This jupyter notebook is prepared by “Nawras Rawas Qalaji”.

#1. Load Data and perform basic EDA

```
#I. import neccessary libriaries
import pandas as pd
import numpy as np
import matplotlib as mpl
import matplotlib.pyplot as plt
%matplotlib inline
import seaborn as sns
import missingno as msno
import scipy.stats as st
import nltk
import string
from wordcloud import WordCloud
from nltk.stem import WordNetLemmatizer
from nltk.corpus import stopwords
from nltk.stem import PorterStemmer
from nltk.stem import LancasterStemmer

#nltk.download() #will take time. You can also download individual
items such as nltk.download('wordnet'), nltk.download('stopwords')
nltk.download('wordnet')
nltk.download('averaged_perceptron_tagger')
nltk.download('punkt')
nltk.download('stopwords')
```

```
[nltk_data] Downloading package wordnet to /root/nltk_data...
[nltk_data]   Package wordnet is already up-to-date!
[nltk_data] Downloading package averaged_perceptron_tagger to
[nltk_data]     /root/nltk_data...
[nltk_data]   Package averaged_perceptron_tagger is already up-to-
[nltk_data]       date!
[nltk_data] Downloading package punkt to /root/nltk_data...
[nltk_data]   Package punkt is already up-to-date!
[nltk_data] Downloading package stopwords to /root/nltk_data...
[nltk_data]   Unzipping corpora/stopwords.zip.

True
```

```
#II. import hrdata.csv to hrdata dataframe
#dataFile = open("/content/drive/MyDrive/Colab Notebooks/news.csv",
"r")
#hrdata = pd.DataFrame([line.rstrip() for line in
open("/content/drive/MyDrive/Colab Notebooks/news.csv")])
#code above revealed that the first line shows the data is seperated
via \t so we can do pd.read_csv and use the sep = '\t' to seperate it
in different columns
```

```
hrdata =  pd.read_csv("/content/drive/MyDrive/Colab
Notebooks/news.csv", sep = '\t', names = ["title", "text", "subject",
"date", "target"])
hrdata
```

```
                                                   title  \
0                                                  title   
1      As U.S. budget fight looms, Republicans flip t...   
2      U.S. military to accept transgender recruits o...   
3      Senior U.S. Republican senator: 'Let Mr. Muell...   
4      FBI Russia probe helped by Australian diplomat...   
...                                                  ...   
44894  McPain: John McCain Furious That Iran Treated ...   
44895  JUSTICE? Yahoo Settles E-mail Privacy Class-ac...   
44896  Sunnistan: US and Allied ‘Safe Zone’ Plan to T...   
44897  How to Blow $700 Million: Al Jazeera America F...   
44898  10 U.S. Navy Sailors Held by Iranian Military ...   

                                                    text       subject
\
0                                                   text       subject

1      WASHINGTON (Reuters) - The head of a conservat...  politicsNews

2      WASHINGTON (Reuters) - Transgender people will...  politicsNews

3      WASHINGTON (Reuters) - The special counsel inv...  politicsNews

4      WASHINGTON (Reuters) - Trump campaign adviser ...  politicsNews

...                                                  ...           ...

44894  21st Century Wire says As 21WIRE reported earl...   Middle-east

44895  21st Century Wire says It s a familiar theme. ...   Middle-east

44896  Patrick Henningsen  21st Century WireRemember ...   Middle-east

44897  21st Century Wire says Al Jazeera America will...   Middle-east

44898  21st Century Wire says As 21WIRE predicted in ...   Middle-east


                     date  target
0                    date  target
1      December 31, 2017       1
2      December 29, 2017       1
3      December 31, 2017       1
```

```
4      December 30, 2017        1
...                  ...      ...
44894    January 16, 2016       0
44895    January 16, 2016       0
44896    January 15, 2016       0
44897    January 14, 2016       0
44898    January 12, 2016       0

[44899 rows x 5 columns]
```

```python
#print 10 first items
print("First 10 items")
print(str(hrdata[:10]) + "\n")

#III. top and bottom 5 rows
print("\nTop Five Rows")
print(hrdata.head())
print("\nBottom Five Rows")
print(hrdata.tail())
```

```
First 10 items
                                               title  \
0                                              title   
1  As U.S. budget fight looms, Republicans flip t...   
2  U.S. military to accept transgender recruits o...   
3  Senior U.S. Republican senator: 'Let Mr. Muell...   
4  FBI Russia probe helped by Australian diplomat...   
5  Trump wants Postal Service to charge 'much mor...   
6  White House, Congress prepare for talks on spe...   
7  Trump says Russia probe will be fair, but time...   
8  Factbox: Trump on Twitter (Dec 29) - Approval ...   
9         Trump on Twitter (Dec 28) - Global Warming   

                                                text       subject  \
0                                               text       subject   
1  WASHINGTON (Reuters) - The head of a conservat...  politicsNews   
2  WASHINGTON (Reuters) - Transgender people will...  politicsNews   
3  WASHINGTON (Reuters) - The special counsel inv...  politicsNews   
4  WASHINGTON (Reuters) - Trump campaign adviser ...  politicsNews   
5  SEATTLE/WASHINGTON (Reuters) - President Donal...  politicsNews   
6  WEST PALM BEACH, Fla./WASHINGTON (Reuters) - T...  politicsNews   
7  WEST PALM BEACH, Fla (Reuters) - President Don...  politicsNews   
8  The following statements were posted to the ve...  politicsNews   
9  The following statements were posted to the ve...  politicsNews   

                 date  target  
0                date  target  
1  December 31, 2017       1  
2  December 29, 2017       1  
3  December 31, 2017       1  
```

```
4  December 30, 2017       1
5  December 29, 2017       1
6  December 29, 2017       1
7  December 29, 2017       1
8  December 29, 2017       1
9  December 29, 2017       1


Top Five Rows
                                               title  \
0                                              title   
1  As U.S. budget fight looms, Republicans flip t...   
2  U.S. military to accept transgender recruits o...   
3  Senior U.S. Republican senator: 'Let Mr. Muell...   
4  FBI Russia probe helped by Australian diplomat...   

                                                text       subject  \
0                                               text       subject   
1  WASHINGTON (Reuters) - The head of a conservat...  politicsNews   
2  WASHINGTON (Reuters) - Transgender people will...  politicsNews   
3  WASHINGTON (Reuters) - The special counsel inv...  politicsNews   
4  WASHINGTON (Reuters) - Trump campaign adviser ...  politicsNews   

                 date  target  
0                date  target  
1  December 31, 2017       1  
2  December 29, 2017       1  
3  December 31, 2017       1  
4  December 30, 2017       1  

Bottom Five Rows
                                                   title  \
44894  McPain: John McCain Furious That Iran Treated ...   
44895  JUSTICE? Yahoo Settles E-mail Privacy Class-ac...   
44896  Sunnistan: US and Allied ‘Safe Zone’ Plan to T...   
44897  How to Blow $700 Million: Al Jazeera America F...   
44898  10 U.S. Navy Sailors Held by Iranian Military ...   

                                                    text      subject
\
44894  21st Century Wire says As 21WIRE reported earl...  Middle-east   

44895  21st Century Wire says It s a familiar theme. ...  Middle-east   

44896  Patrick Henningsen  21st Century WireRemember ...  Middle-east   

44897  21st Century Wire says Al Jazeera America will...  Middle-east   

44898  21st Century Wire says As 21WIRE predicted in ...  Middle-east   
```

```
                   date target
44894  January 16, 2016      0
44895  January 16, 2016      0
44896  January 15, 2016      0
44897  January 14, 2016      0
44898  January 12, 2016      0
```

```
#IV. See whether there are any null values and remove all the rows
with any null values, and then show again that there are no more null
values
print("\nMissing Values Numerically")
missingValues = hrdata.isnull().sum().sort_values(ascending = False)
print(missingValues)
```

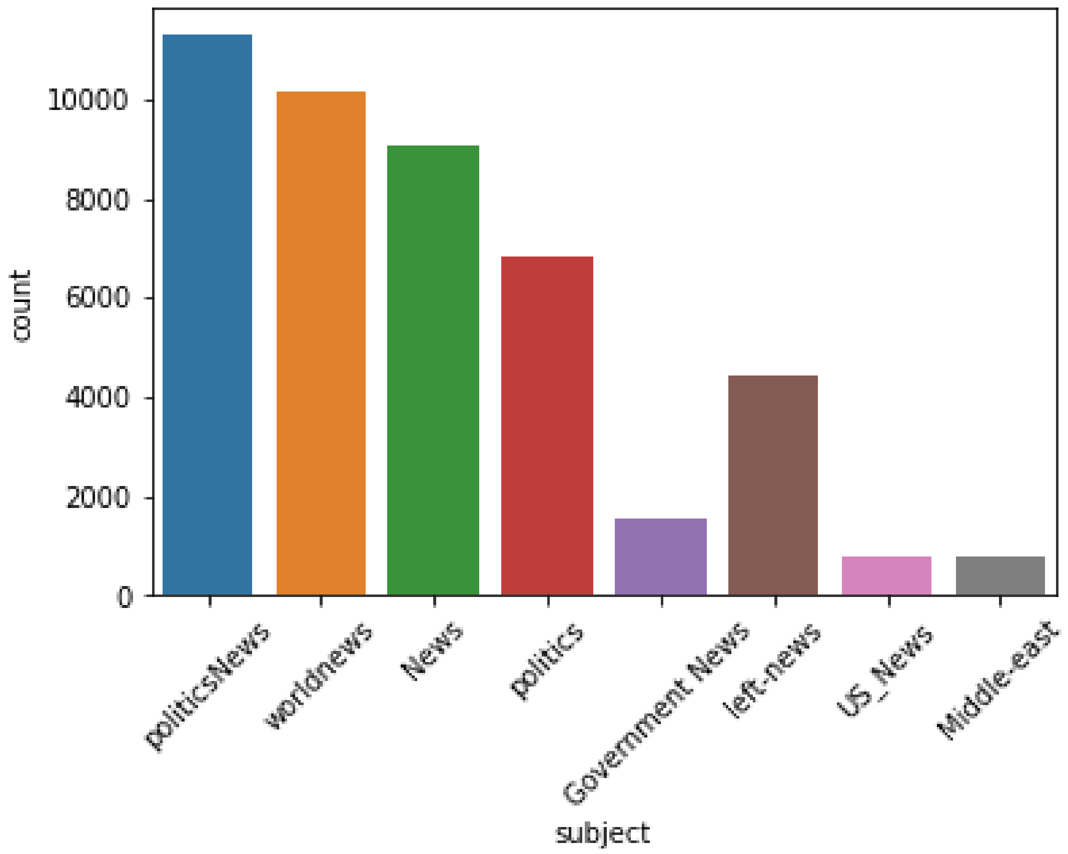
```
Missing Values Numerically
title      0
text       0
subject    0
date       0
target     0
dtype: int64
```

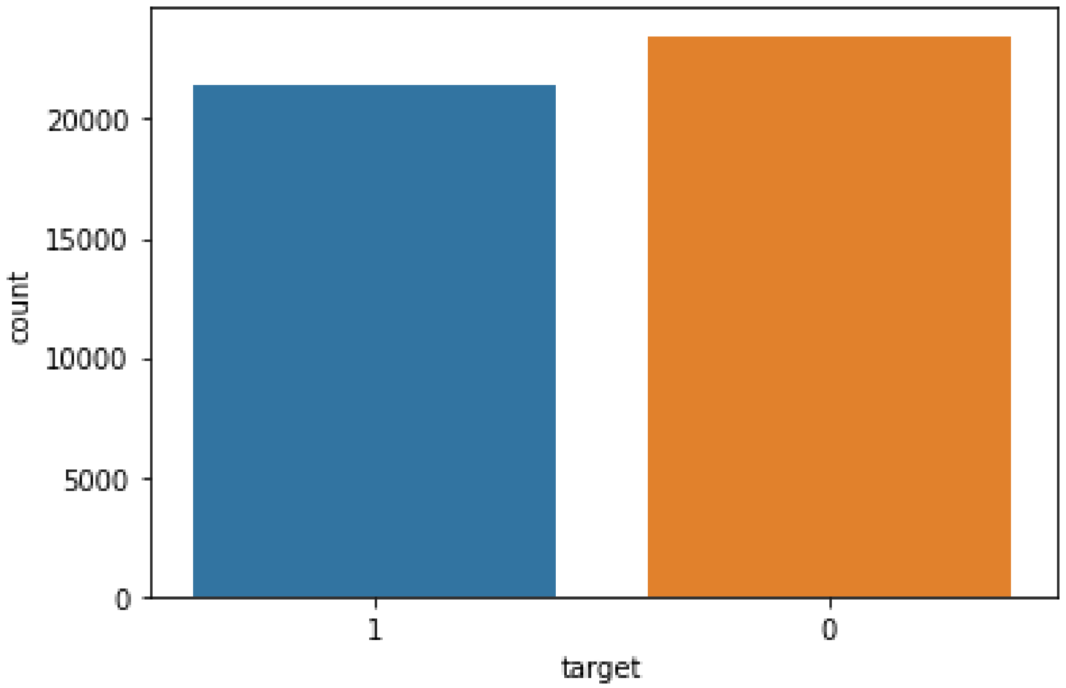
```
#running this will remove all rows with any null values
hrdata = hrdata.dropna()

#Also drop the first row from the data set so it doesnt mess with
other functions, as this row is just to show how the data is formatted

hrdata = hrdata.iloc[1:, :]

#showing there are still no null values
missingValues = hrdata.isnull().sum().sort_values(ascending = False)
print(missingValues)
```

```
title      0
text       0
subject    0
date       0
target     0
dtype: int64
```

```
#V Generate a counterplot to show the number of news in each subject
plt.figure()
plt.xticks(rotation=45)
sns.countplot(x = hrdata["subject"])
plt.show()

#VI Generate a counterplot to show the number of news in each category
```

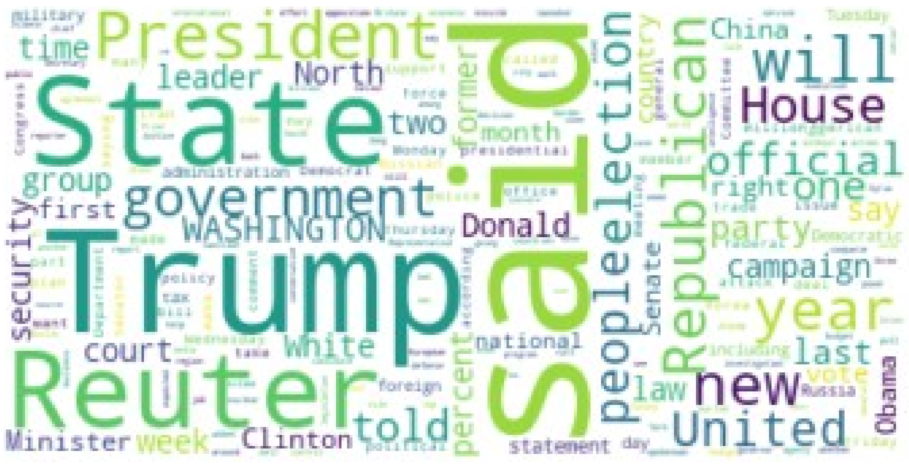
```
(fake/ True)
plt.figure()
sns.countplot(x = hrdata['target'])
plt.show()
```



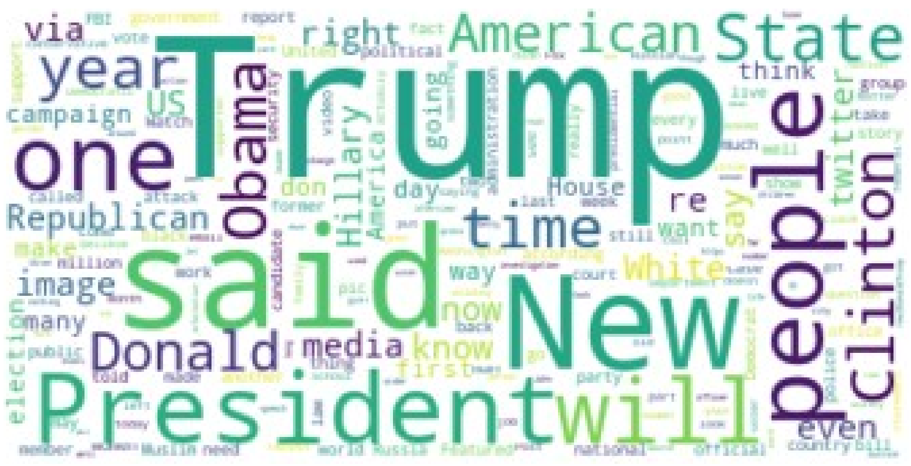


```
#VII Generate two word clouds, one for fake news and one for true
news, and observe the most frequent words in each category and just
write your observation on them
#true news
print("True News")
text = " ".join(cat for cat in hrdata['text'].loc[hrdata["target"] ==
"1"])
word_cloud = WordCloud(collocations = False, background_color =
'white').generate(text)
plt.imshow(word_cloud, interpolation='bilinear')
plt.axis("off")
plt.show()

#fake news
print("\nFake News")
text = " ".join(cat for cat in hrdata['text'].loc[hrdata["target"] ==
"0"])
word_cloud = WordCloud(collocations = False, background_color =
'white').generate(text)
plt.imshow(word_cloud, interpolation='bilinear')
plt.axis("off")
plt.show()
```

```
True News
```



Fake News

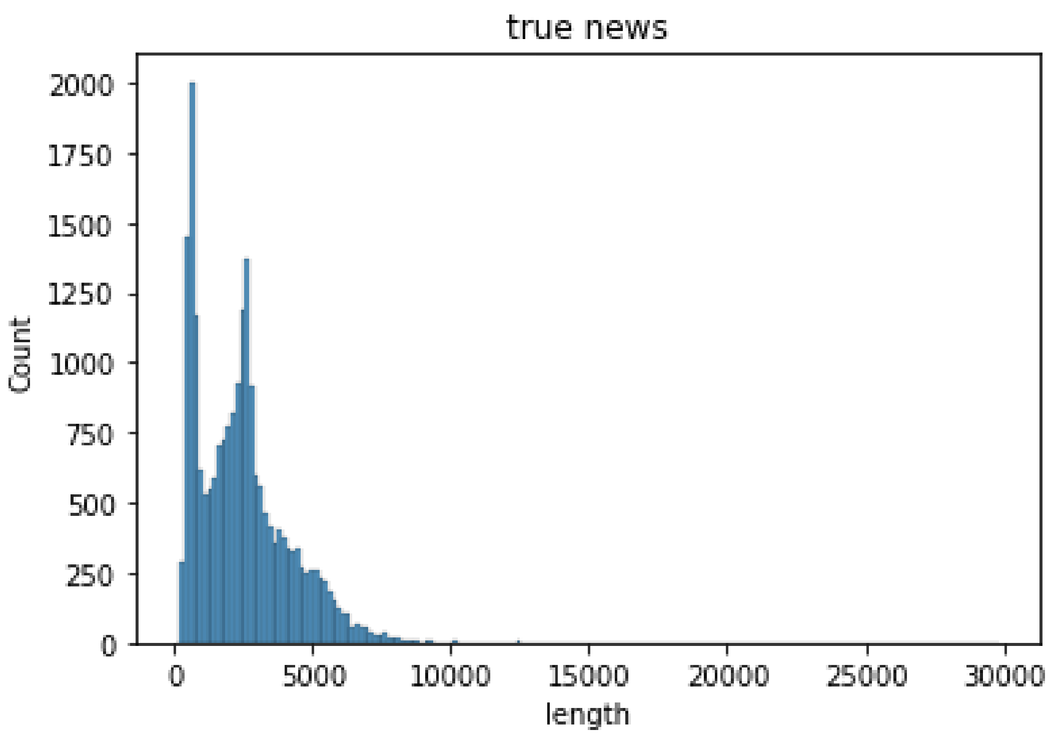


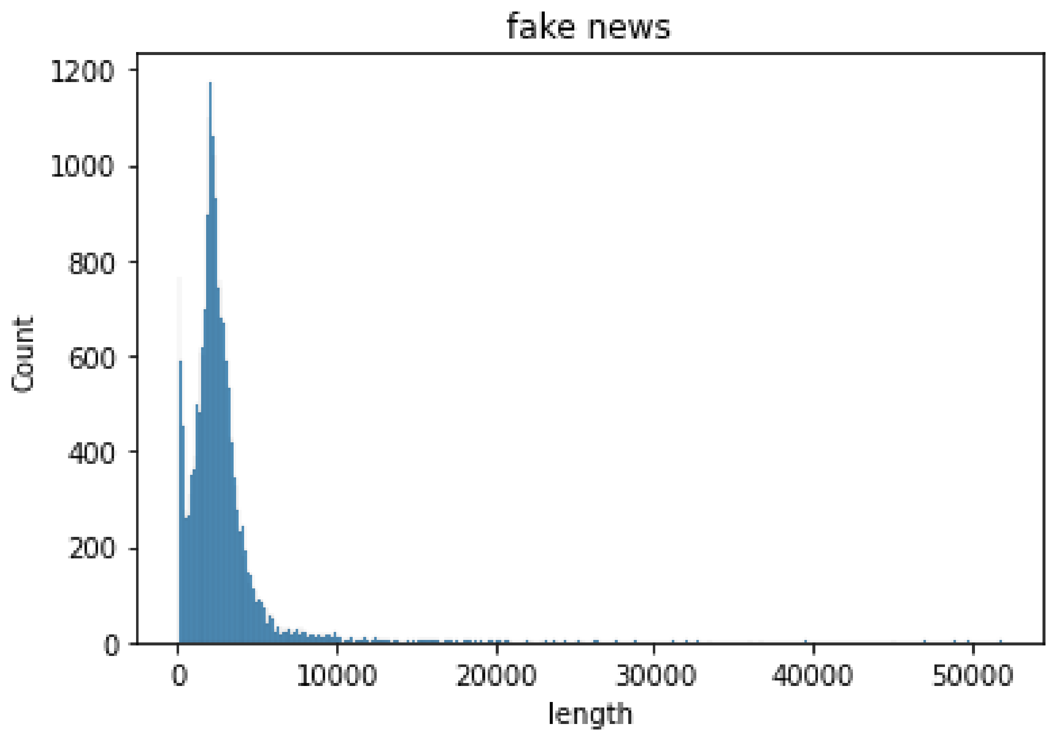
VII Observations

- The word Trump seems to be used more in fake news articles than true ones. The words Clinton and Obama seem to be more commonly used in fake news than true, one possibility is that the target of the articles may be more likely to read the fake article if it includes these two people. One last interesting observation is that Reuter is used way more in true news articles than fake ones, this could indicate that true news articles are more likely to site sources, or at least reference Reuters than fake news articles.

```
#VIII Create a column "AllText" that has the concatenated subject, 
title, and text
col = ["subject", "title", "text"]
hrdata["AllText"] = hrdata[col].apply(lambda row: 
'_'.join(row.values.astype(str)), axis = 1)
```

```
#IX Using the dataframe's copy function, save the data frame into
another dataframe so that you can use it later
newhrdata = hrdata.copy()

#X Drop the title, text, subject, and date columns from the data frame
as we will not use them separately. We have all the text in a single
column that you have generated above
newhrdata = newhrdata.drop(["title", "text", "subject", "date"], axis
= 1)

#XI Calculate the length of each text (I mean AllText column) and put
them in a length column
newhrdata["length"] = hrdata["AllText"].apply(lambda row: len(row))

#XII Plot two histograms to see the distribution of the lengths. One
for fake news and one for true news. Write in words about the plots
plt.figure()
plt.title("true news")
sns.histplot(newhrdata["length"].loc[newhrdata["target"] == "1"])
plt.show()

plt.figure()
plt.title("fake news")
sns.histplot(newhrdata["length"].loc[newhrdata["target"] == "0"])
plt.show()
```





XII Write in words about the plots

- It looks like fake news articles are typically longer than true news articles. Perhaps there is a trend where those who write fake news articles write more in order to make their articles more believable or more attractive.

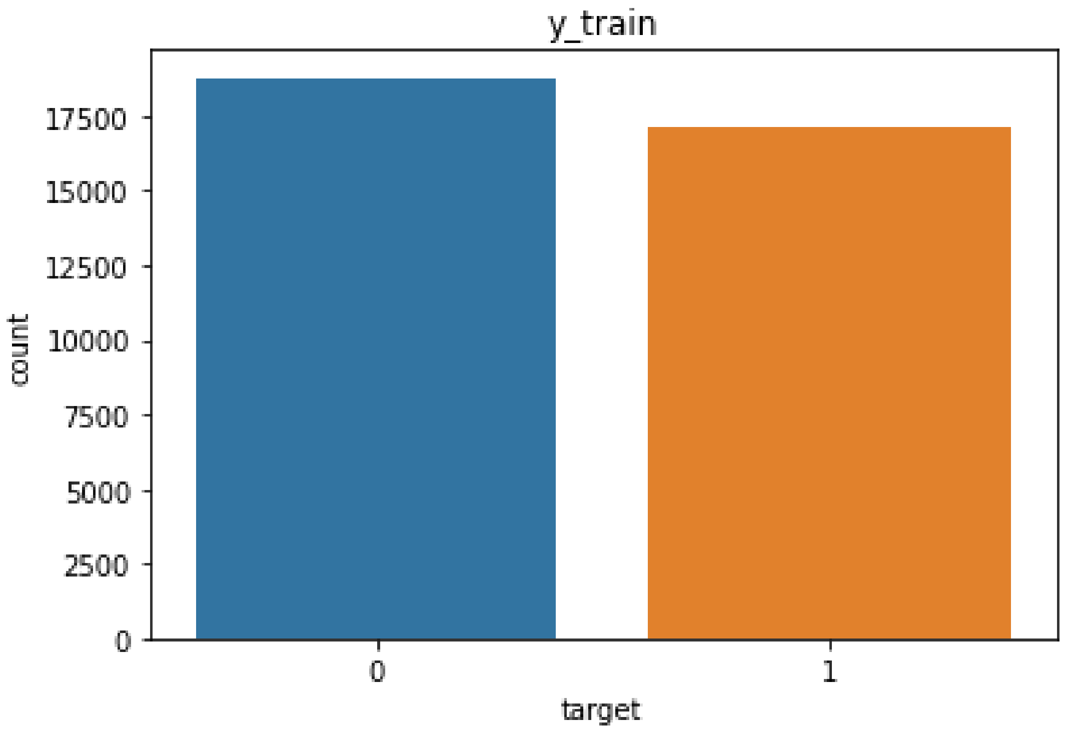
XIII Write in Words: What is TFIDF? How to create bag of words using sklearn? And how to generate TFIDF for the bag of words?

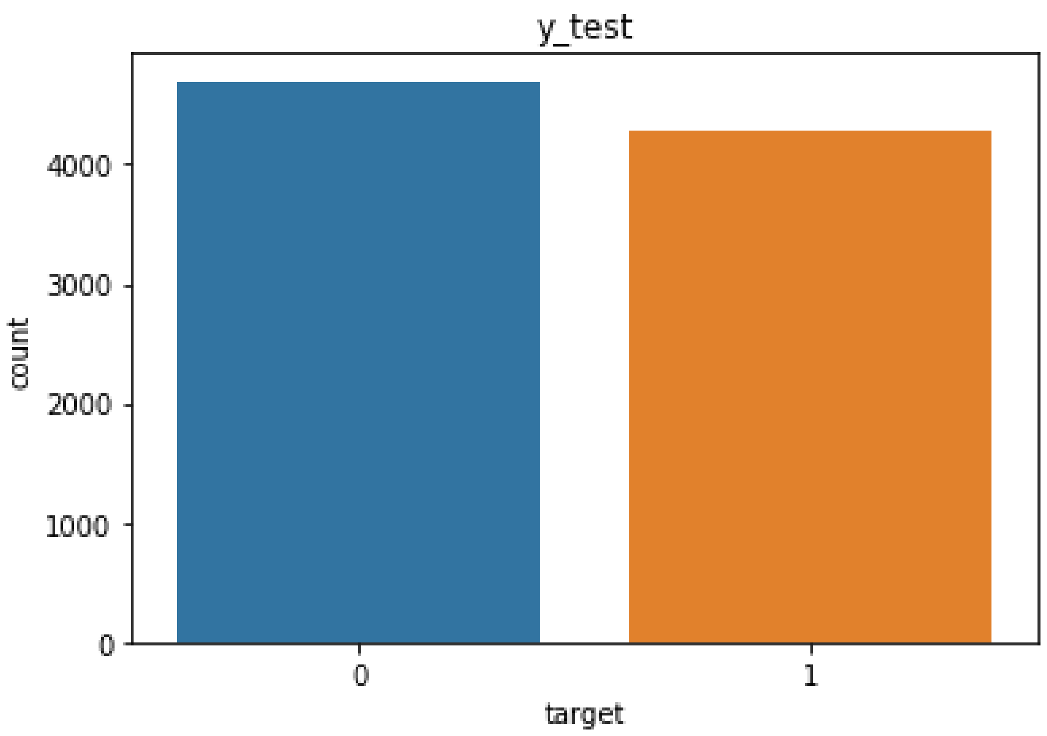
- TFIDF is a way to measure how important a word is across all documents by rewarding frequent use in one document but punishing frequent use in all documents. This way words that add noise are still punished since they don't really tell us alot about the actual document but words like soccer and sports are still rewarded since they may be used frequently in one but never in another.

- Using countVectorizer you can convert a group of documents into a matrix of token counts, then use the TfidfTransformer to convert the counts into weighted TFIDF scores

#2. Train Test Split

```
#I Import related libraries and perform train test split. Keep 20%
data in the test set
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import MinMaxScaler
import sklearn.metrics as metrics
from sklearn.pipeline import Pipeline
from sklearn.feature_extraction.text import CountVectorizer
from sklearn.feature_extraction.text import TfidfTransformer
from sklearn.naive_bayes import MultinomialNB
from sklearn.metrics import classification_report, confusion_matrix

X = hrdata['AllText']
y = hrdata['target']

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size =
0.2, random_state = 0, stratify = y)

#II Using a count plot show how many real and fake news do we have in
the training set and how many in the test set
plt.figure()
plt.title("y_train")
sns.countplot(x = y_train)
plt.show()

plt.figure()
plt.title("y_test")
sns.countplot(x = y_test)
plt.show()
```





#3. Training and Testing Fake news classifier using MultinomialNB

```
#I Create a pipeline that will use countVectorizer with the function
you have created earlier for data preprocessing, then use
Tftransformer and then use the NaiveBayes classifier
stemmer = LancasterStemmer()
stopwordList = stopwords.words('english')

def text_process(mess):
    """
    Takes in a string of text, then performs the following:
    1. Remove all punctuation
    2. Tokenize
    3. convert them to lower case
    4. Remove all stopwords
    3. Perform stemming
    4. Returns a list of the cleaned text
    """



    # Check characters to see if they are in punctuation
    mess = [char for char in mess if char not in string.punctuation]
     # Join the characters again to form the string.
    mess = ''.join(mess)

    words = nltk.word_tokenize(mess)
    words = [t for t in words if t not in stopwordList]
    words = [stemmer.stem(w.lower()) for w in words]

    return words

pipeline = Pipeline([
    ('bow', CountVectorizer(analyzer=text_process)),  # strings to 
token integer counts
    ('tfidf', TfidfTransformer()),  # integer counts to weighted TF-
IDF scores
    ('classifier', MultinomialNB()),  # train on TF-IDF vectors w/ 
Naive Bayes classifier
])

#II Fit the pipeline and then perform prediction
pipeline.fit(X_train,y_train)
pred = pipeline.predict(X_test)

#III Generate classification report and confusion matrix (you have to 
achieve at least 96% accuracy for the test set to receive full credit)
print(classification_report(pred,y_test))
print(confusion_matrix(y_test, pred))
```

```
              precision    recall  f1-score   support

           0       0.96      0.96      0.96      4685
           1       0.95      0.95      0.95      4295

    accuracy                           0.96      8980
   macro avg       0.96      0.96      0.96      8980
weighted avg       0.96      0.96      0.96      8980

[[4492  204]
 [ 193 4091]]
```

IV Discuss the performance like how good the model is overall, how good is it in predicting fake news, and how good is it in predicting true news.

- This model appears to be insanely accurate in its predictions of both fake and true news articles. This is likely due to the use of specific words reports and writers use when creating articles, making this type of model very accurate since it is able to recognize these specific words and commonalities and their abscence in fake and true articles

```
#V Copy a part of any news of your choice from a news website and then 
use the model to predict whether is it true or not.
newSMS = "Dozens of products sold under the brand name Elite are being 
recalled in Canada over fears of salmonella contamination."
pipeline.predict([newSMS])
```

```
array(['0'], dtype='<U1')
```

#4. Training and Testing a Deep Neural Network

```
#I Import related library for using MLPClassifier from sklearn neural
netowrk.
from sklearn.neural_network import MLPClassifier

#II Create a pipeline like 3i, for MLPClassfier you should use at
least two layers and also should verbose = 2 (you can use other
parameters as you wish or use the one you see from the uploaded google
colab)
pipeline = Pipeline([
    ('bow', CountVectorizer(analyzer=text_process)),  # strings to
token integer counts
    ('tfidf', TfidfTransformer()),  # integer counts to weighted TF-
IDF scores
    ('classifier', MLPClassifier(hidden_layer_sizes=(100,4),
random_state=0, early_stopping=True, verbose=2)),  # train on TF-IDF
vectors w/ MLPClassifier classifier with two hidden layers
])

#III Fit the pipeline and then perform prediction
pipeline.fit(X_train,y_train)
pred = pipeline.predict(X_test)
```

```
Iteration 1, loss = 0.32590260
Validation score: 0.989978
Iteration 2, loss = 0.02926850
Validation score: 0.994710
Iteration 3, loss = 0.00900176
Validation score: 0.994432
Iteration 4, loss = 0.00473447
Validation score: 0.995267
Iteration 5, loss = 0.00309784
Validation score: 0.994710
Iteration 6, loss = 0.00239000
Validation score: 0.994710
Iteration 7, loss = 0.00199306
Validation score: 0.994710
Iteration 8, loss = 0.00173814
Validation score: 0.994710
Iteration 9, loss = 0.00155653
Validation score: 0.994710
Iteration 10, loss = 0.00141826
Validation score: 0.994432
Iteration 11, loss = 0.00130756
Validation score: 0.994710
Iteration 12, loss = 0.00121552
Validation score: 0.994432
Iteration 13, loss = 0.00113665
Validation score: 0.994710
Iteration 14, loss = 0.00106729
```

```
Validation score: 0.994710
Iteration 15, loss = 0.00100558
Validation score: 0.994432
Validation score did not improve more than tol=0.000100 for 10
consecutive epochs. Stopping.
```

```
#IV Generate classification report and confusion matrix (You have to
achieve at least 99% accuracy to receive full credit for this model)
print(classification_report(pred,y_test))
print(confusion_matrix(y_test, pred))
```

```
              precision    recall  f1-score   support

           0       0.99      1.00      1.00      4669
           1       1.00      0.99      1.00      4311

    accuracy                           1.00      8980
   macro avg       1.00      1.00      1.00      8980
weighted avg       1.00      1.00      1.00      8980

[[4662   34]
 [   7 4277]]
```

V Discuss the performance like how good the model is overall, how good is it in predicting fake news, and how good is it in predicting true news.

- According to the classificaiton report and confusion matrix it is insanely good at predicting whether news is fake or true, this could also be due to the algorithm revealing specific words or commonalities that are always used in fake or true news articles. Alternatively it could be that it only works this well within this specific sample of news articles, using another sample of articles, maybe older ones, might reveal new patterns and show how media has evolved over time.

```
#VI Use the same news you have used above and then use the model to
predict whether is it true or not.
newSMS = "Dozens of products sold under the brand name Elite are being
recalled in Canada over fears of salmonella contamination."
pipeline.predict([newSMS])
```

```
array(['1'], dtype='<U1')
```

VII Discuss any difference in performance between this model and NB model

- This model marks the news snippet as true while the previous one marks it as false. It also has a higher accuracy score but takes longer to fit and predict