Fake News Detection

### A Project Work Report

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**Abstract**

With the popularity of mobile technology and social media growing, information is readily available. Mobile App and social media platforms have overturned traditional media in the distribution of news. Alongside the increment in the utilization of online media stages like Facebook, Twitter, and so forth news spread quickly among a large number of clients with an extremely limited ability to focus time. Machine learning and Knowledge-based approach and approach are the two techniques utilized for investigating the truthiness of the content. Public and private assessments on a wide assortment of subjects are communicated and spread persistently through various online media. Most methodologies are utilized, for example, regulated AI. The spread of phony news has extensive results like the making of one-sided feelings to influencing political race results to support certain applicants. Additionally, spammers utilize engaging news features to produce income utilizing notices through click baits. In this paper, we intend to perform a parallel grouping of different news stories accessible online with the help of thoughts identifying with Artificial Intelligence, Natural Language Processing, and Machine Learning. The result of the project determines the fake news detection for social networks using machine learning and also checks the authenticity of the publishing news website.

# INTRODUCTION

#### 1.1 The growing popularity of social media & mobile technology with this information is accessible at one’s fingertips. Mobile apps and social media like Facebook and Twitter have overthrown traditional media in the field of information and news. With the convenience and speed that digital media offers, people express preference towards social media. Not only has it empowered consumers with faster access but it has additionally given benefit looking for parties a solid stage to catch a more extensive crowd.

#### With a lot of information or news, the one question occurred whether the given news or information is True or Fake. Fake news is commonly distributed with an intent to mislead or make an inclination to get political or monetary benefits. Let’s consider the example - In the recent elections of India, there has been a lot of discussion in regards to the credibility of different news reports preferring certain applicants and the political thought processes behind them. In this growing interest, exposing fake news is paramount in preventing its negative impact on people and society.

**1.2** The World Wide Web contains data in grouped arrangements like documents, videos, and audios. News distributed online in an unstructured configuration (like news, articles, videos, audios) is moderately hard to distinguish and order as this rigorously requires human mastery. However, computationalprocedures, for example, natural language preparing (NLP) can be utilized to identify irregularities that different a content article that is misleading in nature from articles that depend on realities. Different strategies include the investigation of the spread of fake news interestingly with real news. Specifically, this approach analyses fake news articles propagates differently on the internet relative to a true article. The reaction that an article gets can be separated at a theoretical level to arrange the article as real or fake. The hybrid approach can also be used to investigate the social responsibility of an article alongside investigating the text-based features to examine whether an article is deceptive or not.

The algorithms used by fake news detection systems include machine learning algorithms such as Logistic Regression, Random Forests, Decision trees, Support Vector Machines, Stochastic Gradient Descent, and so on. A simple method of fake news detection based on one of the AI algorithms called the Naive Bayes classifier help to examine how this particular method works for the particular problem with a manually labeled (fake or real) dataset and to support the idea of using machine learning to detect fake news

# LITERATURE REVIEW

[1] Paper Name: - Evaluating Machine Learning algorithms for Fake News Detection.

Author: - Shloka Gilda.

In this article, the author introduced the concept of the importance of NLP in stumbling across incorrect information. They have used time frequency-inverse document frequency (TF-IDF) of bigrams and probabilistic context-free grammar detection. Shloka Gilda introduced the concept of the importance of NLP in stumbling over incorrect information. They used Bi-Gram Count Vectorizer and Probabilistic Context-Free Grammar (PCFG) to detect deceptions. They examined the data set in more than one class of algorithms to find out a better model. The count vectorizer of bi-grams fed directly into a stochastic gradient descent model which identifies noncredible resources with an accuracy of 71.2%.

[2] Paper Name: - Fake News Detection on Social Media: A Data Mining Perspective.

Author: - Kai Shu, Amy Sliva, Suhang Wang, Jiliang Tang and Huan Liu.

In this paper to detect fake news on social media, a data mining perspective is presented that includes the characterization of fake news in psychology and social theories. This article looks at two main factors responsible for the widespread acceptance of fake messages by the user which is naive realism and confirmatory bias. It proposes a general two-phase data mining framework that includes 1) feature extraction and 2) modeling, analyzing data sets, and confusion matrix for detecting fake news.

[3] Paper Name: - Media Rich Fake News Detection: A Survey.

Author: - Shivam B. Parikh and Pradeep K. Atrey.

Social networking sites read news mainly in three ways: The (multilingual) text is analyzed with the help of computational linguistics, which semantically and systematically focuses on the creation of the text. Since most publications are in the form of text, a lot of work has been done on analyzing them. Multimedia: Several forms of media are integrated into a single post. This can include audio, video, images, and graphics. This is very attractive and attracts the viewer's attention without worrying about the text. Hyperlinks allow the author of the post to refer to various sources and thus gain the trust of viewers. In practice, references are made to other social media websites, and screenshots are inserted.

### Literature Review Summary

Table 2.1: Literature review summary

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Year and citation** | **Article Title** | **Purpose of the study** | **Comparison of technique done** | **Source (Journal/ Conference)** | **Findings** | **Data set (if used)** | **Evaluation parameters** |
| 2018  2017 | Media Rich Fake News Detection: A Survey.  Fake News Detection on Social Media: A Data Mining Perspective. | Origination of fake news   Application of existing algorithms through data mining perspective | social engagements on social media, and exploiting this auxiliary information  Deception Modeling, Predictive Modeling | Albany Lab for Privacy and Security  Cornell University | Different methods to detect different fake news  Fake news characterizations on psychology and social theories | BuzzFeedNews Dataset  Survey | Ngrams, Punctuation, Psycho-linguistic features  Evaluation metrics and representative datasets. |

# PROBLEM FORMULATION

# Social media facilitates the creation and sharing of information that uses computer-mediated technologies. This media changed the way groups of people interact and communicate. It allows low cost, simple access and fast dissemination of information to them. The majority of people search and consume news from social media rather than traditional news organizations these days. On one side, where social media have become a powerful source of information and bringing people together, on the other side it also 1 put a negative impact on society. Look at some examples herewith; Facebook Inc’s popular messaging service, WhatsApp became a political battle-platform in Brazil’s election. False rumours, manipulated photos, de-contextualized videos, and audio jokes were used for campaigning. These kinds of stuff went viral on the digital platform without monitoring their origin or reach.

# A nationwide block on major social media and messaging sites including Facebook and Instagram was done in Sri Lanka after multiple terrorist attacks in the year 2019. The government claimed that “false news reports” were circulating online. This is evident in the challenges the world's most powerful tech companies face in reducing the spread of misinformation. Such examples show that Social Media enables the widespread use of “fake news” as well

# disseminated on social media platforms may be of low quality carrying misleading information intentionally. This sacrifices the credibility of the information. Millions of news articles are being circulated every day on the Internet – how one can trust which is real and which is fake? Thus incredible or fake news is one of the biggest challenges in our digitally connected world. Fake news detection on social media has recently become an emerging research domain. The domain focuses on dealing with the sensitive issue of preventing the spread of fake news on social media.

# Fake news identification on social media faces several challenges. Firstly, it is difficult to collect fake news data.

# Furthermore, it is difficult to label fake news manually. Since they are intentionally written to mislead readers, it is difficult to detect them simply based on news content. Furthermore, Facebook, Whatsapp, and Twitter are closed messaging apps. The misinformation disseminated by trusted news outlets or their friends and family is therefore difficult to be considered as fake. It is not easy to verify the credibility of newly emerging and time-bound news as they are not sufficient to train the application dataset. Significant approaches to differentiate credible users, extract useful news features and develop authentic information dissemination systems are some useful domains of research and need further investigations. If we can’t control the spread of fake news, the trust in the system will collapse.

# OBJECTIVES

The proposed work is aimed to carry out work leading to the development of an approach for to solve fake news problem. The proposed aim will be achieved by dividing the work into following objectives:

1. Finding datasets containing both fake and real news alongwith their marker.

2.Model development and training on the datasets.

3.Model validation to improve the accuracy.

4.Creation of the web interface to deploy the model on the internet i.e.,

Create a Flask APP and a virtual environment.

5.Deployment of the model on the internet .

# 5 BACKGROUND OF PROPOSED METHOD

From an NLP perspective, researchers have studied numerous aspects of the credibility of online information. For example, [1] applied the time-sensitive supervised approach by relying on tweet content to address the credibility of a tweet in different situations. [2] used LSTM in a similar problem of early rumour detection. In another work, [3] aimed at detecting the stance of tweets and determining the veracity of the given rumour with convolution neural networks. A submission [4] to the SemEval 2016 Twitter Stance Detection task focuses on creating a bag-of-words autoencoder and training it over the tokenized tweets. Another team, [5], combined multiple models in an ensemble providing a 50/50 weighted average between a deep convolutional neural network and a gradient-boosted decision tree. Though this work seems to be similar to our work, the difference lies in the construction of an ensemble of classifiers. In a similar attempt, a team [6] concatenated various features vectors and passed them through an NLP model. Passive Aggressive algorithm is a margin-based online learning algorithm for binary classification. It is also an algorithm of a soft margin-based method and robust to noise. It can be used in fake news detection [16] Term Frequency-Inverse Document Frequency is also a method used to represent text in Fake News Detector 12 a format that can be easily processed by machine learning algorithms. It is a numerical statistic that shows how important a word is to news in a news dataset. The importance of a word is proportional to the number of times the word appears in the news (fake and real) but inversely proportional to the number of times the word appears in the news dataset (fake or real) [15]

# 6 METHODOLOGY

The following methodology will be followed to achieve the objectives defined for proposed research work:

1. Detailed study of existing system will be done.
2. Installation and hand on experience on existing approaches of proposed system will

be done. Relative pros and cons will be identified.

1. Various parameters will be identified to evaluate the proposed system.
2. Comparison of new implemented approach with exiting approaches will be done.

There are 3 main segments of the methodology :

* The core Machine Learning model
* The web interface.
* The common platform that brings the model and the interface together.

The Machine Learning Model There are two parts to the ML Model building. Machine Learning is a part of our life that can help us in predicting. We are using two types of model in this case. For the first part, we used passive-aggressive classifiers. And the steps include:

1. **Data** **Loading:** We are loading a CSV file for the data sorting and training-testing part of the model. The CSV file is turned into an array for easier work purpose.
2. **Vectorization:** Vectorization is needed for determining the frequency of the words present in a passage. This is needed to determine which words are used often.
3. **Classifier:** Passive-aggressive algorithms are a family of great learning algorithms. They are similar to Perceptron because it does not require a reading scale. However, unlike Perceptron, they include parameter correction. Passive is used when the prediction is correct and there is no change in the model. But if there is any kind of change in the model, that is if the prediction is not correct then the aggressive part is called, which changes the model accordingly. The aggressive part of the model changes the model according to its wish on the backend.
4. **Model Building:** The model is built through the train and test of the dataset, by ensuring that the training is done for 80% of the dataset and testing is done in the rest of the 20% of the dataset.

**6.1** **Tfidfvectorizer**

* In NLP, tf-idf is an important measure and is used by algorithms like cosine similarity to find documents that are similar to a given search query.
* Here in this blog, we will try to break tf-idf and see how sklearn’s TfidfVectorizer calculates tf-idf values. I had a hard time matching the tf-idf values generated by TfidfVectorizer and with the ones I calculated. The reason is that there are many ways in which tf-idf values are calculated, and we need to be aware of the method that TfidfVectorizer uses to calculate tf-idf. This will save a lot of time and effort for you. I spent a couple of days troubleshooting before I could realize the issue.
* We will write a simple Python program that uses TfidfVectorizer to calculate tf-idf and manually validate this. Before we get into the coding part, let’s go through a few terms that make up tf-idf.
* tf is the number of times a term appears in a particular document. So it’s specific to a document. A few of the ways to calculate tf is given below:-

tf(t) = No. of times term ‘t’ occurs in a document

OR

tf(t) = (No. of times term ‘t’ occurs in a document) / (No. Of terms in a document)

OR

tf(t) = (No. of times term ‘t’ occurs in a document) / (Frequency of most common term in a document)

sklearn uses the first one i:e No. Of times a term ‘t’ appears in a document

**Inverse Document Frequency (idf)**

idf is a measure of how common or rare a term is across the entire corpus of documents. So the point to note is that it’s common to all the documents. If the word is common and appears in many documents, the idf value (normalized) will approach 0 or else approach 1 if it’s rare. A few of the ways we can calculate idf value for a term is given below

idf (t) =1 + log e [ n / df(t) ]

**OR**

idf(t) = log e [ n / df(t) ]

where

n = Total number of documents available

t = term for which idf value has to be calculated

df(t) = Number of documents in which the term t appears

But as per sklearn’s online documentation, it uses the below method to calculate idf of a term in a document.

idf(t) = log e [ (1+n) / ( 1 + df(t) ) ] + 1 (default i:e smooth\_idf = True)

and

idf(t) = log e [ n / df(t) ] + 1 (when smooth\_idf = False)

* **Term Frequency-Inverse Document Frequency (tf-idf)**

**tf-idf**value of a term in a document is the product of its tf and idf. The higher is the value, the more relevant the term is in that document.

* 1. **Stemming**

Stemming is the process of producing morphological variants of a root/base word. Stemming programs are commonly referred to as stemming algorithms or stemmers. A stemming algorithm reduces the words “chocolates”, “chocolatey”, “choco” to the root word, “chocolate” and “retrieval”, “retrieved”, “retrieves” reduce to the stem “retrieve”. Stemming is an important part of the pipelining process in Natural language processing. The input to the stemmer is tokenized words.

**Errors in Stemming:**   
There are mainly two errors in stemming –

* over-stemming
* under-stemming

Over-stemming occurs when two words are stemmed from the same root that are of different stems. Over-stemming can also be regarded as false-positives.

**Applications of stemming :** 

1. Stemming is used in information retrieval systems like search engines.
2. It is used to determine domain vocabularies in domain analysis.

*Fun Fact*: Google search adopted a word stemming in 2003. Previously a search for “fish” would not have returned “fishing” or “fishes”.

**Some Stemming algorithms are:**

* **Porter’s Stemmer algorithm**   
  It is one of the most popular stemming methods proposed in 1980. It is based on the idea that the suffixes in the English language are made up of a combination of smaller and simpler suffixes. This stemmer is known for its speed and simplicity. The main applications of Porter Stemmer include data mining and Information retrieval. However, its applications are only limited to English words. Also, the group of stems is mapped on to the same stem and the output stem is not necessarily a meaningful word. The algorithms are fairly lengthy in nature and are known to be the oldest stemmer.  
  **Example:**EED -> EE means “if the word has at least one vowel and consonant plus EED ending, change the ending to EE” as ‘agreed’ becomes ‘agree’.

**Advantage:** It produces the best output as compared to other stemmers and it has less error rate.

**Limitation:**  Morphological variants produced are not always real words.

* **Lovins Stemmer**   
  It is proposed by Lovins in 1968, that removes the longest suffix from a word then the word is recorded to convert this stem into valid words.   
  **Example:**sitting -> sitt -> sit

**Advantage:** It is fast and handles irregular plurals like 'teeth' and 'tooth' etc.

**Limitation:** It is time consuming and frequently fails to form words from stem.

* **Dawson Stemmer**   
  It is an extension of Lovins stemmer in which suffixes are stored in the reversed order indexed by their length and last letter.

**Advantage:** It is fast in execution and covers more suffices.

**Limitation:** It is very complex to implement.

* **Krovetz Stemmer**   
  It was proposed in 1993 by Robert Krovetz. Following are the steps:   
  1) Convert the plural form of a word to its singular form.   
  2) Convert the past tense of a word to its present tense and remove the suffix ‘ing’.   
  **Example:**‘children’ -> ‘child’

**Advantage:** It is light in nature and can be used as pre-stemmer for other stemmers.

**Limitation:** It is inefficient in case of large documents.

* **Xerox Stemmer**   
  **Example:**
  + ‘children’ -> ‘child’
  + ‘understood’ -> ‘understand’
  + ‘whom’ -> ‘who’
  + ‘best’ -> ‘good’
* **N-Gram Stemmer**   
  An n-gram is a set of n consecutive characters extracted from a word in which similar words will have a high proportion of n-grams in common.

**Example:**‘INTRODUCTIONS’ for n=2 becomes : \*I, IN, NT, TR, RO, OD, DU, UC, CT, TI, IO, ON, NS, S\* 

**Advantage:** It is based on string comparisons and it is language dependent.

**Limitation:** It requires space to create and index the n-grams and it is not

time efficient.

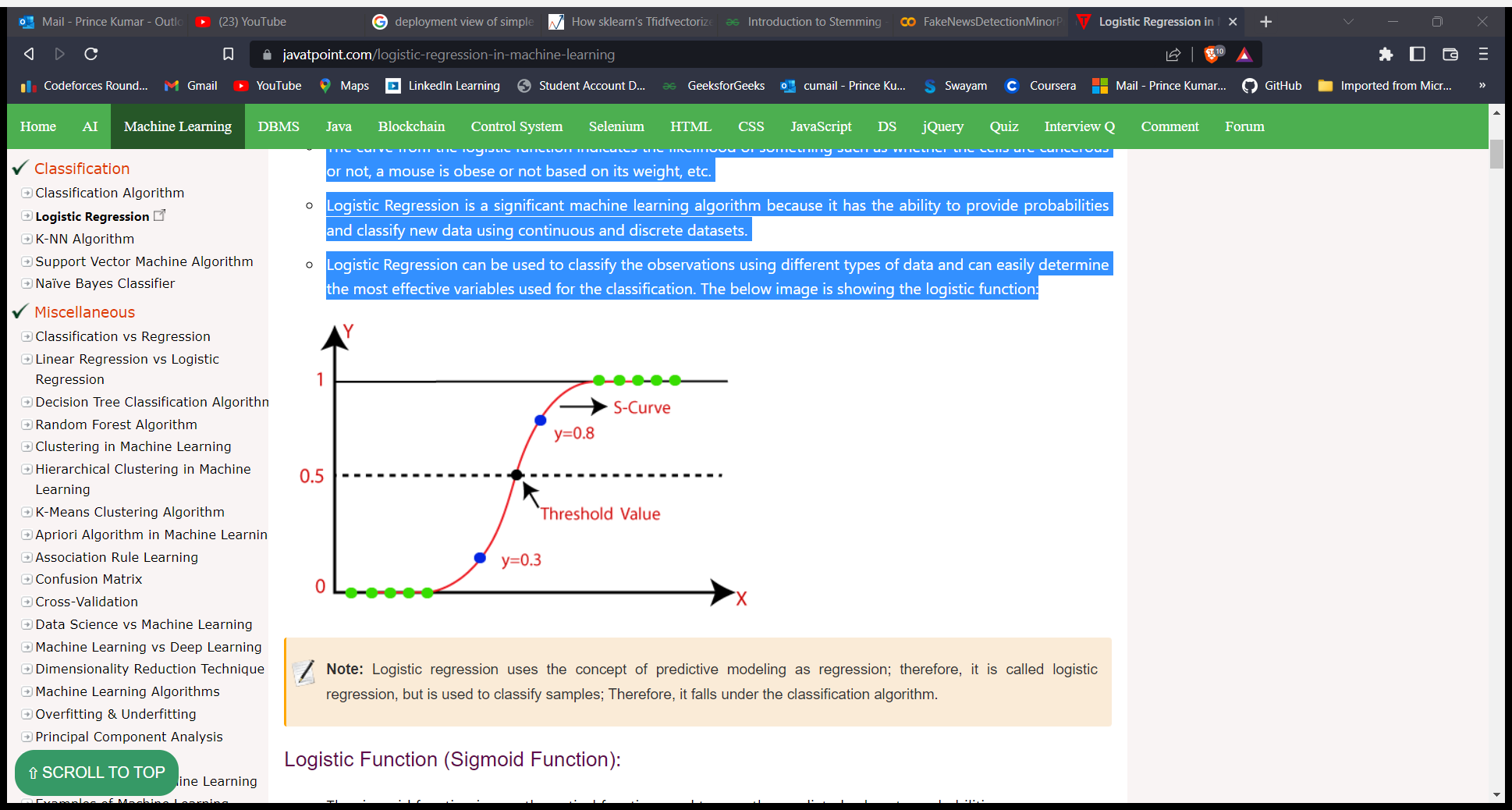
* **Snowball Stemmer:**

When compared to the Porter Stemmer, the Snowball Stemmer can map non-English words too. Since it supports other languages the Snowball Stemmers can be called a multi-lingual stemmer. The Snowball stemmers are also imported from the nltk package. This stemmer is based on a programming language called ‘Snowball’ that processes small strings and is the most widely used stemmer. The Snowball stemmer is way more aggressive than Porter Stemmer and is also referred to as Porter2 Stemmer. Because of the improvements added when compared to the Porter Stemmer, the Snowball stemmer is having greater computational speed.

* **Lancaster Stemmer:**

The Lancaster stemmers are more aggressive and dynamic compared to the other two stemmers. The stemmer is really faster, but the algorithm is really confusing when dealing with small words. But they are not as efficient as Snowball Stemmers. The Lancaster stemmers save the rules externally and basically uses an iterative algorithm.

* 1. **Logistic Regression**
* Logistic regression is one of the most popular Machine Learning algorithms, which comes under the Supervised Learning technique. It is used for predicting the categorical dependent variable using a given set of independent variables.
* Logistic regression predicts the output of a categorical dependent variable. Therefore the outcome must be a categorical or discrete value. It can be either Yes or No, 0 or 1, true or False, etc. but instead of giving the exact value as 0 and 1, **it gives the probabilistic values which lie between 0 and 1**.
* Logistic Regression is much similar to the Linear Regression except that how they are used. Linear Regression is used for solving Regression problems, whereas **Logistic regression is used for solving the classification problems**.
* In Logistic regression, instead of fitting a regression line, we fit an "S" shaped logistic function, which predicts two maximum values (0 or 1).
* The curve from the logistic function indicates the likelihood of something such as whether the cells are cancerous or not, a mouse is obese or not based on its weight, etc.
* Logistic Regression is a significant machine learning algorithm because it has the ability to provide probabilities and classify new data using continuous and discrete datasets.
* Logistic Regression can be used to classify the observations using different types of data and can easily determine the most effective variables used for the classification. The below image is showing the logistic function:

****

**Logistic Function (Sigmoid Function):**

* The sigmoid function is a mathematical function used to map the predicted values to probabilities.
* It maps any real value into another value within a range of 0 and 1.
* The value of the logistic regression must be between 0 and 1, which cannot go beyond this limit, so it forms a curve like the "S" form. The S-form curve is called the Sigmoid function or the logistic function.
* In logistic regression, we use the concept of the threshold value, which defines the probability of either 0 or 1. Such as values above the threshold value tends to 1, and a value below the threshold values tends to 0.

**Assumptions for Logistic Regression:**

* The dependent variable must be categorical in nature.
* The independent variable should not have multi-collinearity.

Logistic Regression Equation:

The Logistic regression equation can be obtained from the Linear Regression equation. The mathematical steps to get Logistic Regression equations are given below:

* We know the equation of the straight line can be written as:

Logistic Regression in Machine Learning

* In Logistic Regression y can be between 0 and 1 only, so for this let's divide the above equation by (1-y):

Logistic Regression in Machine Learning

* But we need range between -[infinity] to +[infinity], then take logarithm of the equation it will become:

Logistic Regression in Machine Learning

The above equation is the final equation for Logistic Regression.

**Type of Logistic Regression:**

On the basis of the categories, Logistic Regression can be classified into three types:

* Binomial: In binomial Logistic regression, there can be only two possible types of the dependent variables, such as 0 or 1, Pass or Fail, etc.
* Multinomial: In multinomial Logistic regression, there can be 3 or more possible unordered types of the dependent variable, such as "cat", "dogs", or "sheep"
* Ordinal: In ordinal Logistic regression, there can be 3 or more possible ordered types of dependent variables, such as "low", "Medium", or "High".

Python Implementation of Logistic Regression (Binomial)

To understand the implementation of Logistic Regression in Python, we will use the below example:

Example: There is a dataset given which contains the information of various users obtained from the social networking sites. There is a car making company that has recently launched a new SUV car. So the company wanted to check how many users from the dataset, wants to purchase the car.

For this problem, we will build a Machine Learning model using the Logistic regression algorithm. The dataset is shown in the below image. In this problem, we will predict the purchased variable (Dependent Variable) by using age and salary (Independent variables).

# 7 RESULTS AND DISCUSSION

A robust logistic regression model of accuracy having 90.3456721% was trained which is able to predict the fake news .

In the fake news detection technology, there have been multiple instances where both unsupervised learning and supervised learning algorithms are used to classify text. Most of the literature survey focus on specific domains, most important the domain of politics. Therefore, the algorithm trained best works on a particular type of article’s domain and does not gives optimal results when presented to articles from different areas. Since articles from various areas have a special literary construction, it is hard to train a generic algorithm that works best on all specific news spaces. In this review paper, we find the solution for the fake news detection problem using the machine learning approach. We observed that the Random Forests algorithm with a simple term frequency-inverse document frequency vector gives the best output compares to others. Our study examines various text properties that can be used to distinguish fake and real content, and we trained a combination of different machine learning algorithms using these properties.

# 8 CONCLUSION AND FUTURE SCOPE

Manual classification of news articles requires in-depth knowledge and expertise in identifying anomalies in the text. It takes a lot of time to verify a single article manually that’s why we have discussed the problem of classifying fake news articles using machine learning models and ensemble techniques. It is important that we have a mechanism to detect fake news, or at least an awareness that not everything we read on social media may be true. That is why we always have to think critically. This way, we can help the people to make more informed decisions, and they won't be led to think about what others are trying to manipulate them into believing.

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