A COMPARATIVE ANALYSIS OF MACHINE LEARNING TECHNIQUES FOR FAKE NEWS DETECTION

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ABSTRACT
The increasing problem of disinformation in the digital age is addressed by this study, which investigates the effectiveness of many machine learning algorithms for the identification of fake news. The effectiveness of various algorithms have been compared for identifying false and true news stories using a wide range of models, such as Logistic Regression, Decision Tree, Support Vector Machines, Naïve Bayes Classifier and Random Forests. Using features extracted from news articles, the algorithms are trained on a large dataset that includes both accurate and inaccurate information. Models seek to determine the most reliable model for efficient fake news identification by methodically assessing each algorithm's precision, recall, f1-score and accuracy. This work advances the capacity to identify and counteract fake news using cutting-edge machine learning approaches, which contributes to the ongoing attempts to create sophisticated tools that can lessen the negative effects of disinformation on society.

Key Words: fake news detection, logistic regression, decision tree, random forest, support vector machine

I. INTRODUCTION

As false information becomes more common in the digital sphere, identifying fake news has emerged as a crucial field for research and development. The swift distribution of information via digital channels has made it increasingly difficult to distinguish between authentic and fake news. A variety of methods are used in the field of false news identification, such as source credibility assessments, machine learning algorithms, and natural language processing. Researchers and practitioners analyze language patterns, source reliability, social network dynamics, and other pertinent aspects in an effort to develop strong algorithms that can automatically identify fraudulent information. The ultimate objective is to equip news organizations, social media platforms, and consumers with powerful tools to stop the spread false information and preserve the accuracy of information in the digital age. Numerous strategies have been used to address the widespread problem of identifying fake news. Using natural language processing (NLP) techniques to examine the linguistic elements of news items is one such tactic. This method concentrates on spotting irregularities or trends that differ from typical language usage and may be signs of false information. Using machine learning algorithms to identify news stories based on attributes taken from the content and metadata such as Logistic Regression, Decision Tree, Random Forests, and Support Vector Machines is another important approach. Another method is source credibility analysis, which involves assessing the standing and dependability of news organizations or websites. Social network analysis is also used to track information distribution trends and identify anomalous propagation that may be a sign of false news. Additionally, some techniques use fact-checking tools to cross-reference information with reliable databases and sources. These various methods highlight how multifaceted the problem of fake news detection is, indicating the need for an all-encompassing, multidisciplinary approach to effectively combat misinformation in the digital age.

II. OBJECTIVES

This study assesses the capability of machine learning algorithms in the detection of fake news, including SVM, Random Forests, Decision Trees, Naïve Bayes Classifier and Logistic Regression. It looks at how well they can handle language patterns and social network dynamics when dealing with bogus news. The impact of feature engineering and representation strategies on algorithmic performance is also investigated in this work. It evaluates the interpretability and computational efficiency of various models, looks at how well they generalize across a range of datasets, and points out the advantages and disadvantages of each in terms of scalability, precision, recall, and accuracy. In order to improve fake news identification, it also looks into hybrid approaches and ensemble algorithms. The intention is to aid in the creation of efficient methods for identifying false news.

III. RELATED WORKS

Author [1] provides a method that users can use to identify and exclude websites that provide inaccurate and misleading information. The title and post's carefully chosen, basic attributes are utilized to reliably detect fraudulent posts. According to the experimental results, the logistic classifier has a 99.4% accuracy rate.
Author [2] provides a straightforward method for identifying false news using the Naive Bayes classifier. This method was put into practice as a software system and evaluated using a set of Facebook news post data. Given the model's relative simplicity, the model's classification accuracy of roughly 74% on the test set is a respectable result.
Author [3] predicts whether a Facebook post will be classified as FAKE or REAL using the Naive Bayes classification model. Using a few of the methods covered in the paper should help the outcomes. The results obtained indicate that machine learning techniques can be used to address the issue of fake news identification.
Author [4] creates a technique for automating the detection of fake news on Twitter by learning to predict accuracy assessments in two credibility-focused Twitter datasets: PHEME, a dataset of potential rumors on Twitter and journalistic assessments of their veracity, and CREDBANK, a crowdsourced dataset of accuracy assessments for events on Twitter. This approach is used to Twitter material obtained from BuzzFeed's fake news dataset, demonstrating that models trained on crowdsourced laborers outperform models derived from the evaluation of journalists and models trained on a combined dataset comprising journalists and crowdsourced laborers.
Author [5] offers a typology of many truth evaluation techniques that fall into two main categories: network analysis techniques and linguistic cue techniques (which incorporate machine learning). The Author investigates the use of network-based behavioral data and an inventive hybrid approach that blends language cue and machine learning. Despite the fact that creating a fake news detector is a challenging task, it offers practical instructions for a workable system.
Author [6] suggests a mechanism for detecting fake news that makes use of machine learning and n-gram analysis. It examines and contrasts six distinct machine classification methods as well as two distinct feature extraction methods. With an accuracy of 92%, the most successful experimental assessment makes use of Term Frequency-Inverse Document Frequency (TF-IDF) as a feature extraction strategy and Linear Support Vector Machine (LSVM) as a classifier.
By categorizing news dissemination channels, author [7] offers a unique methodology for the early detection of bogus news on social media. In the first, each news story's propagation path is modeled as a multivariate time series, with each tuple denoting a numerical vector that describes a user's attributes who participated in distributing the news. Then, to identify bogus news, create a time series classifier that combines both recurrent and convolutional networks, which respectively, capture the global and local modifications of user characteristics along the propagation path. The model can detect bogus news with accuracy of 85% and 92% on Sina Weibo and Twitter, respectively, according to experimental results on three real-world datasets. This is much faster than the state-of-the-art baselines.

IV. METHODOLOGY

Fake news detection can be represented as a supervised classification problem where the text content of the news can be considered as an independent variable and the label of the news can be considered as a dependent variable. Since the classes are only 0 (real) and 1(fake) so this is a binary classification problem. In this paper several baseline classifiers have been used to predict whether a news is real or fake. For experiment ISOT [8-9] dataset has been used for training and testing of the model. The dataset contains 21,417 real and 23,481 fake news in two separate csv files. Every news item contains Title, Text, subject and Date columns as shown in Figure 1.

The proposed system has following steps-
Step 1: Import both the csv file into two separate data frame and assign the label 0 for real news and 1 for fake news.
Step 2: Merge both the data frames into a single data frame.
Step 3: Merge the Title, Text and subject columns and drop the column Date published.
Step 4: Apply different text preprocessing techniques on the merge column.
Step 5: TF-IDF vectorization is used for feature extraction from text data.
Step 6: Split the data into training and testing in the ratio of 80:20.
Step 7: Apply different machine learning classifiers on the data.
Step 8: Compare the efficiency of different classifiers.

	title	text	subject	date	label
3478	Fearing Trump's next move, liberals urge Supre...	WASHINGTON (Reuters) - Liberal activists are u...	politicsNews	June 1, 2017	0
3940	The Hilariously Amazing Video Weâ™ve Been Wa...	We are now in the finally days leading up to t...	News	November 4, 2016	1
17586	SHOCKING VERDICT: Kate Steinle Murdered By Ill...	A shocking verdict and race baiting was on the...	left-news	Nov 30, 2017	1
10349	Energy market affected decision on Atlantic dr...	WASHINGTON (Reuters) - Energy market dynamics ...	politicsNews	March 15, 2016	0
181	Trump Just Closed The Office That Coordinates...	With Donald Trump late on implementing the new...	News	October 27, 2017	1

Figure 1. sample of ISOT dataset

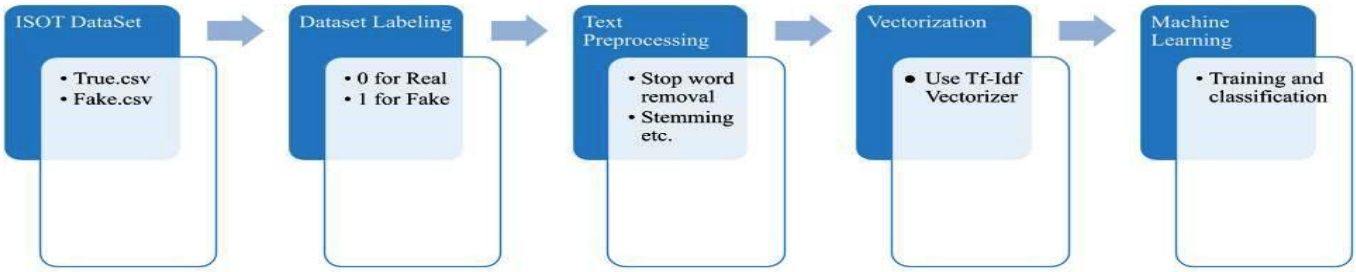

Figure 2. overall flow of the study

	text	label
3687	ryan says to send health bill to senate after ...	0
7348	bernie sanders gave excellent speech on israe...	1
3258	trump officials to unveil plan to cut factory ...	0
17429	iraq says iran has shut border with kurdistanb...	0
7532	factbox where the bookies and trading exchang...	0
14804	communist filmmaker michael moore recruits lef...	1
7386	trump u s congress will agree on some issues...	0
1681	new york governor wants credit reporting firms...	0
13248	muslims silent after terror attacksâ but blam...	1
3943	newsweek outs trump as putinâ s puppet and o...	1

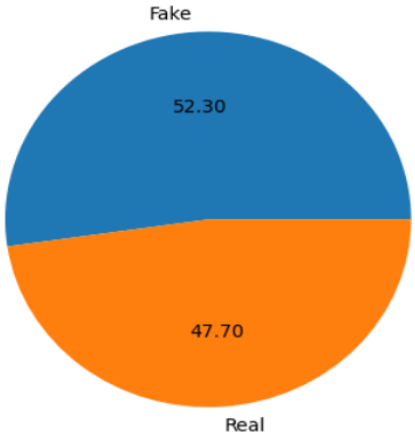

Figure 3. data frame after preprocessing

The overall architecture of the work has been shown in Figure 2. Dataset has been imported as a data frame and assigned the label 0 for real and 1 for fake news. The process of categorizing news articles into real and fake categories entails importing two CSV files into separate data frames, labeling the actual and fake news, integrating the "Title," "Text," and "Subject" columns into a single dataset, and giving labels to each. To improve the quality of the data, text preparation techniques including lowercasing, tokenization, and stemming or lemmatization are used. To extract features from the dataset based on frequency and rarity, TF-IDF vectorization is applied. For efficient model evaluation, the dataset is divided into training and testing sets by the ratio of 80:20. The training data is subjected to a variety of machine learning classifiers, including algorithms such as Decision Trees and Support Vector Machines. The effectiveness of the various classifiers is thoroughly compared, offering insights into their advantages and disadvantages. This methodical methodology provides a thorough grasp of how well various machine learning techniques differentiate between authentic and fraudulent news stories. In natural language processing (NLP) pipelines, text data pre-processing is an essential step that converts unprocessed text into a format appropriate for analysis or machine learning applications. Tokenization, handling contractions, deleting HTML elements and URLs, removing stop words, punctuation, and special characters, handling text conversion to lowercase, and removing numerical values are some of the stages involved. Typos can also be fixed by using spell check and repair. Pre-processing text data generally improves the quality of the data for tasks that come after, such as information retrieval, sentiment analysis, and classification. After that different preprocessing techniques have been applied to the text content of the news shown in Figure 3. TF-IDF (Term Frequency- Inverse Document Frequency) vectorizer is used for feature extraction from text for classification tasks. In natural language processing, TF-IDF vectorization is a potent method for transforming textual data into a numerical format. This approach provides a numerical representation that reflects the significance of terms on both a local and global scale by quantifying the importance of words in a document in relation to the total dataset. By examining how often a phrase appears in a given document (TF) and inversely how common it is across the entire dataset (IDF), TF-IDF assigns higher weights to terms that are indicative of the document's content. This method makes it possible to analyze huge text corpora effectively and meaningfully. After that different machine learning techniques have been applied to the dataset and efficiency of different approaches has been compared in Table 1. Figure 4 and Figure 5 illustrate the performances of various algorithms.

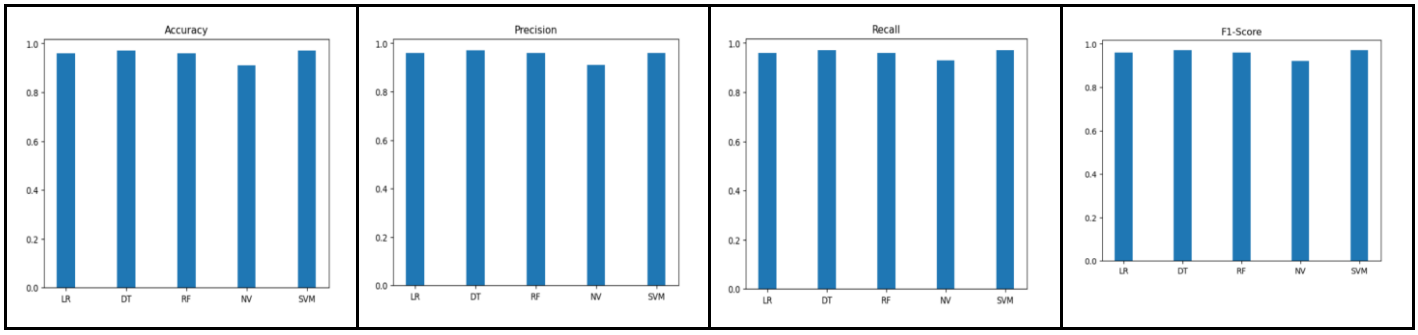

Figure 4. graph of accuracy, precision, recall, f1-score of different algorithm

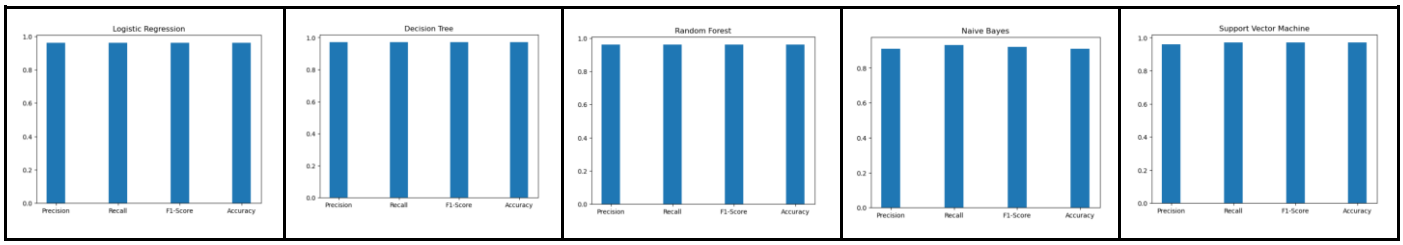

Figure 5. graph of accuracy, precision, recall, f1-score of different algorithm

Table 1. comparative study of different techniques

Algorithm	Class	Precision	Recall	F1 Score	Accuracy
Logistic Regression	0	0.96	0.96	0.96	0.96
	1	0.96	0.96	0.96	
Decision Tree	0	**0.97**	**0.97**	**0.97**	**0.97**
	1	**0.97**	**0.97**	**0.97**	
Random Forest	0	0.96	0.96	0.96	0.96
	1	0.96	0.96	0.96	
Naive Bayes	0	0.92	0.90	0.91	0.91
	1	0.91	0.93	0.92	
Support Vector Machine	0	**0.97**	**0.96**	**0.96**	**0.97**
	1	**0.96**	**0.97**	**0.97**	

VI. CONCLUSION

Our findings show that Support Vector Machines (SVM) and Decision Trees perform better than other models in terms of accuracy and performance measures, following an extensive study of several machine learning models for fake news identification. The Support Vector Machine (SVM) exhibits efficacy in capturing complex patterns linked to authentic and fraudulent news by identifying optimal hyperplanes in high-dimensional feature spaces. Decision Trees also exhibit exceptional interpretability and adaptability when managing non-linear relationships in the data. These advantages make SVM and Decision Trees attractive options for reliable and accurate fake news identification systems. It is important to remember that the performance of these models can differ based on the particular dataset, and more investigation into user credibility is advised.

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