Fake News Detection and Evaluation with Confusion Matrix

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1. Abstract

The project is on fake detection of news and its evaluation with a confusion matrix which explores how machine learning can be applied to the growing problem of misinformation in digital media . The primary objective is to classify news articles as either real or fake based by analyzing their textual content. This task is crucial because the spread of false information can significantly impact public opinion,political decisions, and social stability. For this purpose , the project uses a dataset containing both genuine and fake news articles. The project began with thorough data preprocessing which involved reading of CSV files,merging true and fake datasets and shuffling entries.Several machine learning algorithms were trained to detect fake news, and their performances were carefully evaluated. A confusion matrix was used to measure the accuracy of predictions. Therefore , the project presents a full pipeline from gathering and cleaning data to training and evaluating models which shows how machine learning can be an effective way to detect fake news.

2. Introduction

In today's digital world, the rapid spread of misinformation and fake news has become one of the biggest challenges of our time. To address this problem, my project " Fake News Detection and Evaluation with Confusion Matrix" uses machine learning techniques to automatically classify news articles as real or fake. This project is highly relevant because it shows how data science can be applied to real world issues. By studying patterns in language and writing style, we can identify key differences between genuine and fabricated news. Websites like Politifact are helpful for fact-checking but since they depend on manual work , they cannot keep up with fast misinformation spreads. That is why researchers have been turning to machine learning for automated solutions.

The list of topics that I received training on during the first two weeks of internship are Python basics (Data, Variables,Lists,Loop, Data Structures, Class, Functions, OOPS,Numphy, Pandas), Machine Learning introduction, Regression Lab ,Classification Lab, Llm fundamentals, Communication Skills.

3. Project Objective

The main objectives of the project are:

1. To build a machine learning model that can classify news articles as real or fake.

2. To study how text preprocessing and feature extraction (TF-IDF, Bag of Words) help in improving model performance.

3. To compare different supervised learning algorithms (Logistic Regression, Naïve Bayes, Decision Tree, Random Forest) for fake news detection.

4. To evaluate the performance of these models using accuracy, precision, recall, F1-score, and confusion matrix.

5. To understand the limitations of traditional machine learning in handling misinformation.

The project is trying to illustrate:

1. How machine learning can automate the task of distinguishing fake news from real news.

2. That evaluation metrics (confusion matrix, accuracy, recall, etc.) give deeper insight into model strengths and weaknesses.

4. Methodology

This project was carried out systematically to detect and evaluate fake news using machine learning techniques.

1. Data Collection:

The dataset used in this project contained two categories of news: real and fake.Real news articles were taken from Reuters, a trusted news agency.Fake news articles were collected from unreliable sources listed on Politifact and Wikipedia.

2. Data Cleaning and Preprocessing

The collected dataset was not ready for direct analysis. The following preprocessing steps were performed:

1. Loading the dataset into Python using pandas.

2. Merging datasets for real and fake news into a single file.

3. Removing null values and duplicate entries.

4. Shuffling records to avoid bias in training.

5. Resetting index for consistency.

6. Text cleaning:Removal of punctuation, numbers, and special symbols.Conversion of text to lowercase.

3. Feature Extraction

Since machine learning models cannot understand text directly, the cleaned text was converted into numerical form:

Bag-of-Words (BoW): Counts word frequency.

TF-IDF (Term Frequency – Inverse Document Frequency): Gives importance to unique words while reducing the weight of common ones.These transformed the text into a structured numerical dataset.

4. Model Development

Several machine learning models were tested:

Logistic Regression

Naïve Bayes

Decision Trees / Random Forests (if included in notebook)

Model Selection and Validation:

Models were chosen because they are widely used for text classification.

Confusion Matrix was used to visualize correct and incorrect predictions.

Performance metrics included Accuracy, Precision, Recall, and F1-Score.

5. Evaluation

Logistic Regression and Naïve Bayes performed best in terms of accuracy and efficiency.

6. Flowchart of Activities

Data Collection

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Data Cleaning & Preprocessing

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Feature Extraction (BoW, TF-IDF)

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Train-Test Split (80%-20%)

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Model Training (Logistic Regression, Naïve Bayes, etc.)

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Model Evaluation (Confusion Matrix, Accuracy, Precision, Recall, F1-Score)

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Findings & Conclusion

5. Data Analysis and Results

1.Imported CSV File

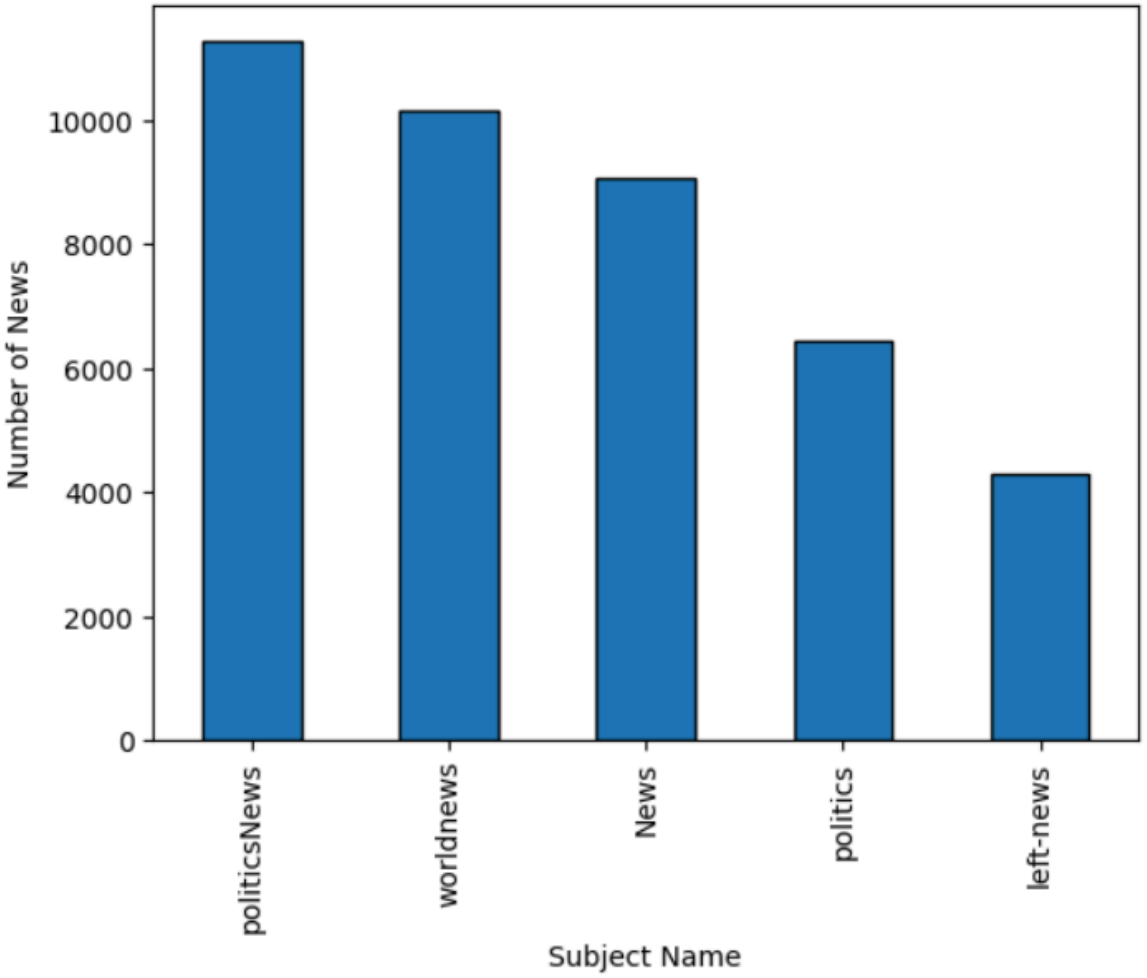
```
Fake News Data:

True News Data:
```

	title	text	subject	date
0	As U.S. budget fight looms, Republicans flip t...	WASHINGTON (Reuters) - The head of a conservat...	politicsNews	December 31, 2017
1	U.S. military to accept transgender recruits o...	WASHINGTON (Reuters) - Transgender people will...	politicsNews	December 29, 2017
2	Senior U.S. Republican senator: 'Let Mr. Muell...	WASHINGTON (Reuters) - The special counsel inv...	politicsNews	December 31, 2017
3	FBI Russia probe helped by Australian diplomat...	WASHINGTON (Reuters) - Trump campaign adviser ...	politicsNews	December 30, 2017
4	Trump wants Postal Service to charge 'much mor...	SEATTLE/WASHINGTON (Reuters) - President Donal...	politicsNews	December 29, 2017

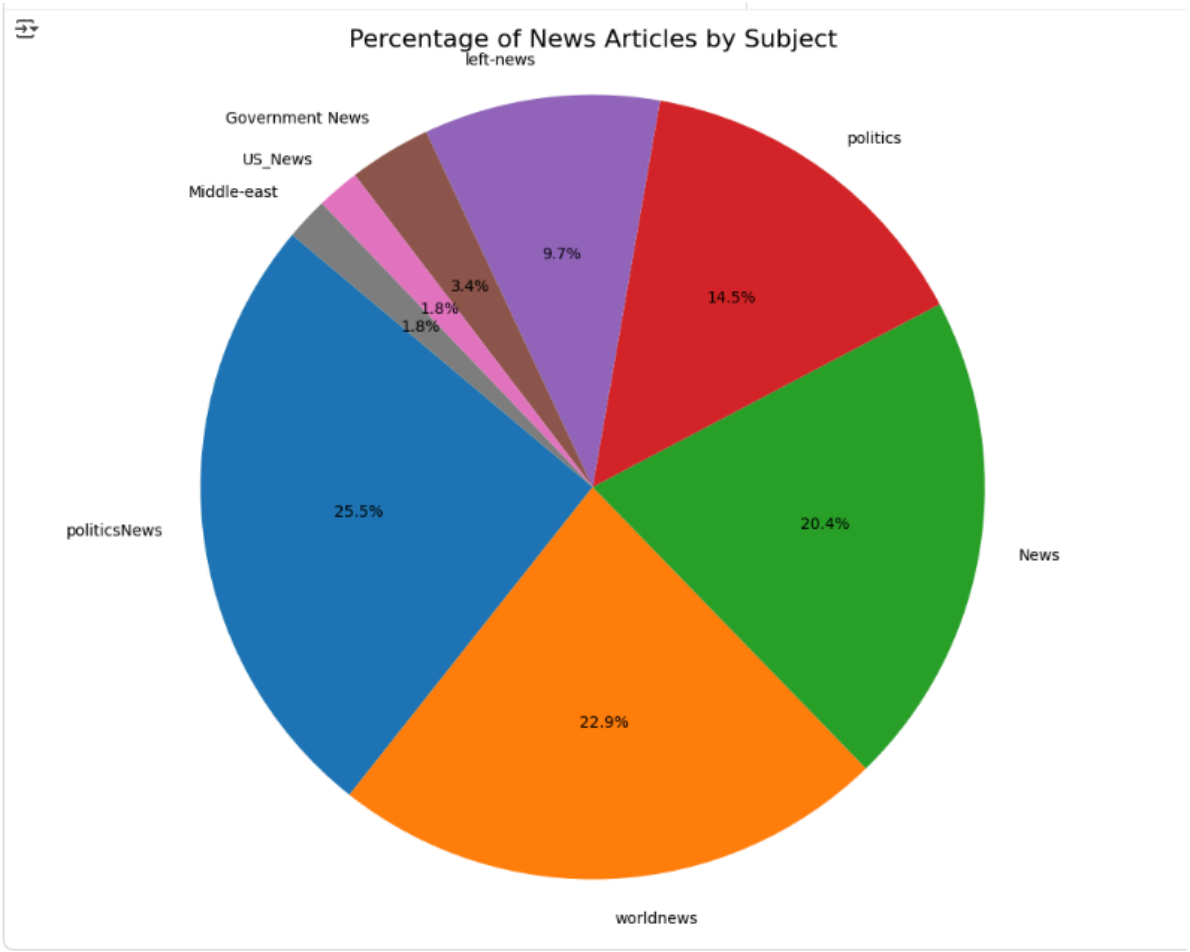
2.Shuffled Data

	title	text	subject	date	class
0	Protesters gather in Kiev after police recaptu...	KIEV (Reuters) - Ukrainian police recaptured t...	worldnews	December 8, 2017	0
1	Papuan separatists to petition U.N. against In...	GENEVA (Reuters) - The people of West Papua ar...	worldnews	September 6, 2017	0
2	Local Citizens To Bundy Terrorists: 'Get The H...	Harney County resident Jarvis Kennedy has a me...	News	January 7, 2016	1
3	Tunisian labor union says Jerusalem decision a...	TUNIS (Reuters) - Tunisia s powerful labor uni...	worldnews	December 6, 2017	0
4	Montana congressman-elect sentenced to communi...	BOZEMAN, Mont. (Reuters) - A Montana Republica...	politicsNews	June 12, 2017	0
5	Russia's RT America registers as 'foreign agen...	MOSCOW/WASHINGTON (Reuters) - The Kremlin-back...	worldnews	November 13, 2017	0
6	MUSLIMS SILENT AFTER TERROR ATTACKS…BUT BLAME ...	Whenever we have a terror attack in America, t...	politics	Aug 14, 2016	1
7	Turkey says hopes U.S. will lift decision on v...	ANKARA (Reuters) - Turkey hopes the United Sta...	worldnews	October 11, 2017	0
				September 20,	

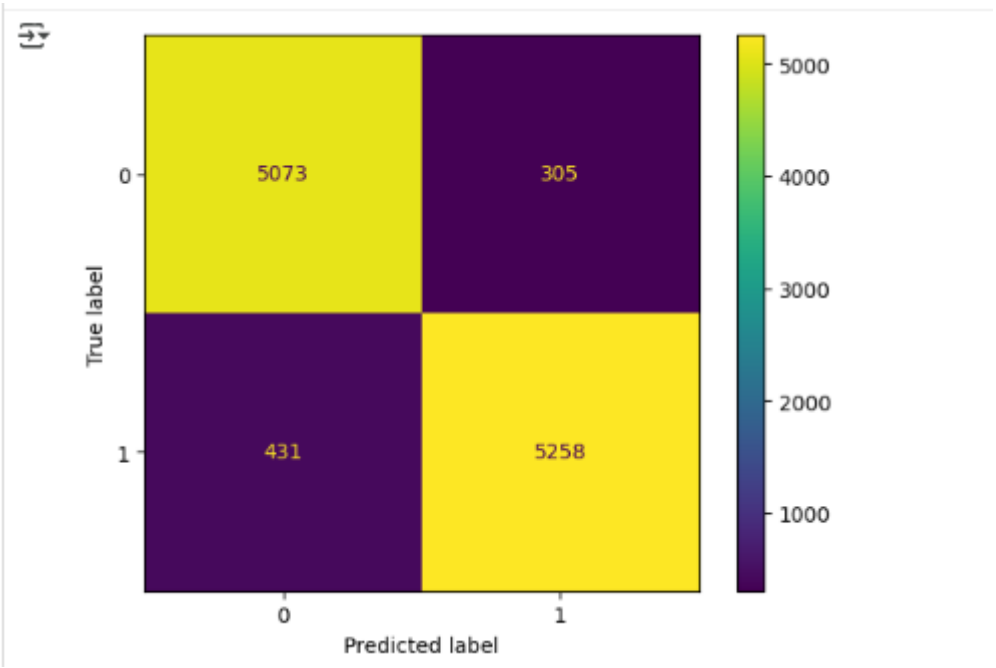
3.Data Visualization


Number of News
10000
8000
6000
4000
2000
0
politicsNews
worldnews
News
politics
left-news
Subject Name

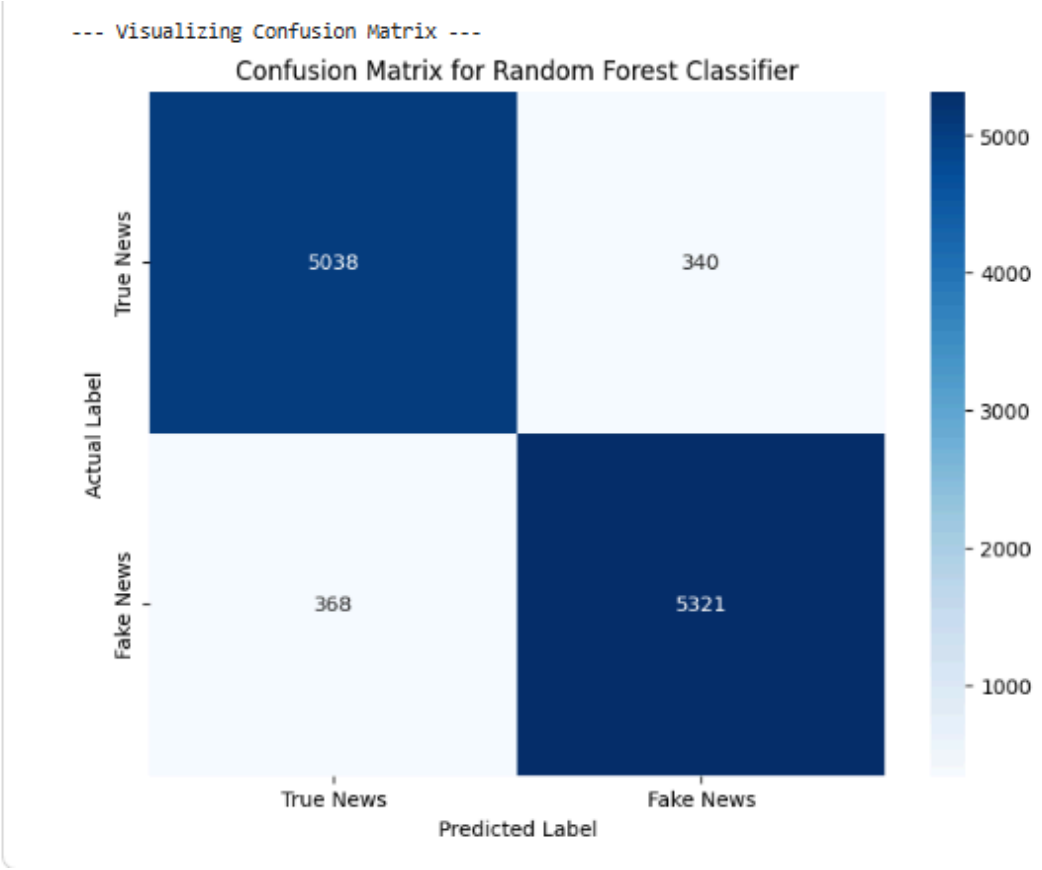
4. Piechart



5.Accuracy and Confusion Matrix



6. Confusion Matrix for Random Forest Classifier



6. Conclusion

After completing this project, we can conclude that machine learning methods are effective in detecting fake news. By using text preprocessing, feature extraction, and supervised learning models, the system was able to classify news articles into real and fake categories with good accuracy.

From the findings:

Logistic Regression and Naïve Bayes performed well in terms of accuracy and speed.

The confusion matrix showed that most articles were correctly classified.

Evaluation metrics such as precision, recall proved useful in understanding where the models performed strongly and where they struggled.

7. APPENDICES

1. This dataset was compiled from real-world sources; the genuine articles were scraped from Reuters.com (a reputable news website). In contrast, the fake news articles were gathered from various unreliable platforms identified by Politifact and Wikipedia.

2. Github link for the codes developed (if any):

https://github.com/shreyabhowmik/Fake-News-Detection2