np.shape(Y_test2)
        a=np.shape(tfidf_X_test)[0] -
        np.shape(tfidf_X_test2)[0] b =
np.shape(tfidf_X_test)[1] - np.shape(tfidf_X_test2)[1]
print(a) print(b)
5058
6982
an_array = tfidf_X_test2 shape
= np.shape(an_array)
padded_array = np.zeros((a+1000, b+1000))
padded_array[:shape[0],:shape[1]] = an_array.toarray()
print(padded_array) shape
```

```
[[0. 0. 0. ... 0. 0. 0.]
```

```
 [0. 0. 0. ... 0. 0. 0.]
[0. 0. 0. ... 0. 0. 0.]
...
 [0. 0. 0. ... 0. 0. 0.]
 [0. 0. 0. ... 0. 0. 0.]
 [0. 0. 0. ... 0. 0. 0.]]

(1901, 7492) np.shape(padded_array)

(6058, 7982)


Y_pred_fr_df = classifier.predict(padded_array)
score = metrics.balanced_accuracy_score(Y_test2[:1901,], Y_pred_fr_df)
print(f'Accuracy: {round(score*100,2)}%') cm =
metrics.confusion_matrix(Y_test2, Y_pred_fr_df)
plot_confusion_matrix(cm, classes=['FAKE Data', 'REAL Data'])

---------------------------------------------------------------------------
-----
ValueError                                Traceback (most recent call
last)
~\AppData\Local\Temp/ipykernel_6936/2987689534.py in <module>
----> 1 Y_pred_fr_df = classifier.predict(padded_array)
2 score = metrics.balanced_accuracy_score(Y_test2[:1901,],
Y_pred_fr_df)
3 print(f'Accuracy: {round(score*100,2)}%')
4 cm = metrics.confusion_matrix(Y_test2, Y_pred_fr_df)
5 plot_confusion_matrix(cm, classes=['FAKE Data', 'REAL Data'])

~\AppData\Roaming\Python\Python39\site-packages\sklearn\linear_model\
_base.py in predict(self, X)
307               Predicted class label per sample.
308               """
--> 309           scores = self.decision_function(X)
310               if len(scores.shape) == 1:
311               indices = (scores > 0).astype(int)

~\AppData\Roaming\Python\Python39\site-packages\sklearn\linear_model\
_base.py in decision_function(self, X)
286   n_features = self.coef_.shape[1] 287   if
X.shape[1] != n_features:
--> 288              raise ValueError("X has %d features per sample;
expecting %d"
    289                                % (X.shape[1], n_features))
290

ValueError: X has 7982 features per sample; expecting 14474
```

APO DW KAI KATW MAS ENDIAFEREI

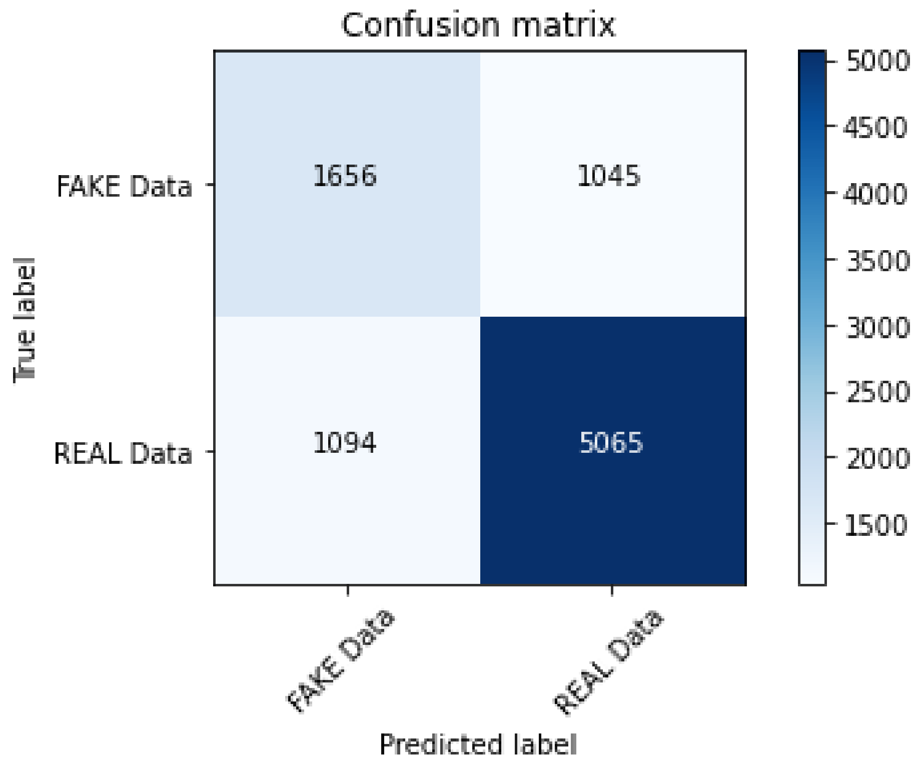
```
### Combine the two datasets, using fr.title feature and df.text since
they follow the same format.

result=pd.read_csv('result.csv') result
                                                    title label
0     miley cyrus liam hemsworth secretly get married  FAKE
1     paris jackson cara delevingne enjoy night matc...  FAKE
2     celebrity join tax march protest donald trump  FAKE3 cindy
crawford daughter kaia gerber wear wig d...  FAKE 4 full list
oscar nomination variety  FAKE ...
...    ... 29526  state department say cant find email clinton
s...  REAL
29527 p pb stand plutocratic pentagon  FAKE
29528 antitrump protester tool oligarchy information
FAKE29529 ethiopia obama seek progress peace security ea...
REAL 29530      jeb bush suddenly attacking trump here matter
REAL
[29531 rows x 2 columns]
dachecking data qualitites...

 class 'pandas.core.frame.DataFrame'>
 RangeIndex: 29531 entries, 0 to 29530 <

                                       Data columns (total 2 columns):
 #   Column  Non-Null Count  Dtype
---  ------  --------------  -----
0   title   29531 non-null  object  1
label   29531 non-null  object
dtypes: object(2) memory usage:
461.5+ KB check finished.
create_distribution(result)
<AxesSubplot:xlabel='label', ylabel='count'>
```



```
shape1 = np.shape(df) shape2
= np.shape(fr_title)
print(shape1,shape2)
(23196, 2) (6335, 2)
result.title
0     Did Miley Cyrus and Liam Hemsworth secretly ge...
1     Paris Jackson & Cara Delevingne Enjoy Night Ou...
2     Celebrities Join Tax March in Protest of Donal...
3     Cindy Crawford's daughter Kaia Gerber wears a ...4
Full List of 2018 Oscar Nominations – Variety
                                ..
29526 State Department says it can't find emails fro...
29527 The ‘P’ in PBS Should Stand for ‘Plutocratic’ ...29528
Anti-Trump Protesters Are Tools of the Oligarc...
29529    In Ethiopia, Obama seeks progress on peace, se...
29530    Jeb Bush Is Suddenly Attacking Trump. Here's W...
Name: title, Length: 29531, dtype: object

for x in range(len(result)) :     corpus
= []
    review = result['title'][x]
    review = re.sub(r'[^a-zA-Z\s]', '', str(review))     review
= review.lower()
```

```
    review = nltk.word_tokenize(review)      for y in
review :          if y not in stpwrds :
corpus.append(lemmatizer.lemmatize(y))      review = '
'.join(corpus)      result['title'][x] = review

label_train3=result['label']
X_train3, X_test3, Y_train3, Y_test3 =
train_test_split(result['title'], label_train3, test_size=0.3,
random_state=1)

tfidf_v3 = TfidfVectorizer()
tfidf_X_train3 = tfidf_v3.fit_transform(X_train3) tfidf_X_test3 =
tfidf_v3.transform(X_test3)

def plot_confusion_matrix(cm, classes,
normalize=False,                           title='Confusion
matrix',                           cmap=plt.cm.Blues):

    plt.imshow(cm,    interpolation='nearest',    cmap=cmap)
plt.title(title)         plt.colorbar()        tick_marks  =
np.arange(len(classes))      plt.xticks(tick_marks, classes,
rotation=45)     plt.yticks(tick_marks, classes)

    if normalize:        cm = cm.astype('float') / cm.sum(axis=1)[:,
np.newaxis]          print("Normalized confusion matrix")      else:
print('Confusion matrix, without normalization')

    thresh = cm.max() / 2.      for i, j in
itertools.product(range(cm.shape[0]), range(cm.shape[1])):
plt.text(j, i, cm[i, j],
horizontalalignment="center",
                 color="white" if cm[i, j] > thresh else "black")

    plt.tight_layout()     plt.ylabel('True
label')     plt.xlabel('Predicted label')

classifier3 = PassiveAggressiveClassifier()
classifier3.fit(tfidf_X_train3,Y_train3)
PassiveAggressiveClassifier()
```

```
Y_pred3 = classifier3.predict(tfidf_X_test3) score3 =
metrics.accuracy_score(Y_test3, Y_pred3) print(f'Accuracy:
{round(score3*100,2)}%') cm1 =
metrics.confusion_matrix(Y_test3, Y_pred3)
plot_confusion_matrix(cm1, classes=['FAKE Data', 'REAL Data'])
Accuracy: 75.86%

Confusion matrix, without normalization
```



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```
tfidf_v3 = TfidfVectorizer()
tfidf_X_train3 = tfidf_v3.fit_transform(X_train3)
tfidf_X_test3 = tfidf_v3.transform(X_test3)

import pandas as pd import xgboost
as xgb from sklearn import
datasets
from sklearn.model_selection import train_test_split
from xgboost import XGBClassifier from sklearn import
preprocessing


# load breast cancer data
#dataset = result
```

```
#X = dataset.title
#y = dataset.label


#result.label
# split data in train and valid dataset
#X_train, X_valid, y_train, y_valid = train_test_split(X, y,
test_size=0.3, random_state=1)

# introduce some data drift in valid by filtering with 'worst
symmetry' feature  AYTO DE TO KANW GIATI THEWRHTIKA EXOUME HDH
#
DHMIOURGHSEI DRIFT
#y_valid = y_valid[X_valid.values > 0.3]
#X_valid = X_valid.loc[X_valid.values > 0.3, :].copy() le
= preprocessing.LabelEncoder() le.fit(Y_train3) Y_train3=
le.transform(Y_train3)

clf1 = XGBClassifier(use_label_encoder=False,eval_metric='logloss')
clf1.fit(X=tfidf_X_train3, y=Y_train3, verbose=10) pred =
clf1.predict(tfidf_X_test3)

le = preprocessing.LabelEncoder() le.fit(Y_test3)
Y_test3= le.transform(Y_test3)

mse=balanced_accuracy_score(Y_test3, pred) print(np.sqrt(mse))
0.8215576851569643
X_train_di = tfidf_X_train3.toarray()
Y_train_di = Y_train3
X_test_di = tfidf_X_test3.toarray() Y_test_di
= Y_test3

X_train_di_df= pd.DataFrame(X_train_di)
Y_train_di_df= pd.DataFrame(Y_train_di)
X_test_di_df= pd.DataFrame(X_test_di) Y_test_di_df=
pd.DataFrame(Y_test_di)



from pandas.util.testing import assert_frame_equal

X_train_di_df.reset_index(drop=True,inplace=True)
Y_train_di_df.reset_index(drop=True,inplace=True)
X_test_di_df.reset_index(drop=True,inplace=True)
Y_test_di_df.reset_index(drop=True,inplace=True)
```

```
C:\Users\Christos\AppData\Local\Temp/ipykernel_6208/944316578.py:13:
FutureWarning: pandas.util.testing is deprecated. Use the functions in
the public API at pandas.testing instead.   from pandas.util.testing
import assert_frame_equal
```

EDW GYRNOUSE TO ERROR, EIXE NA KANEI ME TA SPARPSE MATRICES, OPOTE TA EKANA NP ARRAYS ENTELEI TA PRINTARA GIA NA TA DEITE KIOLAS

TWRA EXW THEMA TO XGBOOST , OPOTE KANW AUTO XWRIS TO WRAPPER ALLA MOU EPISTREFEI ENA THEMA ME TO MEMORY ALLOCATION https://stackoverflow.com/questions/70255620/xgboost-typeerror-predict-got-anunexpected-keywordargument-pred-contribs

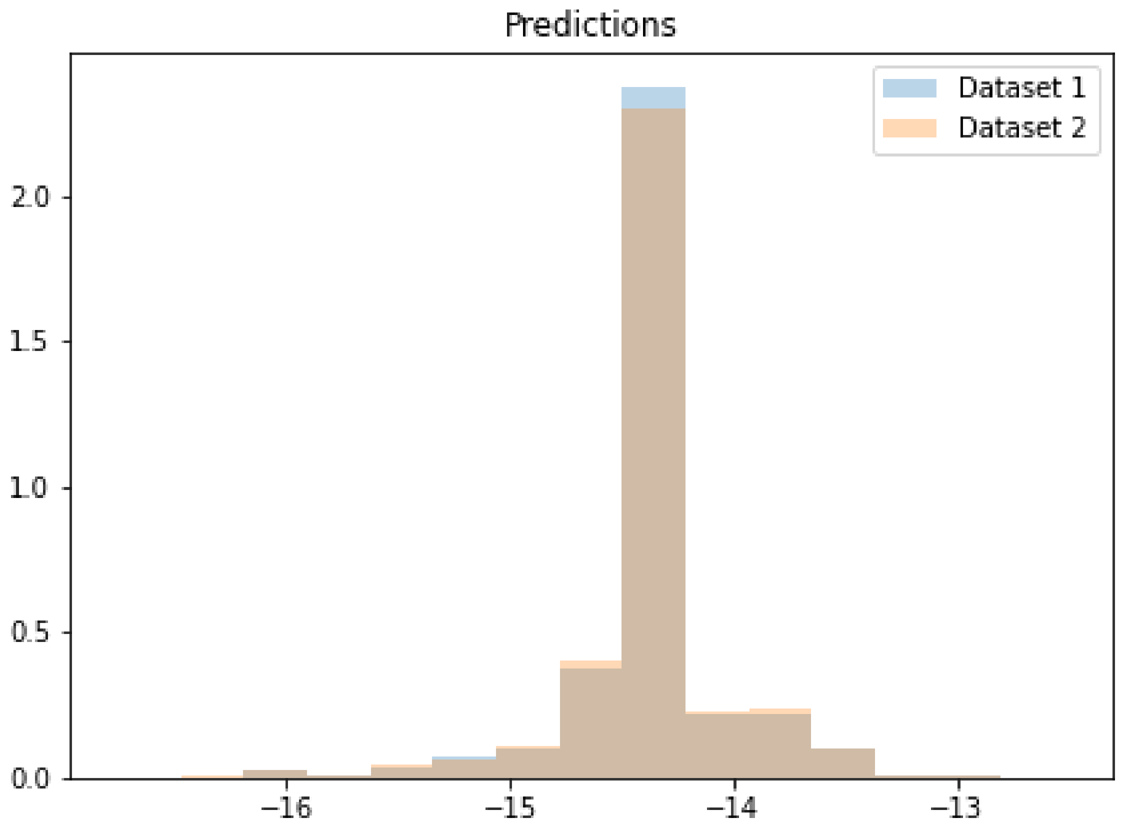
EIDA KAI STACKOVERFLOW KAI LEGAN OTI FTAIEI H EKDOSH THS PYTHON(AN EINAI 32bit ALLA EMENA EINAI 64bit ARA DEN EINAI APO AUTO)

```
nX = tfidf_X_train3.astype(np.uint8) ny=
Y_train3
data =  xgb.DMatrix(nX, label = ny)
model = xgb.train({"learning_rate": 0.01, "max_depth": 4}, data)
model.predict(data, pred_contribs = True)
array([[0.        , 0.        , 0.        , ..., 0.        , 0.        ,
        0.5190497],

       [0.        , 0.        , 0.        , ..., 0.        , 0.        ,
        0.5190497],

       [0.        , 0.        , 0.        , ..., 0.        , 0.        ,
        0.5190497],
       ...,

       [0.        , 0.        , 0.        , ..., 0.        , 0.        ,
        0.5190497],

       [0.        , 0.        , 0.        , ..., 0.        , 0.        ,
        0.5190497],

       [0.        , 0.        , 0.        , ..., 0.        , 0.        ,
        0.5190497]], dtype=float32)
NX1=tfidf_X_train3.toarray()
NX2=tfidf_X_test3.toarray() from cinnamon.drift import
ModelDriftExplainer

# initialize a drift explainer with the built XGBClassifier and fit it on
train
# and valid data
drift_explainer = ModelDriftExplainer(model=clf1)
drift_explainer.fit(X1=X_train_di_df, X2=X_test_di_df, y1=Y_train_di_df,
y2=Y_test_di_df)
```

```
<cinnamon.drift.model_drift_explainer.ModelDriftExplainer at
0x2055d4bad90>
```

MemoryError: Unable to allocate 2.72 GiB for an array with shape (20671, 17645) and data type float64

```
# Distribution of logit predictions
drift_explainer.plot_prediction_drift(bins=15)
```


Predictions
Dataset 1
Dataset 2
2.0
1.5
1.0
0.5
0.0
−16
−15
−14
−13