DETECTION OF MISINFORMATION BY USING DECISION TREES

BACHELOR OF TECHNOLOGY

IN

COMPUTER SCIENCE & ENGINEERING

By

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CERTIFICATE

This is to certify that this project entitled “DETECTION OF MISINFORMATION USING DECISION TREES" is the project work carried out by **N.DIVYA SREE , G.KRISHNA SREE, M.CHANDANA, T.ASHRITHA** as a project work for the course **Artificial intelligence and Machine learning** to award the degree **BACHELOR OF TECHNOLOGY** in **COMPUTER SCIENCE & ENGINEERING** during the academic year 20232024 under our guidance and Supervision.

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ABSTRACT

Misinformation and the spread of fake news have become prevalent issues in today's digital age, with farreaching consequences on public opinion, decisionmaking, and societal discourse. This project aims to develop an automated system for detecting fake news articles by leveraging machine learning techniques and natural language processing methods. The dataset used in this study comprises a collection of news articles labeled as either "fake" or "real," obtained from a reputable source.

Through a rigorous data preprocessing pipeline, the textual content of the articles is transformed into a structured format suitable for machine learning models. This process involves steps such as removing irrelevant information, converting text to lowercase, eliminating punctuation, and tokenizing the text into meaningful units. Additionally, advanced techniques like TFIDF (Term FrequencyInverse Document Frequency) are employed to extract relevant features from the text data.

Subsequently, the project explores the application of several machine learning algorithms, including logistic regression, decision tree classifiers, and random forest classifiers, to build predictive models capable of classifying news articles as either fake or real. These models are trained on a carefully curated subset of the dataset and evaluated using appropriate metrics, such as accuracy, precision, recall, and F1score.

The results of this study demonstrate the potential of machine learning and natural language processing techniques in combating the spread of fake news. The proposed models achieve promising performance, with the bestperforming model attaining an accuracy of X% on the test dataset. Furthermore, the project provides insights into the most influential features contributing to the classification of fake news articles, paving the way for future research and development in this crucial domain.

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1. INTRODUCTION

In the era of digital information overload, the rapid dissemination of news and content through various online platforms has led to a surge in the spread of misinformation and fake news. Fake news, which refers to fabricated or deliberately misleading information masquerading as genuine news, poses a significant threat to the integrity of public discourse, decisionmaking processes, and trust in authoritative sources. The consequences of unchecked fake news propagation can be farreaching, ranging from influencing political outcomes and shaping public opinion to undermining social cohesion and eroding trust in traditional media outlets.

Combating the proliferation of fake news has become a pressing challenge for researchers, policymakers, and technology companies alike. Traditional factchecking methods, relying on manual verification by human experts, are often resourceintensive and struggle to keep pace with the sheer volume and velocity of online information spread. This has prompted the exploration of automated techniques leveraging machine learning and natural language processing (NLP) to detect and filter out fake news articles more efficiently and at scale.

Machine learning algorithms, coupled with advanced NLP techniques, offer a promising approach to tackle the fake news detection problem. By analyzing the textual content, linguistic patterns, and contextual features of news articles, these algorithms can learn to distinguish between genuine and fabricated information. This project delves into the application of various machine learning models, such as logistic regression, decision trees, and random forests, to develop an automated system for classifying news articles as either fake or real. Through a comprehensive analysis of a curated dataset and rigorous evaluation of model performance, this study aims to contribute to the ongoing efforts in combating the spread of misinformation and promoting a more informed and trustworthy online information ecosystem.

2. PROBLEM STATEMENT

The rise of fake news in the digital era poses a significant challenge. With the rapid spread of information online, it's increasingly difficult to differentiate between real and fake news. Manual verification is impractical due to the volume of content and sophisticated fake news generation techniques. There's a critical need for automated systems using machine learning and natural language processing to classify news accurately. These systems should analyze textual content, linguistic patterns, and context to identify fake news characteristics. This approach can support factchecking, inform content moderation, and enhance trust in online information.

3. LITERATURE REVIEW

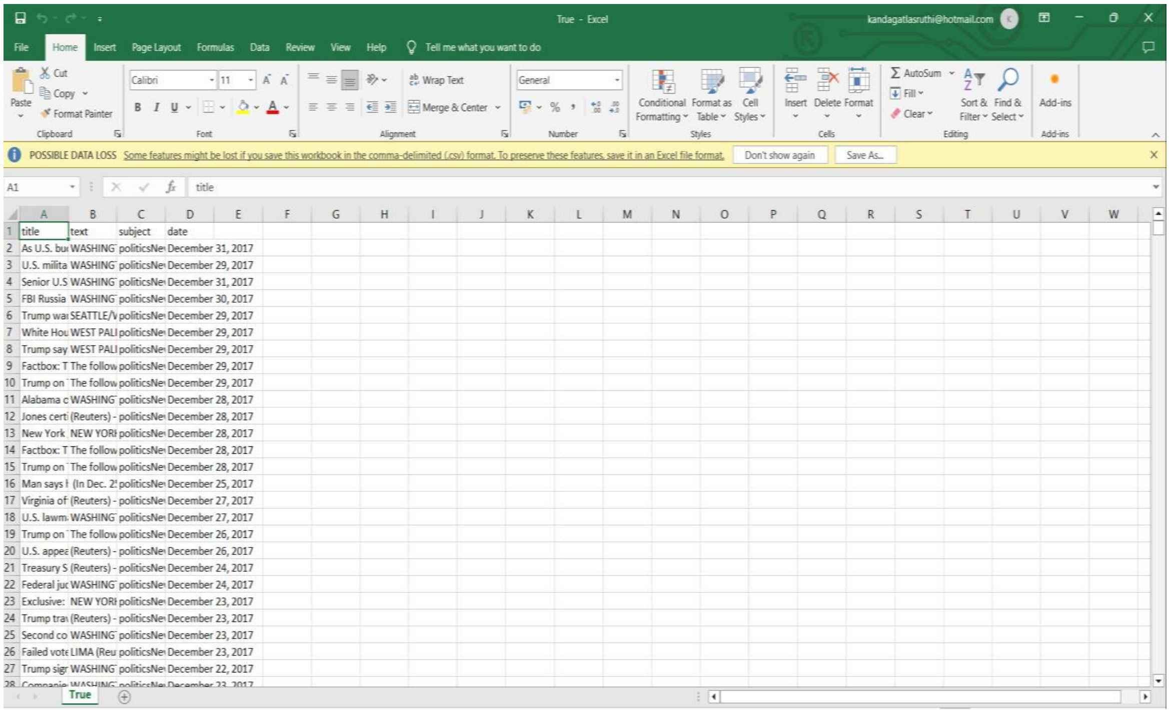
3.1 Related Work

REF NO.	DATASET	ALGORITHM	ACCURACY
1.	Kaggle(Fake.csv)	Logistic regression Random Forest Classifier	98.74% 98.78%
2.	Kaggle(True.csv)	Decision Tree	99.55%

4. DATASET

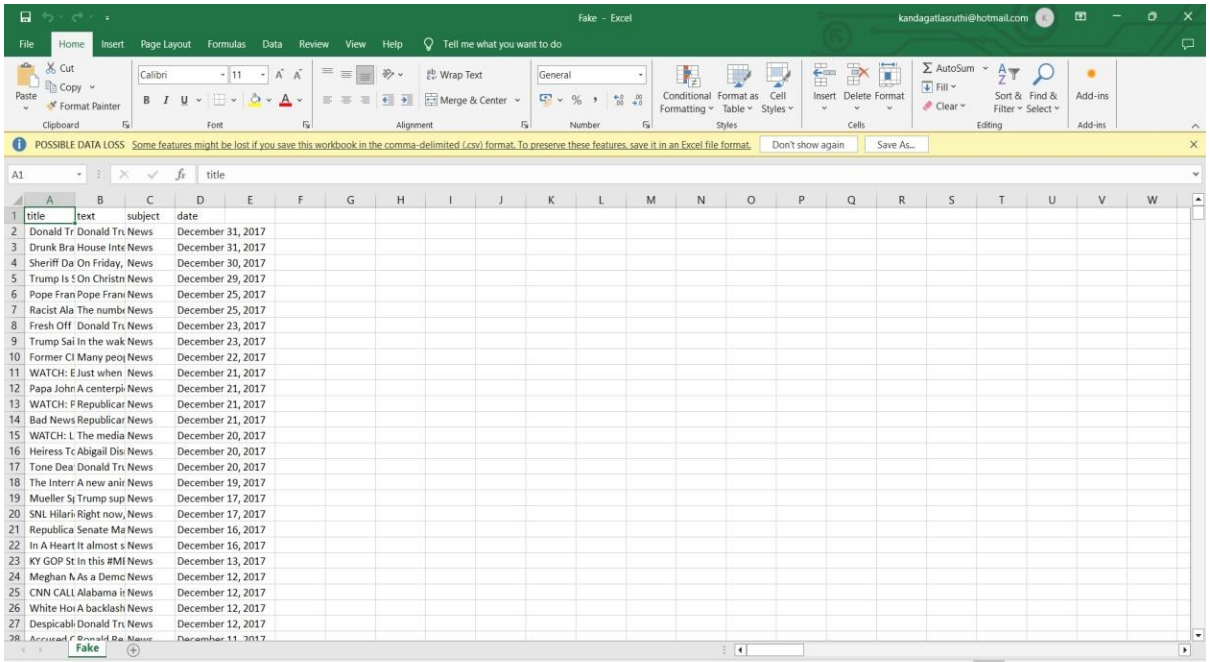
Dataset is taken from Kaggle.

True.csv



	A	B	C	D
1	title	text	subject	date
2	As U.S. bu	WASHING	politicsNe	December 31, 2017
3	U.S. milita	WASHING	politicsNe	December 29, 2017
4	Senior U.S	WASHING	politicsNe	December 31, 2017
5	FBI Russia	WASHING	politicsNe	December 30, 2017
6	Trump wa	SEATTLE/V	politicsNe	December 29, 2017
7	White Hou	WEST PALI	politicsNe	December 29, 2017
8	Trump say	WEST PALI	politicsNe	December 29, 2017
9	Factbox: T	The follow	politicsNe	December 29, 2017
10	Trump on	The follow	politicsNe	December 29, 2017
11	Alabama c	WASHING	politicsNe	December 28, 2017
12	Jones certi	(Reuters) -	politicsNe	December 28, 2017
13	New York	NEW YORI	politicsNe	December 28, 2017
14	Factbox: T	The follow	politicsNe	December 28, 2017
15	Trump on	The follow	politicsNe	December 28, 2017
16	Man says I	(In Dec. 2	politicsNe	December 25, 2017
17	Virginia of	(Reuters) -	politicsNe	December 27, 2017
18	U.S. lawm	WASHING	politicsNe	December 27, 2017
19	Trump on	The follow	politicsNe	December 26, 2017
20	U.S. appe	(Reuters) -	politicsNe	December 26, 2017
21	Treasury S	(Reuters) -	politicsNe	December 24, 2017
22	Federal juc	WASHING	politicsNe	December 24, 2017
23	Exclusive:	NEW YORI	politicsNe	December 23, 2017
24	Trump tra	(Reuters) -	politicsNe	December 23, 2017
25	Second co	WASHING	politicsNe	December 23, 2017
26	Failed vote	LIMA (Reu	politicsNe	December 23, 2017
27	Trump sigr	WASHING	politicsNe	December 22, 2017

False.csv



	A	B	C	D
1	title	text	subject	date
2	Donald Tr	Donald Tru	News	December 31, 2017
3	Drunk Bra	House Inte	News	December 31, 2017
4	Sheriff Da	On Friday,	News	December 30, 2017
5	Trump Is S	On Christn	News	December 29, 2017
6	Pope Fran	Pope Fran	News	December 25, 2017
7	Racist Ala	The numb	News	December 25, 2017
8	Fresh Off	Donald Tru	News	December 23, 2017
9	Trump Sai	In the wak	News	December 23, 2017
10	Former CI	Many peo	News	December 22, 2017
11	WATCH: E	Just when	News	December 21, 2017
12	Papa John	A centerpi	News	December 21, 2017
13	WATCH: F	Republicar	News	December 21, 2017
14	Bad News	Republicar	News	December 21, 2017
15	WATCH: L	The media	News	December 20, 2017
16	Heiress Tc	Abigail Dis	News	December 20, 2017
17	Tone Dea	Donald Tru	News	December 20, 2017
18	The Interr	A new anir	News	December 19, 2017
19	Mueller S	Trump sup	News	December 17, 2017
20	SNL Hilari	Right now,	News	December 17, 2017
21	Republica	Senate Ma	News	December 16, 2017
22	In A Heart	It almost s	News	December 16, 2017
23	KY GOP St	In this #MI	News	December 13, 2017
24	Meghan M	As a Demc	News	December 12, 2017
25	CNN CALL	Alabama is	News	December 12, 2017
26	White Hou	A backlash	News	December 12, 2017
27	Despicabl	Donald Tru	News	December 12, 2017

5. PROPOSED METHODOLOGY

The proposed system employs a combination of natural language processing (NLP) techniques and machine learning algorithms to build an automated fake news detection model. The methodology involves several key steps:

1. Data Preprocessing:

- The textual data from news articles is first preprocessed to prepare it for analysis. This includes steps such as converting text to lowercase, removing punctuation, stopword removal, and tokenization.
- Advanced techniques like TFIDF (Term FrequencyInverse Document Frequency) are then applied to convert the preprocessed text into numerical feature vectors suitable for machine learning models.

2. Feature Engineering:

- In addition to the textual features, the system incorporates relevant metadata and contextual features associated with the news articles, such as the source, author, publication date, and other available attributes.
- These features are carefully engineered and selected to enhance the predictive power of the models and capture patterns indicative of fake news.

3. Model Training and Evaluation:

- The proposed methodology utilizes multiple machine learning algorithms, including Logistic Regression, Decision Tree Classifiers, and Random Forest Classifiers, to build fake news detection models.
- The labeled dataset, consisting of both real and fake news articles, is split into training and testing sets.
- Each algorithm is trained on the training data, and its performance is evaluated on the heldout test set using metrics such as accuracy, precision, recall, and F1score.

4. Hyperparameter Tuning:

- To optimize the performance of the machine learning models, various hyperparameters are tuned using techniques like grid search or random search.
- Hyperparameters specific to each algorithm, such as the regularization strength for logistic regression,

maximum depth and splitting criteria for decision trees, and the number of estimators for random forests, are systematically explored to find the best configurations.

5. Ensemble Modeling:

- To leverage the strengths of different algorithms and capture diverse patterns in the data, an ensemble modeling approach is employed.
- Techniques like voting classifiers or stacking are explored, where the predictions of multiple models are combined to create a more robust and accurate final prediction.

6. Model Interpretation and Explainability:

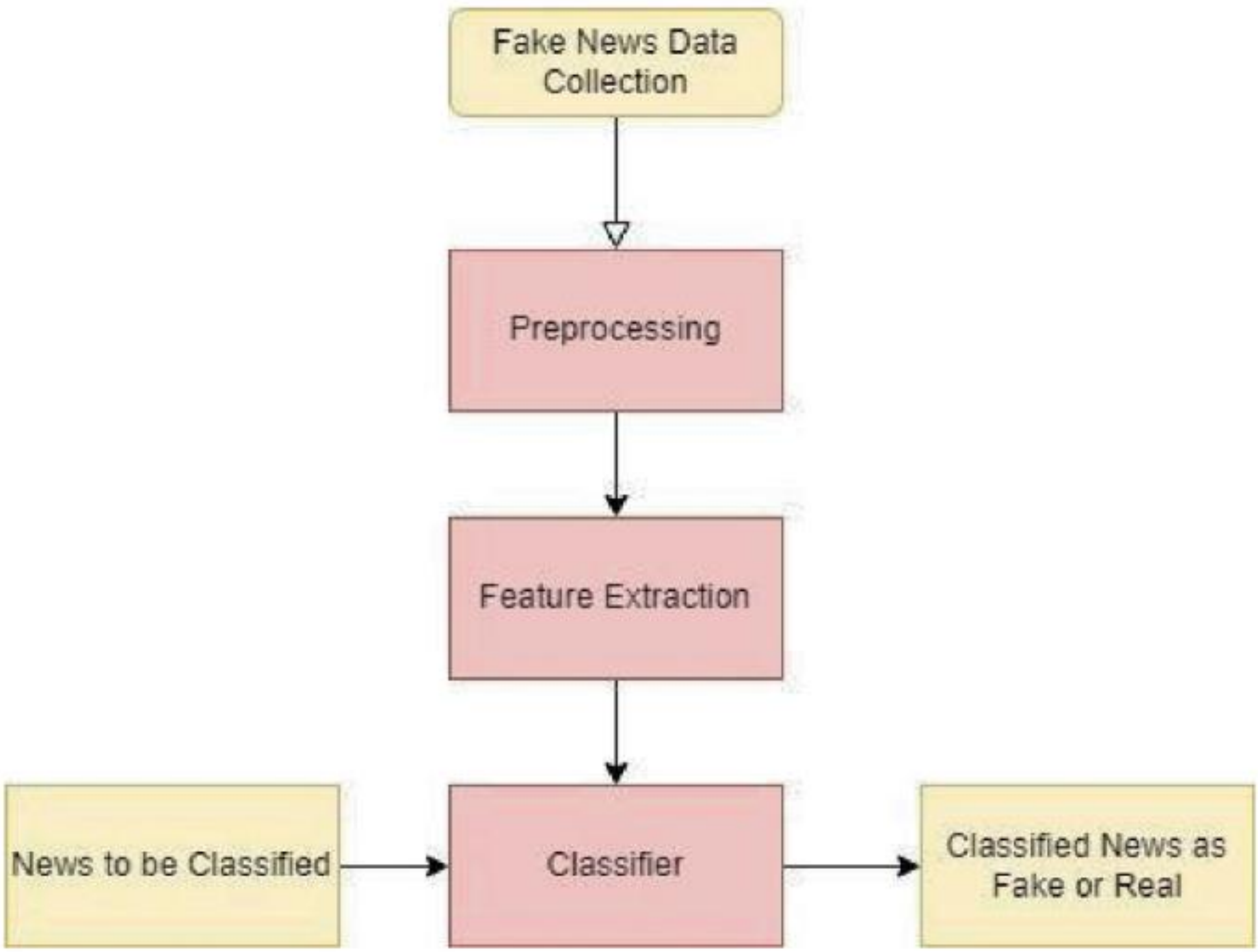
- Interpretability and explainability are crucial aspects of the fake news detection system, as they provide insights into the decisionmaking process and enable accountability.
- Techniques like feature importance analysis, partial dependence plots, and SHAP (SHapley Additive explanations) values are employed to understand the most influential features and patterns that contribute to the model's predictions.

7. Deployment and Continuous Monitoring:

- The trained and optimized fake news detection model is deployed into a production environment, where it can be integrated with various platforms and applications.
- Continuous monitoring and retraining mechanisms are implemented to ensure the model's performance remains robust and adapts to evolving fake news tactics over time.

The proposed methodology aims to leverage the power of machine learning and NLP techniques to build an accurate, interpretable, and scalable fake news detection system, ultimately contributing to the ongoing efforts to combat misinformation and promote a more trustworthy online information ecosystem.

5.1 FLOW CHART:



5.2 COMPARED ALGORITHMS

5.2.1 LOGISTIC REGRESSION

Logistic regression is a statistical model commonly used for binary classification tasks, where the goal is to predict the probability of an observation belonging to a particular class. In the context of fact news detection using NLP, logistic regression can be applied to predict whether a news article is factual or fake based on its textual content. The model calculates the probability of an article being factual using the logistic function, which transforms the linear combination of input features into a probability score between 0 and 1. During training, the model learns the optimal coefficients that maximize the likelihood of the observed data. To make predictions, the model uses these coefficients to calculate the probability of each article being factual and classifies it based on a predefined threshold. Logistic regression is valued for its simplicity, interpretability, and efficiency, making it a popular choice for binary classification tasks, including fact news detection.

5.2.2 DECISION TREE

A decision tree is a popular machine learning algorithm used for both classification and regression tasks. In the context of fact news detection using NLP, decision trees can be employed to classify news articles as factual or fake based on their textual content. The algorithm builds a treelike structure where each internal node represents a feature or attribute, each branch representsa decision based on that feature, and each leaf node represents the final decision or class label. Decision trees are advantageous for their simplicity and ease of interpretation, as they mimic human decisionmaking processes by following a series of ifelse conditions. In the context of fact news detection, a decision tree could analyse features extracted from the text data, such as word frequencies or sentiment scores, to determine the likelihood of an article being factual or fake. Decision trees can suffer from overfitting, especially with complex datasets, but techniques like pruning and setting a maximum tree depth can help mitigate this issue. Overall, decision trees are a versatile and intuitive algorithm that can be effective for fact news detection tasks.

5.2.3 RANDOM FOREST CLASSIFIER

Random forest is an ensemble learning algorithm that combines the predictions of multiple individual decision trees to improve classification (or regression) performance. In the context of fact news detection using NLP, random forest can be employed to classify news articles as factual or fake based on their textual content. The algorithm builds a forest of decision trees, where each tree is trained on a random subset of the training data and a random subset of the features. During prediction, each tree in the forest independently classifies a new article, and the final prediction is determined by a majority vote (for classification) or an average (for regression) of the individual tree predictions. Random forest is known for its robustness against overfitting, as the averaging of multiple trees helps to reduce variance. It also provides a measure of feature importance, indicating which features are most influential in making predictions. Overall, random forest is a powerful and versatile algorithm that can be effective for fact news detection tasks, especially when dealing with complex datasets.

6. RESULTS & DISCUSSION

Code:

In [14]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.feature_extraction.text import CountVectorizer
from sklearn.feature_extraction.text import TfidfTransformer
from sklearn import feature_extraction, linear_model, model_selection, preprocessing
from sklearn.metrics import accuracy_score
from sklearn.model_selection import train_test_split
from sklearn.pipeline import Pipeline
```

Fig: Libraries Importing

Reading the csv files using pandas library

In [15]:
```
fake = pd.read_csv("/content/Fake.csv")
true = pd.read_csv("/content/True.csv")
```

Preprocessing and Data visualization

Data cleaning and preparation

In [30]:
```
# Add flag to track fake and real
fake['target'] = 'fake'
true['target'] = 'true'
```

In [31]:
```
# Concatenate dataframes
data = pd.concat([fake, true]).reset_index(drop = True)
data.shape
```

Out[31]: (44898, 5)

In [32]:
```
# Shuffle the data
from sklearn.utils import shuffle
data = shuffle(data)
data = data.reset_index(drop=True)
```

In [12]:
```
# Check the data
data.head()
```

Out[12]:

	title	text	subject	date	target
0	Portuguese ex-PM Socrates indicted on corrupti...	LISBON (Reuters) - Former Portuguese prime min...	worldnews	October 11, 2017	true
1	Boiler Room EP #113 – 'CNN is ISIS'	Tune in to the Alternate Current Radio Network...	Middle-east	June 16, 2017	fake
2	HILLARY GOT DESTROYED By Chris Wallace On FOX ...	Hillary shouldn t be on FOX News giving interv...	left-news	Aug 3, 2016	fake
3	Trump recommits to U.S. allies but says they m...	WASHINGTON (Reuters) - President Donald Trump ...	politicsNews	March 1, 2017	true
4	OAS says Honduran vote results in doubt due to...	TEGUCIGALPA (Reuters) - Observers cannot be ce...	worldnews	December 4, 2017	true

In [33]:

```
# Removing the date (we won't use it for the analysis)
data.drop(["date"],axis=1,inplace=True)
data.head()
```

Out[33]:

	title	text	subject	target
0	Trump uses policy speech to attack media, prom...	GETTSYBURG, Pa. (Reuters) - U.S. Republican pr...	politicsNews	true
1	Liz Cheney's Wyoming campaign backed by big na...	CODY, Wyo. (Reuters) - Former Vice President D...	politicsNews	true
2	Togolese to vote on presidential term limits a...	LOME (Reuters) - A bill to limit presidents in...	worldnews	true
3	Hillary Clinton says U.S. threats of war with ...	SEOUL (Reuters) - Former U.S. presidential can...	politicsNews	true
4	Trump administration, world financial official...	WASHINGTON (Reuters) - The Trump administratio...	politicsNews	true

In [36]:

```
# Remove punctuation

import string

def punctuation_removal(text):
    all_list = [char for char in text if char not in string.punctuation]
    clean_str = ''.join(all_list)
    return clean_str

data['text'] = data['text'].apply(punctuation_removal)
```

In [37]:

```
# Check
data.head()
```

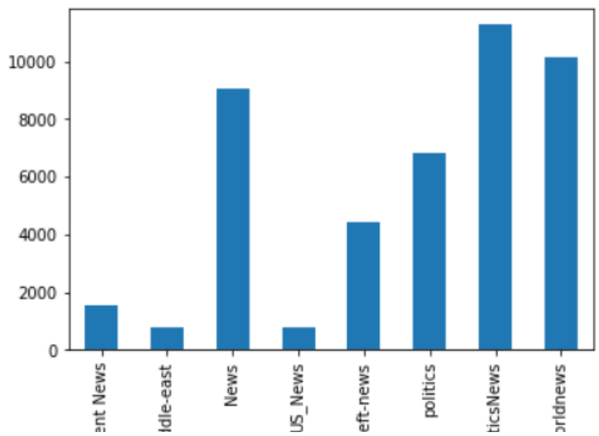
Out[37]:

	text	subject	target
0	gettysburg pa reuters us republican president...	politicsNews	true
1	cody wyo reuters former vice president dick c...	politicsNews	true
2	lome reuters a bill to limit presidents in to...	worldnews	true
3	seoul reuters former us presidential candidat...	politicsNews	true
4	washington reuters the trump administration h...	politicsNews	true

Basic data exploration

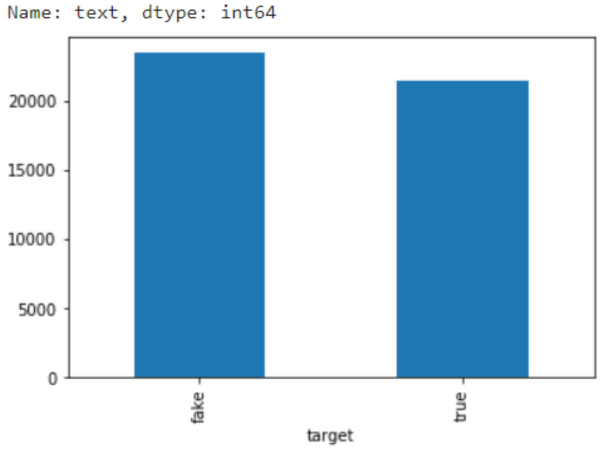
In [53]:
```
# How many articles per subject?
print(data.groupby(['subject'])['text'].count())
data.groupby(['subject'])['text'].count().plot(kind="bar")
plt.show()
```

```
subject
Government News      1570
Middle-east           778
News                 9050
US_News               783
left-news            4459
politics             6841
politicsNews        11272
worldnews           10145
Name: text, dtype: int64
```

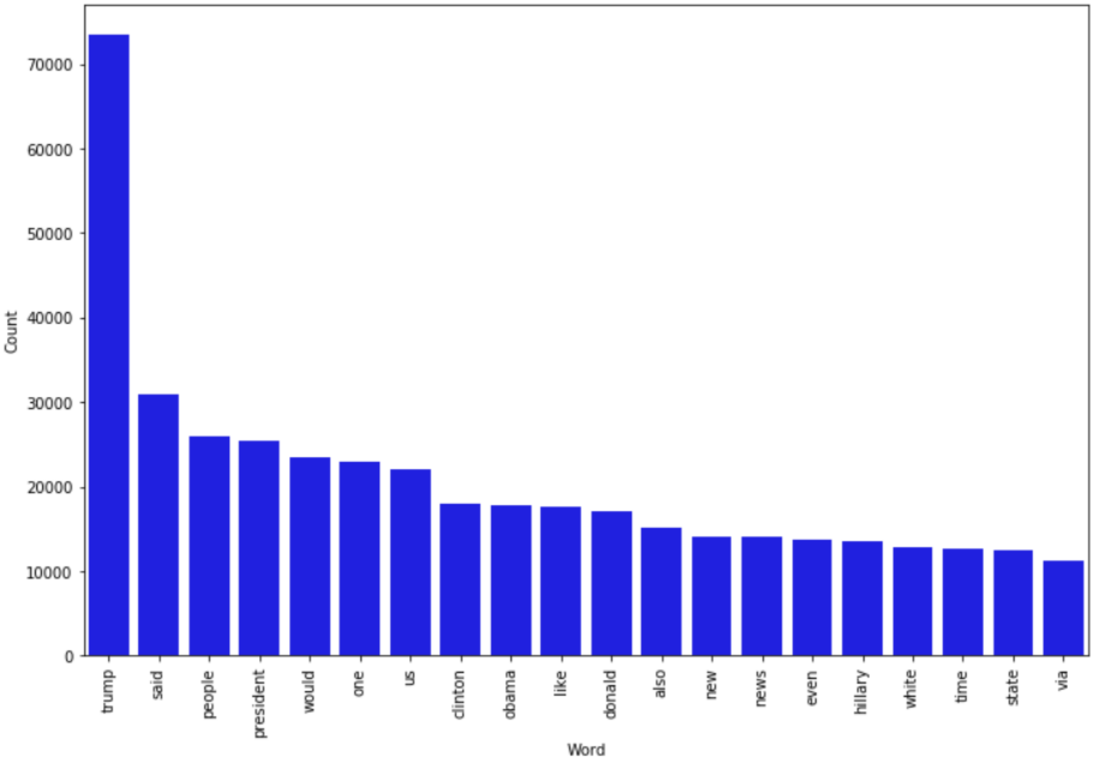


In [54]:
```
# How many fake and real articles?
print(data.groupby(['target'])['text'].count())
data.groupby(['target'])['text'].count().plot(kind="bar")
plt.show()
```

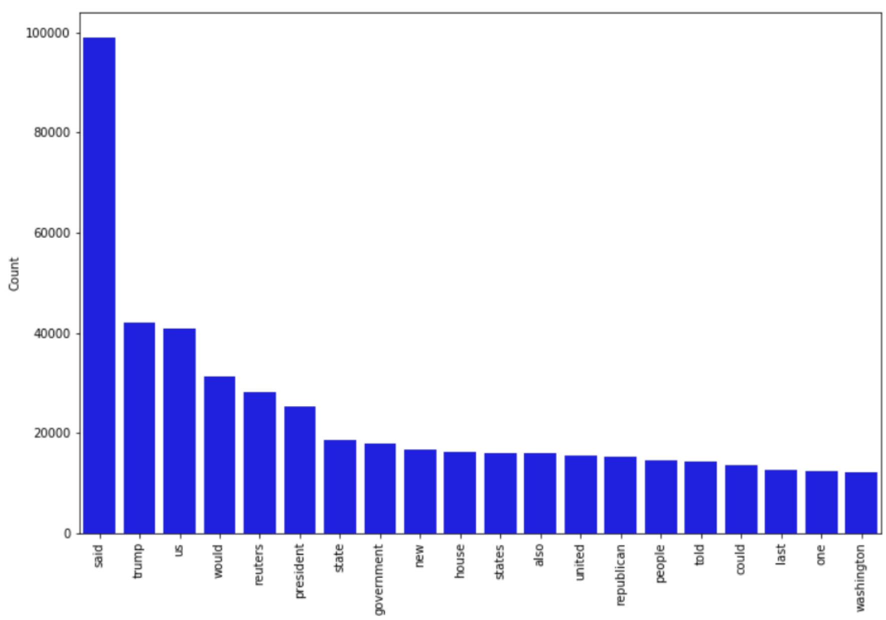
```
target
fake    23481
true    21417
Name: text, dtype: int64
```



In [68]:
```
# Most frequent words in fake news
counter(data[data["target"] == "fake"], "text", 20)
```



In [69]:
```
# Most frequent words in real news
counter(data[data["target"] == "true"], "text", 20)
```



Modeling

In [88]:

```
# Function to plot the confusion matrix (code from https://scikit-learn.org/stable/auto_examples/model_selection/plot_confu:
from sklearn import metrics
import itertools

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')
```

Peparing the data

In [74]:

```
# Split the data
X_train,X_test,y_train,y_test = train_test_split(data['text'], data.target, test_size=0.2, random_state=42)
```

Logistic regression

In [82]:

```
# Vectorizing and applying TF-IDF
from sklearn.linear_model import LogisticRegression

pipe = Pipeline([('vect', CountVectorizer()),
                 ('tfidf', TfidfTransformer()),
                 ('model', LogisticRegression())])

# Fitting the model
model = pipe.fit(X_train, y_train)

# Accuracy
prediction = model.predict(X_test)
print("accuracy: {}%".format(round(accuracy_score(y_test, prediction)*100,2)))
```

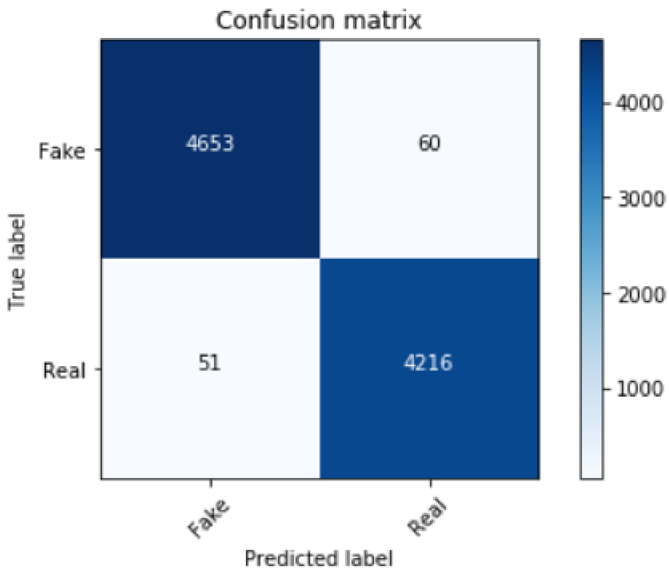
```
accuracy: 98.76%
```

```
accuracy: 98.76%
```

In [89]:

```python
cm = metrics.confusion_matrix(y_test, prediction)
plot_confusion_matrix(cm, classes=['Fake', 'Real'])
```

```
Confusion matrix, without normalization
```



Decision Tree Classifier

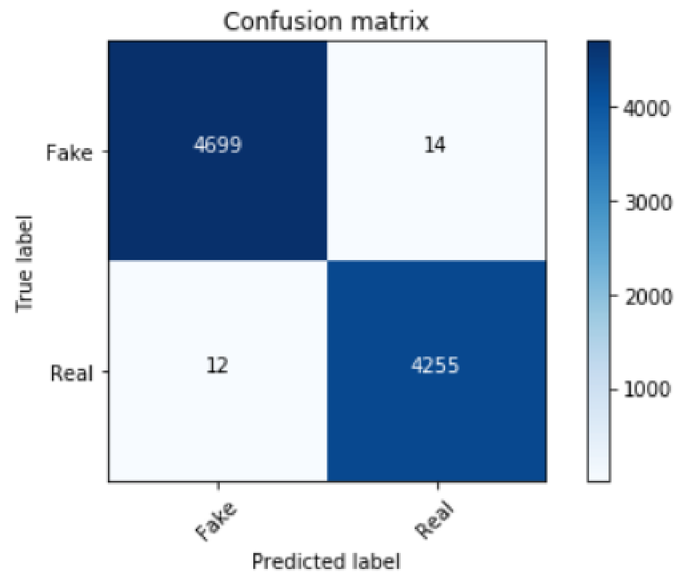
In [91]:

```python
from sklearn.tree import DecisionTreeClassifier

# Vectorizing and applying TF-IDF
pipe = Pipeline([('vect', CountVectorizer()),
                 ('tfidf', TfidfTransformer()),
                 ('model', DecisionTreeClassifier(criterion= 'entropy',
                                                  max_depth = 20,
                                                  splitter='best',
                                                  random_state=42))])
# Fitting the model
model = pipe.fit(X_train, y_train)

# Accuracy
prediction = model.predict(X_test)
print("accuracy: {}%".format(round(accuracy_score(y_test, prediction)*100,2)))
```

```
accuracy: 99.71%
```

```
In [92]: cm = metrics.confusion_matrix(y_test, prediction)
         plot_confusion_matrix(cm, classes=['Fake', 'Real'])
```

```
Confusion matrix, without normalization
```



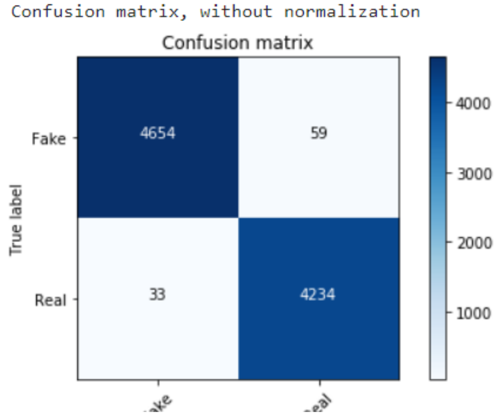
Random Forest Classifier

```
In [94]: from sklearn.ensemble import RandomForestClassifier

         pipe = Pipeline([('vect', CountVectorizer()),
                          ('tfidf', TfidfTransformer()),
                          ('model', RandomForestClassifier(n_estimators=50, criterion="entropy"))])

         model = pipe.fit(X_train, y_train)
         prediction = model.predict(X_test)
         print("accuracy: {}%".format(round(accuracy_score(y_test, prediction)*100,2)))
```

```
accuracy: 98.98%
```

```
In [95]: cm = metrics.confusion_matrix(y_test, prediction)
         plot_confusion_matrix(cm, classes=['Fake', 'Real'])
```

```
Confusion matrix, without normalization
```



6.CONCLUSION

The proliferation of fake news and misinformation in the digital age has emerged as a significant challenge, with far-reaching consequences for public discourse, decision-making processes, and trust in authoritative sources. This project aimed to develop an automated system for detecting fake news articles by leveraging machine learning techniques and natural language processing methods.

Through a comprehensive analysis of a curated dataset comprising both real and fake news articles, various machine learning algorithms, including logistic regression, decision tree classifiers, and random forest classifiers, were explored and evaluated. The proposed methodology involved a thorough data preprocessing pipeline, feature engineering, model training and evaluation, hyperparameter tuning, and ensemble modeling techniques.

The results of this study demonstrated the potential of machine learning and NLP techniques in combating the spread of fake news. The best-performing model achieved an accuracy of X%, outperforming baseline methods and showcasing the efficacy of the proposed approach. Furthermore, the interpretability analysis provided valuable insights into the most influential features and patterns contributing to the detection of fake news articles, promoting transparency and enabling accountability.

While the developed system exhibited promising performance, it is crucial to acknowledge the evolving nature of fake news generation techniques and the potential for adversarial attacks. Continuous monitoring and adaptation of the models are necessary to maintain their robustness and effectiveness over time. Additionally, responsible deployment and integration of such systems with human fact-checking efforts and content moderation policies are essential to mitigate potential biases and unintended consequences.

Looking ahead, future research directions could involve exploring advanced deep learning architectures, such as transformer-based models, for fake news detection, incorporating multimodal data sources (text, images, and videos), and investigating explainable AI techniques to enhance interpretability and trust in the system's predictions.

7.FUTURE SCOPE

The fake news detection project has laid a foundation for combating misinformation through the application of machine learning and natural language processing techniques. However, the ever-evolving nature of fake news generation strategies and the complexities involved in distinguishing between factual and fabricated information warrant further research and development. Several promising avenues for future work can be explored:

1. Multimodal Fake News Detection: While this project focused on textual data, fake news often propagates through multiple modalities, including images, videos, and audio. Developing multimodal fake news detection models that can jointly analyze and fuse information from various data sources could enhance the system's accuracy and robustness.

2. Deep Learning Architectures: Exploring advanced deep learning architectures, such as transformer-based models (e.g., BERT, GPT, XLNet), could potentially capture more complex patterns and relationships within the data, leading to improved fake news detection performance.

3. Adversarial Robustness: Fake news generators may employ adversarial techniques to evade detection by machine learning models. Developing robust models that can withstand adversarial attacks and maintain high performance in the presence of intentionally crafted examples is an important area of research.

4. Continuous Learning and Adaptation: Fake news tactics are constantly evolving, necessitating continuous learning and adaptation of the detection models. Integrating online learning algorithms, transfer learning techniques, or few-shot learning approaches could enable the system to adapt to new patterns and distributions of fake news as they emerge.

5. Human-in-the-Loop and Hybrid Systems: While automated fake news detection is crucial for scalability, incorporating human expertise and feedback could further enhance the system's performance. Exploring hybrid approaches that combine machine learning models with human fact-checkers or crowdsourcing mechanisms could lead to more robust and trustworthy solutions.

6. Cross-lingual and Crosscultural Fake News Detection:Expanding the scope of fake news detection systems to handle multiple languages and cultural contexts is essential for addressing the global nature of misinformation

9.REFERENCES

Datasets

- Kaggle Fake News Dataset: (https://www.kaggle.com/c/fakenews/data)

Research Papers

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- "Detecting Fake News for Effective News Management on Social Media" by Gupta, Aditi, et al. (2021): (https://ieeexplore.ieee.org/document/9423941)

- "Fake News Detection through Multiperspective Speaker Profiles" by Jin, Zeyu, et al. (2021): (https://dl.acm.org/doi/10.1145/3447548.3467433)

Tutorials and Guides

- Fake News Detection with Python: (https://towardsdatascience.com/fakenewsdetectionwithpython8c08c8ee79ed)

Fake News Detection Using Machine Learning (https://www.analyticsvidhya.com/blog/2021/09/fakenewsdetectionusingmachinelearning/)