

# Fake News Detection

\*Note: After algorithm analysis, the model has been implemented on a proper front-end.

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**Abstract**—Now-a-days it's exceedingly common in this digital world that someone for his or her benefit try to manipulate a mass with false information. With the massive use of social media by the population which is beneficial for the users most of the time, can also be used as a really good platform to spread a fake news and at worse try to create chaos in society. Fake death news of celebrities, fake news regarding wars and fake news related to politics are the day-to-day life examples. Bad impact on society is one of the results of fake news. Hence, for the reasons of safety and avoiding above consequences, "Fake News Detection" has been one of the top emerging research topics to enhance the quality of social media. So, in this research paper, our main aim is to search for the perfect model and algorithm to implement detection of fake news. We have taken various successful machine learning models and implemented them on multiple datasets. We will also review about some of the problems faced and related research areas.

**Index Terms**—Fake news Detection

1. Machine Learning
2. Data set
3. Methodology
4. Algorithm
5. Front end Interactive platform
6. Confusion Matrix
7. Multinomial Naive Bayes

## I. INTRODUCTION

In 2016, an extremely well-known Australian dictionary named "Macquarie Dictionary" released a statement stating that "Fake News" has been named as word of the year. This happened because in 2016 United States Presidential Elections, a fake theory named "Pizzagate Conspiracy" went viral and after the elections were over it is estimated that above 1 million tweets were related to the topic. Similar theory was generated in 2020 named "QAnon". In past, there has been many consequences world has faced due to widespread of fake news. In last decade, due to "Indian

Digital Civilization", India has been a hub of fake news. For example, aftermath of 2016 Indian Banknote demonetization, there were many false reports about having a "chip" inside the newly printed 2000 rupees bills. Another prominent example recently occurred in 2020 after the outbreak of COVID-19 Pandemic, there were lot of false information on social media regarding cure of novel corona virus using home remedies. [1]

According to a study, it has been observed the more than 75 percent of people following a fake news consider it as somewhat or very accurate. In the same study it is also observed that approximately 80 percent of the high school students can't differentiate between a real and fake news. For the purpose to meet our objective of proliferation of fake news, we have different ideas for implementing after the creation of model. Some of the ideas are checking the structure of URL and ranging up to checking the credibility of the author.

Various countermeasures have been made in past by every social media platform like Facebook partnering with fact-checking websites like BOOM and Webqoof and WhatsApp limiting the number of users a person can forward a message. Still, in August 2020, Hash tag StopHateForProfit movement was launched against hate speeches and misinformation on Facebook which was supported worldwide and over 1000 companies joined the boycott movement. Google has even banned over 200 publishers in support of providing better news and information to public. [2]

The summarized objective of the paper is:

1. Creating and importing data set of the most important topics revolving currently around the globe as fake news are generally related to important news so that it can be circulated widely.
2. Selecting multiple algorithms to compare the accuracy

result on a common data set. Selection of algorithms will mainly contain some of the algorithms which had been used for a long while and some which has been developed in recent times.

3. After building the model and comparing the accuracy, we can select a particular model which gives the best result to continue the implementation on the front-end part.

4. Building a user friendly interface for predicting the model.

## II. DATA SET

### A. Data set Examples

USA elections have been majorly influenced by fake news in past so the main dataset will be the news revolving around politics in US as we can get enough number of news for our machine learning algorithms to detect and analyse. [3] [4]

Let's have a look on some of the examples:

**TITLE:** "Drunk Bragging Trump Staffer Started Russian Collusion Investigation"

**CONTEXT:** Presidential elections

**TEXT:** "House Intelligence Committee Chairman Devin Nunes is going to have a bad day. He s been under the assumption, like many of us, that the Christopher Steele-dossier was what prompted the Russia investigation so he is been lashing out at the Department of Justice and the FBI in order to protect Trump."

**TITLE:** "DISNEY Introduces New Marvel Comic Books: Captain America (Captain Socialist) Beats Up Conservative Terrorists Defending U.S. Borders And More [VIDEO]"

**CONTEXT:** Comic Satire [5]

**TEXT:** "Indoctrination by Disney pretty much covers every demographic: toddlers with sipping cups watching the Disney channel and Disney movies, teens reading Marvel comic books, young women watching an abortion being performed on ABC s Scandal while Silent Night plays in the background, and full-grown men kicking back with a beer watching sports on ESPN."

**TITLE:** "ILLEGAL ALIEN Who Helps Illegals Stay in U.S. ARRESTED for Drunk Driving and Why the Left May Not Be Able to Stop Her Deportation [VIDEO]"

**CONTEXT:** Rule Violation

**TEXT:** "The Office of Immigration Statistics reported that of the 188,382 deportations of illegal aliens in 2011, 23 percent had committed criminal traffic offenses (primarily driving under the influence). Congressman Steve King (R-IA) estimates that illegal alien drunk drivers kill 13 Americans every day that is a death toll of 4,745 per year."

**TITLE:** "GOOGLE Apologizes After Changing Name of Trump Tower and Trump Hotel on Google Maps"

**CONTEXT:** Maps misinformation

**TEXT:** "Google Maps was alerted to a mysterious change in name on Trump Tower and the Trump Hotel by users and immediately changed the names back. Some small-minded vindictive person changed the name to Dump Tower"

### B. Data set Statistics

- Fake news data – 23481
- True news data – 21417
- Total data set – 44898

PolitiFact and LIAR are two most famous datasets available for assessing the genuinity of a news. But there are many countless researches done on just these two sets and so we decided that we will be implementing our model on other dataset present and add some of our own dataset to build a variety. This also helps to make our model more efficient. [6] [7]

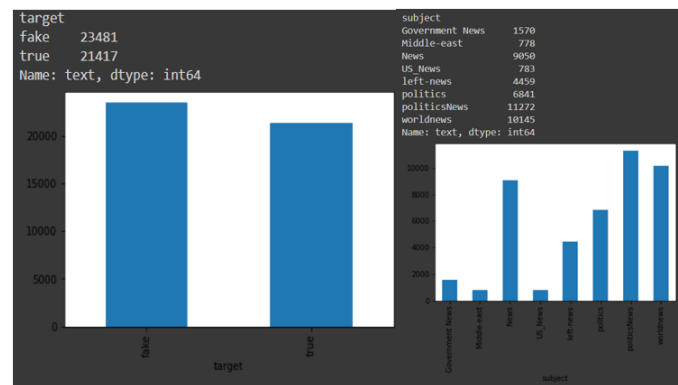


Figure 1. Dataset information

## III. METHODOLOGY

In this section, we will discuss the implementation in depth.

### A. Categorization

- In every aspect of analysis, the first and very important thing is to have the data categorize in pieces for better and easier analysis.
- 80 percentage of the above dataset is prepared and divided for training purpose and rest for testing and validation.

### B. Source

- In late 1440s, with the invention of printing press, historically named as, The Gutenberg press, also emerged as an invention process of Fake news.
- False information has been a serious to misdirect people mainly politically and many other aspects. There has been example of that in all of civilization history. One of the famous examples we can associate is of Adolf Hitler and how he kept the world misdirected for many years. Dictators in past used Fake news as one of their greatest tools to gain power.

### C. Definition

Sometimes fake news is misunderstood as an information biased to a particular entity. But that is not the case that all biased news is fake.

Fake news can be defined as a piece of information that is intentionally or verifiably false.

#### D. Problem Statement

Consider you heard “American President – Donald Trump infected of COVID-19”, one might think it is possible and even consider sometimes fake if the sources are not reliable. But we all know that, this information as of 7th October is true since many of the reliable American sources have confirmed that. But now what if you heard now that “American President - Donald Trump died due to COVID-19”, now you might think it as correct and lose some money in share market. So, now it comes to your mind, is it a “fact or a fake”? So, in this paper we are trying to build a platform which can give you the answer you are looking for.

#### E. Machine Learning

**With the introduction of AI and ML in previous two decades, every area of data science is now progressing with speed. [8] [9]**

**In case to provide correct news and avoid misinformation, the progress done is very low.**

- Even though, there are some algorithm tested as to find the solution in past has given good results, but implementing on a mass live data set will still be difficult in future and hence we need a model where different model are combined and with previous results detected a particular model should be assigned to a particular topic.

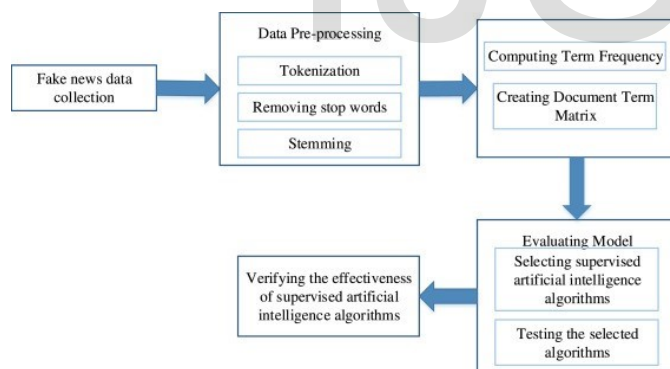


Figure 2. Machine learning methodology flowchart

#### IV. ALGORITHMS

Now let's discuss about the algorithms used here:

- **Logistic Regression**
- **Decision Tree**
- **Random Forest**
- **AdaBoost Classifier**
- **XG Boost Classifier**
- **Multinomial Naive Bayes**

#### A. Logistic Regression

[10]

- This Machine learning model algorithm is basically the most common and is being used from long time since the very first need for differentiating a genuine document to spam. It's application ranges on a wide scale as it is used in our e-mails to detect spam mails by using its keyword-based methods.
- Logistic Regression advantages are, it can be implemented on problems with large and uniform set of features (or number of users). Along with that, Logistic regression possess non-interference property i.e. that restricts the information flow through a system.
- It has been noticed that by using this model for detecting fake news or spam results we will be able to have accuracy above 90 percentage.
- In linear regression, for observation purpose we analyse the values of a function called sigmoid.

$$\text{Sigmoid}(x) = \frac{1}{1 + e^{-x}} \quad (1)$$

#### B. Decision Tree Classifier

[11]

- Decision tree algorithm is easy to comprehend and visualize. One of the features of this algorithm is they are non-parametric i.e. they don't assume (or require) any data to follow a particular distribution and also can handle mixed data types.
- Decision trees advantages are they require little data pre-processing and can handle both categorical and numerical data. The only problem in the model is that it sometimes creates biased learned trees if a single class in database dominates.
- We expect to have good accuracy from this particular algorithm as the database is more eccentric to a particular topic and the data set for different topics is small.

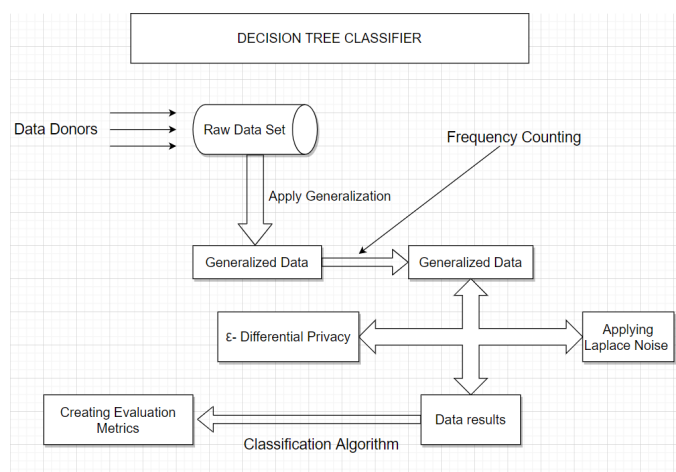


Figure 3. Decision Tree data flow diagram

### C. Random Forest Classifier

[12]

- Random forest classifier algorithm is based on the concept of ensemble learning. It eventually combines many classifiers and solve the subsequent problem to improve the functioning of the model.
- In this algorithm, various subsets of the dataset are formed and then forms multiple decision trees. Further, an average of all is considered to improve the prediction accuracy of the dataset.
- It is really good algorithm to implement when the dataset has different branches (or different topics in our case). Predicting on multiple datasets will be good by this algorithm.

### D. AdaBoost Classifier

[13]

- AdaBoost, short for, Adaptive Boost classifier is basically a combination of many other algorithms. In this algorithm, basically, outputs of other learning algorithms are combined into a weighted sum, which boosts the final output of the model.
- There only disadvantages are they are not efficient to noisy data i.e. data which is meaningless as the output is formed after passing combination of learning algorithms and once an algorithm finds meaning of noisy data, then it affects the whole output.
- Efficient output will only be there when dataset is small, is the only disadvantage.

### E. XG Boost Classifier

[14]

- XG Boost classifier is one of recently developed algorithm in data science. It is a fully “optimized distributed gradient boosting library”. This machine learning algorithm uses “Gradient boosting framework”.
- We have selected this algorithm to compare the output on all classic machine learning algorithm used so far with a newly developed algorithm.
- It evolved basically from decision trees and random forest to make a new classifier.

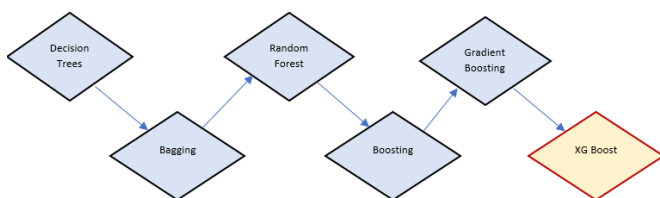


Figure 4. XG Boost Classifier evolution chart

### F. Multinomial Naive Bayes

[15]

- Specialized in classification of text and numeric data, Multinomial Naive Bayes can be considered perfect for the paper objective, since almost all the news consist mainly of text and numbers. [3]
- Here in working of this algorithm, it generally analyse the presence and absence of some particular key words to make the model efficient.
- Tokenization , stemming and lemmatization of the data set texts improves the accuracy of the build model. It explicitly models the word count present in the text.
- We are going to implement this algorithm along with the algorithm with best result on our front-end irrespective of result obtained by this algorithm because it is most preferable with the data set is mostly textual.

$$PosteriorP = \frac{ConditionalP \times PriorP}{PrerdicatorPriorP} \quad (2)$$

Where P is Probability.

## V. FRONT END IMPLEMENTATION

- The front end of this project will be designed using languages named HTML, CSS, JavaScript, bootstrap. There will be a login/sign up page with email verification setup where the users will be asked to fill email and password. After successful authentication user will be directed to the main page which requires user to input news URL link. Clicking the submit button will direct user to the output page where the result related to the news will be displayed and also there will be options for sharing the news to various social media platforms like Facebook, WhatsApp, email etc. On main screen there will be also be option for history section where user can look about previous searches and can also see the output related to them. There will be profile section also where user can provide name and display picture. There will be animations involved in various screen navigation. Bootstrap has been used for making the UI look professional. Bootstrap is a free and open-source CSS framework directed at responsive, mobile-first front-end web development. It contains CSS- and JavaScript-based design templates for typography, forms, buttons, navigation, and other interface components. Proper images, icons, colours will be used to make the design look better. All possible steps will be taken to make the design look more interactive and ideal to use.

- The back-end of this application will be implemented using flask micro-framework. Flask is a micro web framework written in Python. It is classified as a micro-framework because it does not require particular tools or libraries. It has no database abstraction layer, form validation, or any other components where preexisting third-party libraries provide common functions. The machine learning model pipeline is saved using pickle library. The input news URL is taken from the main page on which web scraping is applied. In web scraping the content of the news is extracted and stored in the variable. The content scraped from the URL is fed into the saved machine learning model which predicts and return the output which is then printed out on the screen. The output returned from the model can be fake or real. The authentication system is built using fire-base.
- Fire-base is a Back-end-as-a-Service — BaaS — that started as a YC11 start-up and grew up into a next-generation app-development platform on Google Cloud Platform. Firebase is your server, your API and your data-store, all written so generically that you can modify it to suit most needs. The system asks the user to input email and password for registration. The email verification method has been implemented to make the registration process more secure. After attempting the confirmation process the registration will be successful. Now user can use the provided email and password to login. There is also an option for forget password where user can give the email and the password reset link will be sent to the provided email. From the email link user can successfully reset the password. On successful login the user will be directed to the mail page where the fake news detection can be done using news URL.

## VI. RESULT

### A. Confusion Matrix Evaluation

- **Fake-Fake (FF)** : It means that the value predicted by the model is fake and actually it is fake. So, correct prediction is done by the model.
- **Fake-Real (FR)** : It means that the value predicted by the model is real but actually it is fake. So, incorrect prediction is done by the model
- **Real-Fake (RF)** : It means that the value predicted by the model is fake but actually it is real. So, incorrect prediction is done by the model.
- **Real-Real (RR)** : It means that the value predicted by the model is real and actually it is real. So, correct prediction is done by the model.

### Accuracy of Confusion matrix produced by a model

$$Accuracy = \frac{FF + RR}{FF + FR + RF + RR} \quad (3)$$

Table I  
RESULTS OF DIFFERENT ALGORITHMS

MODEL NAME	Result data value			
	FF	FR	RF	RR
Logistic Regression	4657	49	35	4239
Decision Tree Classifier	4696	10	22	4252
Random Forest Classifier	4638	68	46	4228
AdaBoost Classifier	4688	18	19	4255
XG Boost Classifier	4678	28	13	4261
Multinomial Naive Bayes	4455	312	119	4094

Table II  
ACCURACY CALCULATION OF DIFFERENT ALGORITHMS

MODEL NAME	Result data value			
	FF+RR	FR+RF	Total	Accuracy
Logistic Regression	8896	84	8980	99.06
Decision Tree Classifier	8948	32	8980	99.64
Random Forest Classifier	8866	114	8980	98.73
AdaBoost Classifier	8943	37	8980	99.54
XG Boost Classifier	8939	41	8980	99.59
Multinomial Naive Bayes	8549	431	8980	95.20

## VII. WORKING OF SELECTED ALGORITHM

After considering the results obtained above and the recommendation provided by the different papers we will be going forward with two algorithms which are Decision tree and Multinomial Naive Bayes.

### A. Multinomial Naive Bayes

To apply Multinomial Naive Bayes algorithm, we have to

- Calculate prior probabilities i.e. probability of a particular text falling into a particular category.
- Calculate Likelihood i.e. conditional probability of the particular text falling into a document given that the document fall into a certain category which is known.
- Similarly Multinomial probability is executed on all the words of the text and the category of text is recognised.
- Once category is recognised it searches for similar document in the data set and assess the document and credibility of the document and by doing so we get whether the news can be passed as real or fake.

## VIII. CONCLUSION

After studying all the above algorithms on a particular dataset and analysing the result, we came to a conclusion that with highest accuracy of 99.64, Decision Tree Classifier is the best algorithm among five on Fake news detection.

AdaBoost and XG Boost also provides good accuracy and maybe has a good scope on bigger dataset.

The classic algorithms like Logistic Regression and Random Forest Classifier has also produced good results but compared to other algorithms, they are not so good.

But we have observed that Multinomial Naive Bayes has been recommended algorithms for text classification in many researches so we will be continuing to the frontend part with Multinomial Naive Bayes as well.

The machine learning model used for prediction is Multinomial Naïve Bayes. Multinomial Naive Bayes is a specialized version of Naive Bayes that is designed more for text documents. Whereas simple naive Bayes would model a document as the presence and absence of particular words, multinomial naive bayes explicitly models the word counts and adjusts the underlying calculations to deal with in. The multinomial Naive Bayes classifier is suitable for classification with discrete features (e.g., word counts for text classification). The multinomial distribution normally requires integer feature counts. However, in practice, fractional counts such as TF-IDF may also work. The pipeline build for news prediction consists for count vectorizer function, TF-IDF function with stop words and the machine learning model. The pipeline is saved using python pickle library on the local storage which can be used to make predictions.

## IX. FUTURE ENHANCEMENT

In this paper we have used six different classifier models that are pre-existed in Keras library. For future work we can try to use deep neural network models especially Convolutional Neural Network(CNN) and Recurrent Neural Network(RNN).

We can also make our pre processing more efficient by using stemmer and by lemmatization of the text. Also, removal of stopwords and use of tf-idf are some more options of data pre processing. By this way, we can improve our way of analysing the data set and hence resulting in better efficiency of our ML model.

We can update and increase the dataset size by merging multiple datasets on fake news. Creating website and deploying it on cloud server using advance technology can be help for the society.

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