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COLLEGE OF ELECTRICAL AND MECHANICAL ENGINEERING

DEPARTMENT OF SOFTWARE ENGINEERING

INTRODUCTION TO MACHINE LEARNING (SWEG 4112)

FAKE NEWS DETECTION

SECTION: E

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FAKE NEWS DETECTION USING MACHINE LEARNING

1. Introduction

The initiation of digital media has revolutionized the transmission of information, making it possible to access news and updates in an instant. However, this ease of communication has also paved the way for the quick spread of misinformation or so-called "fake news". Fake news can mislead readers, sway public opinion, and endanger democracy and public safety. Traditional techniques of manually confirming the legitimacy of news reports are no longer adequate due to the sheer volume and rapidity with which information is being generated and shared on the internet. Hence, the need for automated systems to detect and remove fake news has become increasingly urgent. In response to this challenge, this project provides a machine learning–based Fake News Detection System that categorizes news articles as real or fake using Natural Language Processing (NLP) and supervised learning algorithms. The system is developed based on a labeled dataset of news articles, subjected to extensive text preprocessing, and trains four different classifiers: Support Vector Machine, Decision Tree, Gradient Boosting, and Random Forest. The final forecast is then decided by a majority voting process, which ensures more reliability through ensemble learning. The solution is given by a simple Streamlit web interface where users can input news text and receive an immediate prediction, giving an efficient means of combating the distribution of misinformation. In addition to improving the effectiveness of fake news identification, the creation and implementation of such a system helps to ensure the integrity of public discourse and encourage the spread of trustworthy information.

1.1. Background

In recent years, the growth of social media and online news portals has altered the way individuals receive and transfer information. Despite these developments that have made it easier than ever before to receive news, these have also become a breeding ground for the rampant spread of misinformation and artificial news. High profile incidents such as a falsely claimed conspiracy theory claiming that a Washington DC pizzeria – Pizzagate – was a center of child trafficking ring linked to prominent politicians, including Hillary Clinton leading to a man entering the restaurant with a rifle to “self-investigate” or the misleading health information about virus’s origin, fake cures and vaccine safety circulating during the COVID-19 pandemic have unleashed the serious consequences of unchecked fake news. Thus, public opinion, institutional trustworthiness, and even public safety have begun to concern individuals, institutions, and governments alike due to the influence of misinformation. Unlike traditional news sources that undergo editorial review, online content can be published and circulated without verification, which accelerates the

proliferation of misinformation by leaps and bounds. Using the primitive methods to authenticate the online news is almost impossible as human verification won't be able to cope up with the overwhelming amount and rapidity of online content produced. This gap has prompted scholars and technology companies to explore automated solutions, with machine learning emerging as a promising approach. By analyzing large datasets of news articles and leveraging natural language processing techniques, machine learning models can be taught to identify subtle linguistic cues and patterns that distinguish false news from genuine reporting. Considering this, our project attempts to contribute a strong machine learning driven classifier that will support timely and effective false news detection, in turn strengthening initiatives to promote information integrity in the digital age.

1.2. Statement of the problem

The large-scale spread of false information through digital media sources risks destabilizing public safety and ability to make informed decisions. Primitive human-fact checking is inelastic and slow to keep up with the sheer volume of content shared. As a result, there's a desperate need for an automated system to identify and flag deceptive news to avoid the adverse of misinformation. Our projects aim to fulfill this need using NLP, machine learning techniques.

1.3. Objectives

1.3.1. General Objectives

This project aims to provide a machine learning system capable of classifying news content as real or fake.

1.3.2. Specific Objectives

- ✓ To preprocess and clean textual data.
- ✓ To use various machine learning algorithms to classify news.
- ✓ To evaluate the performance of each model and achieve higher accuracy.
- ✓ To build an interactive Streamlit application.

1.4. Scope

This project aims to develop a machine learning based system that classifies English news articles as real or fake using Natural Language Processing (NLP), four classification models and a Streamlit web app to accept inputs and deliver results. It solely focuses on textual news articles excluding multi-media content, real-time fact checking or multilingual support.

1.5. Significance of the study

This study contributes to addressing the broad societal, political and economic issues brought by the rapid distribution of fake news via digital platforms. By utilizing the concept of Natural Language Processing and machine learning algorithms, the project provides an automated, scalable and precise approach to detect fake news which promotes media literacy, enhance public awareness and support efforts to maintain the integrity of online information. Furthermore, the study offers a foundation for future research and the development of more advanced misinformation detection tools.

2. Related Works

Several researchers have explored fake news detection using NLP and ML algorithms. For instance, the work by S. Aphiwongsophon and P. Chongstitvatana (2018), “Detecting Fake News with Machine Learning Method”, used three popular methods in the experiments: Navie Bayes, Neural Network and Support Vector Machine. The initial technique resulted in a 96.08% accuracy whereas the latter two showed 99.90% accuracy. A core point stated is that the normalization method is an essential step in cleaning the dataset being used. The Fake News Challenge has also elevated the provision of labeled datasets and how to use various machine learning and natural language processing that might be leveraged to combat the fake news problem.

3. Methodology

- ✓ **Data Collection**: Used Kaggle datasets 'Fake.csv' and 'True.csv'.
- ✓ **Data Preprocessing**: Removal of punctuation, numbers, special characters, and stop words; text normalization.
- ✓ **Feature Extraction**: TF-IDF vectorization.
- ✓ **Model Training**: Support Vector Machine, Decision Tree, Gradient Boosting, and Random Forest.
- ✓ **Evaluation**: Used accuracy and classification reports to evaluate performance.
- ✓ **Interface**: Developed a user-friendly Streamlit application.

3.1. Experimental Datasets

- ✓ Source: Kaggle (https://www.kaggle.com/datasets/clmentbisaillon/fake-and-real-news-dataset).
- ✓ Size: 44, 919 articles (23502 are fake news articles and 21417 are real news articles).
- ✓ Format: CSV files with columns of title, text, subject and date.

3.2. Tools

- ✓ Programming Language: Python
- ✓ Libraries: pandas, scikit-learn, re, string, joblib, streamlit, collections.Counter
- ✓ Interface: Steamlit web application

3.3. Techniques

- ✓ Text Processing (NLP) using regular expressions: to reduce noise and variability within the text to make suitable for vectorization and model training.
- ✓ Feature Extraction using TF-IDF (Term Frequency - Inverse Document Frequency): convert raw text to numerical vectors which are suitable for machine learning models.
- ✓ Machine Learning Models: Support Vector Machine, Decision Tree, Gradient Boosting, Random Forest.

The machine learning models used are all supervised learning models because the dataset used to train and test the model is a labeled one. In addition, we will be performing a binary classification of textual data as fake (0) and real (1) and learning from historical examples to find patterns – area in which supervised learning models excel.

Despite having various supervised learning classifiers, for fake news classifier project the above four were selected because:

Model	Why it's used
Support Vector Machine	Effective for high-dimensional text data to capture complex relationships.
Decision Tree	Easy to interpret and good for seeing how features split decisions.
Gradient Boosting	More accurate than Random Forest in many cases, particularly when fine-tuned.
Random Forest	Reduces overfitting of Decision Trees, handles noisy data well, and works well with tabular/text data.

✓ Majority voting for ensemble-like decisions

4. Results and Analysis

4.1. Experimental Results

Each model was tested using 80/20 train-test split. The performance of each trained model was evaluated using classification metrics and confusion matrix:

Support Vector Mechanism

Confusion Matrix:

[[4539 34]

[20 4383]]

Classification Report:

Class	Precision	Recall	F1-Score	Support
Fake (0)	0.9956	0.9926	0.9941	4573
Real (1)	0.9923	0.9955	0.9939	4403
Accuracy			0.9940	8976
Macro Avg	0.9940	0.9940	0.9940	8976
Weighted Avg	0.9940	0.9940	0.9940	8976

Decision Tree

Confusion Matrix:

[[4557 16]

[14 4389]]

Classification Report:

Class	Precision	Recall	F1-Score	Support
Fake (0)	0.9969	0.9965	0.9967	4573
Real (1)	0.9964	0.9968	0.9966	4403
Accuracy			1.00	8976
Macro Avg	0.9966	0.9966	0.9966	8976
Weighted Avg	0.9967	0.9967	0.9967	8976

Gradient Boosting

Confusion Matrix:

[[4542 31]

[9 4394]]

Classification Report:

Class	Precision	Recall	F1-Score	Support
Fake (0)	0.9980	0.9932	0.9956	4573
Real (1)	0.9930	0.9979	0.9954	4403
Accuracy			0.9955	8976
Macro Avg	0.9955	0.9956	0.9955	8976
Weighted Avg	0.9955	0.9955	0.9955	8976

Random Forest

Confusion Matrix:

[[4526 47]

[47 4356]]

Classification Report:

Class	Precision	Recall	F1-Score	Support
Fake (0)	0.9897	0.9897	0.9897	4573
Real (1)	0.9893	0.9893	0.9893	4403
Accuracy			0.9895	8976
Macro Avg	0.9895	0.9895	0.9895	8976
Weighted Avg	0.9895	0.9895	0.9895	8976

4.2. Analysis of the Results

The experimental results reveal strong overall performance across all four classification models tested on the fake news detection task using an 80/20 train-test split. The Decision Tree classifier achieved the highest overall accuracy at 99.67%, with nearly perfect precision, recall, and F1-score for both classes, indicating excellent ability to distinguish between fake and real news. The Gradient Boosting model closely followed with 99.55% accuracy, showing slightly better performance in recall for real news (0.9979) compared to fake news (0.9932), suggesting it was particularly effective at identifying legitimate news articles. The Support Vector Machine (SVM) also performed robustly, with 99.40% accuracy

and balanced precision and recall across both classes, showing consistent classification strength. The Random Forest model had the lowest performance among the four, with 98.95% accuracy. Although still high, it showed equal levels of misclassification for both fake and real news (47 instances each), indicating a slightly reduced sensitivity and specificity compared to the others.

To enhance robustness and reliability in real-time predictions, the system uses a majority voting approach during inference. This technique aggregates the predictions of all four models—SVM, Decision Tree, Gradient Boosting, and Random Forest—and selects the final class based on the most frequent (majority) prediction. This ensemble strategy helps reduce the likelihood of incorrect predictions made by any single model, leveraging the strengths of each classifier while mitigating individual weaknesses. For example, even if the Random Forest misclassifies a news article, the more accurate predictions from Decision Tree or Gradient Boosting may still lead the ensemble to a correct final classification. Majority voting, therefore, improves generalization and stability, especially when dealing with varied and noisy text data in fake news detection.

5. Conclusion and Future Works

This project successfully developed a machine learning-based Fake News Detection System using Natural Language Processing (NLP) and supervised learning algorithms. The system classifies news articles as real or fake by applying four models: Support Vector Machine, Decision Tree, Gradient Boosting, and Random Forest. Using majority voting as an ensemble technique, the system enhanced prediction reliability. The model was trained on a labeled dataset, and a user-friendly Streamlit interface was built for easy interaction, providing quick predictions on news authenticity.

While the system shows promising results in detecting fake news, there are several areas for future improvement. Expanding the system to support multiple languages and integrating real-time fact-checking could enhance its global applicability. Additionally, exploring deep learning techniques and incorporating more features like sentiment analysis and source credibility could improve accuracy. Integrating the system with social media platforms for real-time detection of fake news is another valuable avenue. Finally, ethical considerations, such as bias and privacy concerns, should be explored to ensure responsible use of technology. These advancements could strengthen the fight against misinformation and ensure the integrity of public discourse.

References

B. Trending, “The saga of ‘Pizzagate’: The fake story that shows how conspiracy theories spread,” *BBC News*, Dec. 02, 2016. https://www.bbc.com/news/blogs-trending-38156985

“fake-and-real-news-dataset,” *Kaggle*, Apr. 19, 2024. https://www.kaggle.com/datasets/clmentbisaillon/fake-and-real-news-dataset

Louisiana State University (LSU), “COVID-19.” https://faculty.lsu.edu/fakenews/protect_yourself/covid-19.php

S. Aphiwongsophon and P. Chongstitvatana, "Detecting Fake News with Machine Learning Method," 2018 15th International Conference on Electrical Engineering/Electronics, Computer, Telecommunications and Information Technology (ECTI-CON), Chiang Rai, Thailand, 2018, pp. 528-531, doi: 10.1109/ECTICon.2018.8620051. keywords: {Conferences;Telecommunications;Information technology;fake news;social network;Naïve Bayes;Neural network;Support Vector Machine},