```python
# Library Imports (Consolidated and Organized)
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import re
import string
import nltk
from nltk.corpus import stopwords, wordnet
from nltk.tokenize import word_tokenize
from nltk.stem import WordNetLemmatizer
from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.model_selection import train_test_split
from wordcloud import WordCloud
from textblob import TextBlob
import warnings
from sklearn.feature_extraction.text import CountVectorizer
import textstat
import pickle
import warnings
warnings.filterwarnings("ignore")

# Download necessary NLTK data
nltk.download('stopwords')
nltk.download('vader_lexicon')
```

```
[nltk_data] Downloading package stopwords to
[nltk_data]     C:\Users\uthka\AppData\Roaming\nltk_data...
[nltk_data]   Package stopwords is already up-to-date!
[nltk_data] Downloading package vader_lexicon to
[nltk_data]     C:\Users\uthka\AppData\Roaming\nltk_data...
[nltk_data]   Package vader_lexicon is already up-to-date!
```

```
True
```

```python
data =pd.read_csv("Data/WELFake_Dataset.csv")
data.shape
```

```
(72134, 4)
```

```python
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 72134 entries, 0 to 72133
Data columns (total 4 columns):
 #   Column      Non-Null Count  Dtype 
---  ------      --------------  ----- 
 0   Unnamed: 0  72134 non-null  int64 
 1   title       71576 non-null  object
 2   text        72095 non-null  object
 3   label       72134 non-null  int64 
```

```
dtypes: int64(2), object(2)
memory usage: 2.2+ MB
```

```
data.drop(columns=['Unnamed: 0'],axis=1,inplace=True)
```

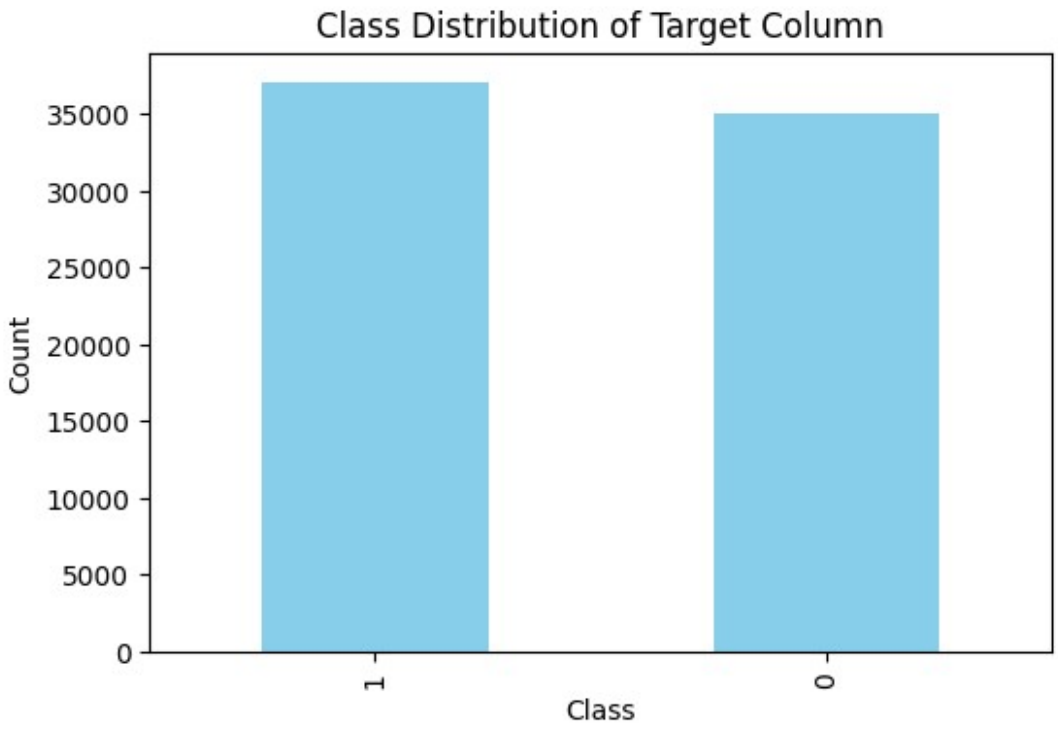
```
data
```

```
                                                   title  \
0      LAW ENFORCEMENT ON HIGH ALERT Following Threat...
1                                                    NaN
2      UNBELIEVABLE! OBAMA’S ATTORNEY GENERAL SAYS MO...
3      Bobby Jindal, raised Hindu, uses story of Chri...
4      SATAN 2: Russia unvelis an image of its terrif...
...                                                  ...
72129  Russians steal research on Trump in hack of U....
72130   WATCH: Giuliani Demands That Democrats Apolog...
72131  Migrants Refuse To Leave Train At Refugee Camp...
72132  Trump tussle gives unpopular Mexican leader mu...
72133  Goldman Sachs Endorses Hillary Clinton For Pre...

                                                    text  label
0      No comment is expected from Barack Obama Membe...      1
1         Did they post their votes for Hillary already?      1
2       Now, most of the demonstrators gathered last ...      1
3      A dozen politically active pastors came here f...      0
4      The RS-28 Sarmat missile, dubbed Satan 2, will...      1
...                                                  ...    ...
72129  WASHINGTON (Reuters) - Hackers believed to be ...      0
72130  You know, because in fantasyland Republicans n...      1
72131  Migrants Refuse To Leave Train At Refugee Camp...      0
72132  MEXICO CITY (Reuters) - Donald Trump’s combati...      0
72133  Goldman Sachs Endorses Hillary Clinton For Pre...      1

[72134 rows x 3 columns]
```

```
class_counts = data['label'].value_counts()
plt.figure(figsize=(6, 4))
class_counts.plot(kind='bar', color='skyblue')
plt.title('Class Distribution of Target Column')
plt.xlabel('Class')
plt.ylabel('Count')
plt.show()
```




```
data = data.dropna()

print(f"number of missing values in label column:
{data['label'].isna().sum()}")
print(f"number of missing values in text column:
{data['text'].isna().sum()}")
print(f"number of missing values in title column:
{data['text'].isna().sum()}")
```

```
number of missing values in label column: 0
number of missing values in text column: 0
number of missing values in title column: 0
```

```
# Filtering the dataset
filtered_data_real = data[data['label'] == 1]
filtered_data_fake = data[data['label'] == 0]

# Concatenate all the text from the 'title' and 'text' columns in the
filtered dataset
text_title = ' '.join(filtered_data_real['title'].dropna())
text_text = ' '.join(filtered_data_real['text'].dropna())

# Generate the word clouds
wordcloud_title = WordCloud(width=400, height=400,
background_color='white').generate(text_title)
wordcloud_text = WordCloud(width=400, height=400,
background_color='white').generate(text_text)
```

```
# Create subplots
fig, axes = plt.subplots(2, 1, figsize=(20, 12))

# Plot the first word cloud (title)
axes[0].imshow(wordcloud_title, interpolation='bilinear')
axes[0].axis('off')
axes[0].set_title('Word Cloud of Titles')

# Plot the second word cloud (text)
axes[1].imshow(wordcloud_text, interpolation='bilinear')
axes[1].axis('off')
axes[1].set_title('Word Cloud of Text')

# Adjust layout
plt.tight_layout()

# Show the combined plot
plt.show()
```

Word Cloud of Titles

Word Cloud of Text

```
# Concatenate all the text from the 'title' and 'text' columns in the
filtered dataset
text_title = ' '.join(filtered_data_fake['title'].dropna())
text_text = ' '.join(filtered_data_fake['text'].dropna())

# Generate the word clouds
wordcloud_title = WordCloud(width=400, height=400,
background_color='white').generate(text_title)
wordcloud_text = WordCloud(width=400, height=400,
background_color='white').generate(text_text)

# Create subplots
fig, axes = plt.subplots(2, 1, figsize=(20, 12))

# Plot the first word cloud (title)
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axes[0].axis('off')
axes[0].set_title('Word Cloud of Titles')

# Plot the second word cloud (text)
axes[1].imshow(wordcloud_text, interpolation='bilinear')
axes[1].axis('off')
axes[1].set_title('Word Cloud of Text')

# Adjust layout
plt.tight_layout()

# Show the combined plot
plt.show()
```
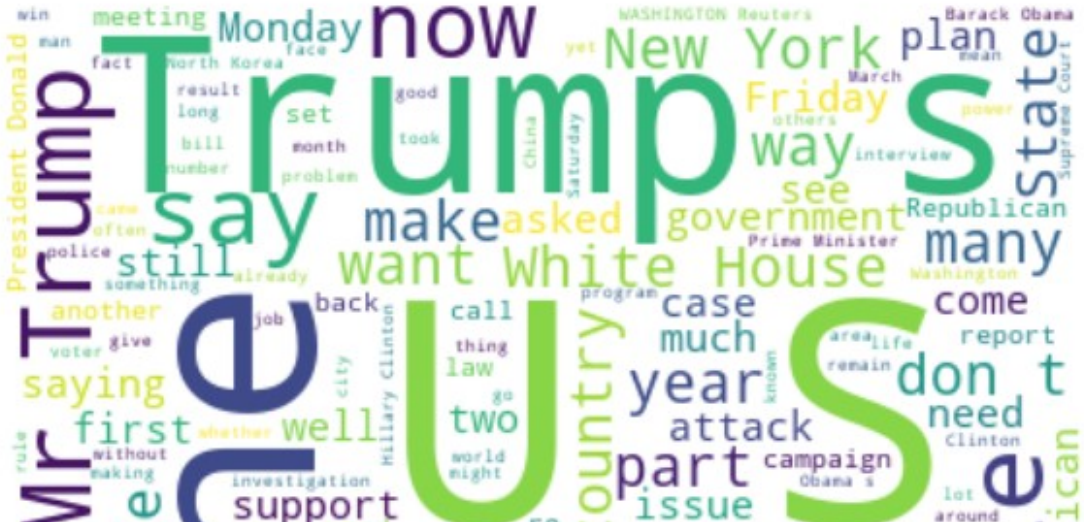

Word Cloud of Titles

Word Cloud of Text



```
# Initialize the WordNet Lemmatizer
lemmatizer = WordNetLemmatizer()

# Preprocess the text data
def preprocess_text(text):
    # Remove punctuation, special characters, exclamation marks, and
question marks
    text = re.sub(r'[^a-zA-Z0-9\s!?]', '', text)

    # Tokenization and removing stopwords
    stop_words = set(stopwords.words('english'))
    words = text.split()
    words = [word for word in words if word not in stop_words]

    # Lemmatization
    words = [lemmatizer.lemmatize(word) for word in words]

    # Join the processed words back into a sentence
    return ' '.join(words)

# Apply preprocessing to the text columns
data['title'] = data['title'].fillna('').apply(preprocess_text)
data['text'] = data['text'].fillna('').apply(preprocess_text)

from textblob import TextBlob
import re

def extract_features(df):

    df['combined_text'] = df['title'] + " " + df['text']

    # Initialize columns for the features
    df['title_length'] = df['title'].str.len()  # Length of the title
    df['text_length'] = df['text'].str.len()    # Length of the text

    df['title_sentiment'] = df['title'].apply(lambda x:
TextBlob(str(x)).sentiment.polarity)  # Sentiment of the title
    df['text_sentiment'] = df['text'].apply(lambda x:
TextBlob(str(x)).sentiment.polarity)    # Sentiment of the text

    # Stylistic and formatting features
    df['title_exclamation_marks'] = df['title'].str.count(r'\!')  #
Count of exclamation marks in title
    df['title_question_marks'] = df['title'].str.count(r'\?')     #
Count of question marks in title
    df['title_all_caps'] = df['title'].str.count(r'\b[A-Z]{2,}\b')  #
Count of all caps words in title
    df['title_repeated_letters'] = df['title'].apply(lambda x:
len(re.findall(r'(.)\1{2,}', str(x))))  # Count of repeated letters in
text
```

```
    df['text_exclamation_marks'] = df['text'].str.count(r'\!')  # Count of exclamation marks in text
    df['text_question_marks'] = df['text'].str.count(r'\?')     # Count of question marks in text
    df['text_all_caps'] = df['text'].str.count(r'\b[A-Z]{2,}\b')  # Count of all caps words in text
    df['text_repeated_letters'] = df['text'].apply(lambda x: len(re.findall(r'(.)\1{2,}', str(x))))  # Count of repeated letters in text

    # Vocabulary analysis
    df['title_unique_words'] = df['title'].apply(lambda x: len(set(str(x).split())))  # Number of unique words in title
    df['text_unique_words'] = df['text'].apply(lambda x: len(set(str(x).split())))    # Number of unique words in text

    # Readability Scores (using one of the readability measures for example)
    df['readability_score'] = df['text'].apply(lambda x: textstat.flesch_reading_ease(x))

    return df

# Extract features from the dataset
feature_data = extract_features(data)

# Display the first few rows with the new features
feature_data.head()
```

```
                                               title  \
0  LAW ENFORCEMENT ON HIGH ALERT Following Threat...
2  UNBELIEVABLE! OBAMAS ATTORNEY GENERAL SAYS MOS...
3  Bobby Jindal raised Hindu us story Christian c...
4  SATAN 2 Russia unvelis image terrifying new SU...
5  About Time! Christian Group Sues Amazon SPLC D...

                                                text  label  \
0  No comment expected Barack Obama Members FYF91...      1
2  Now demonstrator gathered last night exercisin...      1
3  A dozen politically active pastor came private...      0
4  The RS28 Sarmat missile dubbed Satan 2 replace...      1
5  All say one time someone sued Southern Poverty...      1

                                       combined_text  title_length  \
0  LAW ENFORCEMENT ON HIGH ALERT Following Threat...           125
2  UNBELIEVABLE! OBAMAS ATTORNEY GENERAL SAYS MOS...           131
3  Bobby Jindal raised Hindu us story Christian c...            91
4  SATAN 2 Russia unvelis image terrifying new SU...            79
5  About Time! Christian Group Sues Amazon SPLC D...            67
```

```
   text_length  title_sentiment  text_sentiment
title_exclamation_marks  \
0         3341         0.080000        0.013967
0
2          163         0.121875        0.178571
1
3         5663         0.000000        0.121225
0
4         1445        -0.287879        0.066970
0
5         1123        -0.400000       -0.098030
1

   title_question_marks  title_all_caps  title_repeated_letters  \
0                     0               6                       0
2                     0              11                       0
3                     0               0                       0
4                     0               2                       0
5                     0               1                       0

   text_exclamation_marks  text_question_marks  text_all_caps  \
0                       2                    7              1
2                       0                    0              0
3                       0                    1              6
4                       0                    0             11
5                       1                    0             12

   text_repeated_letters  title_unique_words  text_unique_words  \
0                      2                  17                313
2                      0                  18                 22
3                      1                  13                548
4                      4                  12                148
5                      0                   9                111

   readability_score
0             -31.46
2              23.77
3            -353.82
4            -157.25
5             -30.55

feature_data.describe()

              label  title_length   text_length  title_sentiment  \
count  71537.000000  71537.000000  71537.000000     71537.000000
mean       0.510351     69.493717   2332.106700         0.022141
std        0.499896     24.841768   2586.280409         0.252674
min        0.000000      0.000000      0.000000        -1.000000
25%        0.000000     53.000000   1004.000000         0.000000
```

```
50%        1.000000     65.000000   1736.000000          0.000000
75%        1.000000     82.000000   2906.000000          0.100000
max        1.000000    365.000000  87554.000000          1.000000

       text_sentiment  title_exclamation_marks
title_question_marks  \
count    71537.000000              71537.0000          71537.000000

mean         0.052114                  0.0631              0.051484

std          0.108219                  0.2763              0.231971

min         -1.000000                  0.0000              0.000000

25%          0.000000                  0.0000              0.000000

50%          0.048522                  0.0000              0.000000

75%          0.103250                  0.0000              0.000000

max          1.000000                  9.0000              5.000000


       title_all_caps  title_repeated_letters  text_exclamation_marks
\
count    71537.000000            71537.000000            71537.000000

mean         1.280330                0.010316                0.472091

std          2.256425                0.103505                2.135718

min          0.000000                0.000000                0.000000

25%          0.000000                0.000000                0.000000

50%          0.000000                0.000000                0.000000

75%          1.000000                0.000000                0.000000

max         24.000000                3.000000              213.000000


       text_question_marks  text_all_caps  text_repeated_letters  \
count         71537.000000   71537.000000           71537.000000
mean              0.973315       5.974237               0.487314
std               2.950422      10.934578               1.464916
min               0.000000       0.000000               0.000000
25%               0.000000       1.000000               0.000000
50%               0.000000       3.000000               0.000000
75%               1.000000       7.000000               0.000000
max             159.000000     604.000000             115.000000
```

```
       title_unique_words  text_unique_words  readability_score
count        71537.000000       71537.000000       71537.000000
mean            10.690747         220.843368        -150.975878
std              3.998471         194.398153         197.060106
min              0.000000           0.000000       -3027.000000
25%              8.000000         110.000000        -221.870000
50%             10.000000         177.000000        -103.800000
75%             13.000000         279.000000         -17.860000
max             45.000000        4298.000000         206.840000
```

```
# Vectorize the combined text data
tfidf = TfidfVectorizer(max_features=100)
X_text = tfidf.fit_transform(feature_data['combined_text'])

# Selecting the non-text features (excluding 'combined_text' which was
used for TF-IDF)
non_text_features = feature_data.drop(columns=['title', 'text',
'combined_text', 'label'])

# Get the feature names (words)
feature_names = tfidf.get_feature_names_out()

word_tfidf_weights= []
for i in range(len(feature_data['combined_text'])):
    document_tfidf_values = X_text[i, :].toarray().flatten()
    word_tfidf_weights.append(document_tfidf_values)

# Combine text features with other features
X = pd.concat([pd.DataFrame(X_text.toarray()),
non_text_features.reset_index(drop=True)], axis=1)
features=X.to_numpy()
y = feature_data['label']

features.shape,y.shape
```

```
((71537, 115), (71537,))
```

```
pickle.dump(feature_data, open('features.pkl', 'wb'))
pickle.dump(features, open('features_tfidf.pkl', 'wb'))
pickle.dump(y, open('labels.pkl', 'wb'))
pickle.dump(word_tfidf_weights, open('word_tfidf_weights.pkl', 'wb'))
```