A Study On Identifying Fake Reviews by Comparative Analysis of Supervised Machine Learning Algorithms

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This Report Presented in Partial Fulfillment of the Requirements for the Degree of Bachelor of Science in Computer Science and Engineering

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APPROVAL

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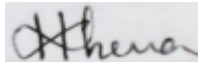
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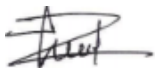Faculty of Science & Information Technology
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We hereby declare that this project has been done by us under the supervision of Ms. Subhenur Latif, **Designation: Assistant Professor, Department of CSE** Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

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Abstract

In today's time e-commerce sites are playing a vital role. Customers are attracted to those product companies whose reviews and quality are good. A positive review can bring fame to the company but on the other hand, a negative review can bring defame to the company. The review section which we are talking about can be fake sometimes. This fake review is harmful to both seller and buyer. A lot of classifiers are used to detect these fake reviews. So our work will be to check the best classifier through their accuracy for detection. Our goal is to detect fake reviews which is a text classification issue. We gathered our data, preprocessed the dataset, feature extraction, and apply supervised machine learning algorithms in the dataset. So, our main target area is to develop a model which classifies a given text either fake or real review, and also do the comparison between different classifiers.

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Chapter 1: Introduction

1.1 Introduction

In this era of web, one of the dominant fields is E-Commerce. Every minute thousand to million of product sales are online. reviews increase proportionately as sales increase. Customers are directly dependent on reviews while they purchase something in E-Commerce or shopping mall. People are social beings. To flow with society a lot of things are needed by humans. One of the important needs is product sales and buying. In today's world if people want to buy a product they give so much importance to product review more than the product. If any product review is worse then people won't buy the product. And if any product review is good then people show interest to buy the product. But in our society, some bad people write a bad review of a good product and write a good review of a bad product for their profit interest. For this reason, people got cheated from buying the right product and buying the bad product. It is harmful to people financially and mentally. to avoid these we are working on a fake review system.

Fake review detection systems have a great contribution to our social life. For this detection system of a fake review, people are getting a good quality of the product. For these detection systems no bad product will not create any good impression in front of people and also any good product's good image will not get hampered to the people. People won't hesitate to buy any product. people won't get affected financially and mentally.

If we want to think about the future of fake review detection systems we can see that when a person gives a bad and good review of a good or bad product and our system will detect fake reviews then that particular person won't give any bad review about the product. When all the fake reviews will detect by our fake review detection system then there will be no fake reviews in society. If there is no fake review in the world then the good product will always remain in our society. when there will be no fake review then we will see many companies will be constructed. It creates a lot of entrepreneurs as a result it creates a lot of employment.

Because there are many industry owners who think that they will make good products but there is a possibility that the product will not create a good impression on society. but when these fake

reviews will be gone forever then the industry owner will not think so much and we will see many new products in our society.

1.2 Motivation

Today's world is full of technology. By using these technologies people want to do all kinds of work. Nowadays because of smart technologies, people can buy products online. But buying these product reviews helps a lot. Because a review gives a decision to a person whether to buy the product or not.

In the past, there was no system to detect bad reviews of a good product and good reviews of a bad product. As a result, people got cheated and bought low-quality products. Because of these fake review detection systems, any false of a good review of a product can be detected easily through our system. As a result, people can buy and get the correct idea of the product which was very tough in the past for people.

In the past when anyone says these products are good people believe that comment and buy the product. Because people don't know that there is a possibility that the comment will be fake. When these fake review systems come, people not only buy the product but also check the quality of the product and check whether the review is real or fake. Now people have aware of this technique. As a result, now people buy and get the correct product they want. So that is the main reason for our motivation for fake review detection.

1.3 Rationale of the Study

The main reason for doing the fake review detection is to support and use the good product and avoid the bad product. In our society, many people give a bad review of a good product and give a good review of a bad product. These are done to gain personal profit. For these purposes, people get confused about which product is good and which product is bad. They get confused also whether they buy a particular product or not. a fake review detection system removes the confusion of people. Let's see an example How a bad or fake review affect a buyer's life

A person gives an image of a product on the online e-commerce website and cancer can be cured by using the product. Because of these reviews, a cancer patient stops his treatment and buys the product from online. After that, he began to use that product. But the product did not give any good results to the cancer patient. The physical condition of the patient is getting worse day by day. Stopping his treatment and using the product too much now the patient is dead. how a fake review destroys a human life we can understand from the above scenarios. So our main goal is to identify the fake review so that any human life can not be destroyed anymore.

1.4 Research Question

➢ Can we collect raw data for Fake reviews detection?

➢ Can the Preprocessing of unprocessed data be used for the ML techniques?

➢ Could the Classifier algorithm be used on the pre-processed data?

➢ Can the Machine Learning process correctly detect or identify the category of fake reviews detection?

➢ Is spam/fake reviews increasing daily?

1.5 Expected output

When a product is uploaded to the e-commerce site then many people give reviews about that product. Some people write good reviews about the product and some people write bad reviews about that product. The main goal of the fake review system is to identify a review. detect whether these reviews are real or fake.

Another outcome of our fake review detection is to check the accuracy rate of each algorithm we have used in our system. From that, we can understand which algorithm is best for our fake review system. in our fake review detection system we have used six supervised machine learning algorithms and we have different types of accuracy rates. Passive classifier accuracy rate 80.2. Logistic regression classifier accuracy rate 85.98% random forest accuracy rate 76.67. K-neighbor classifier accuracy rate is 76.58. decision tree accuracy rate is 75.46. SVM accuracy rate is 86.12. By these accuracy rates, we can determine which algorithm is best for a fake review detection system.

Another outcome we have found is that we have to label the data fake and real. We have also given a graph representation in our code. From the graph, we have found that real reviews are around 78000. And the fake review is around 12000. from these, we can say that out of 10000 data we have found 78000 real reviews and 12000 fake reviews.

1.6 Research layout

The report will be followed as follows:

Chapter 1 describes the introductory part of the fake review detection. Alongside side motivation, the rationale of the study, research paper question, expected outcome all are discussed in chapter1 part. In chapter 2 we broadly study the background study of fake review detection. Then all the related works about fake review detection, the whole working process in the research summary, and problems and challenges are all discussed in chapter 2.

The third chapter is committed to a hypothetical discourse of this inquiry about the venture. This chapter elaborates on the factual strategies utilized in this way of thinking to address the hypothetical parcel of the investigation. The conclusion of the whole ponder and thesis is talked about in Chapter 4. This chapter contains some experimental photos that help with the realization of the proposal. The conclusion topics of the think about are the premise for Chapter 5.

This chapter is mindful for illustrating that the whole proposition report takes after the recommendations. The chapter closes by clarifying the disadvantages of our work, which may be of interest to those fascinated by working in this zone within the future.

Chapter 2: Background

2.1 Introduction

Before the era of smart technologies people could buy products from online stuff, But there was no scope to check if the product which he/she is ordering is good or bad. Because there is no scope to see or check reviews of that particular product. People also go to the market to buy products without discussing to others whether the product will be good or not. Because of this they maximum time get cheated or buy the low-quality product which doesn't last long.

But when the smart technologies came they can get the information about products which he/they wanted to buy. They can also check the review of that particular product. Now this time they benefited a little bit because of these smart technologies. But they also have some disadvantages too. There are a lot of reviews by customers. So buyers cannot decide whether the review of that particular product is real or fake. For this reason, they see the review but cannot buy the correct product. As a result, it doesn't last long. Here the fake review detection system comes.

So to detect the fake review a lot of research paper has been done. A lot of systems has been developed by using different types of supervised machine learning algorithm like SVM, Decision Tree, K-neighbors, LR, PA, etc. By using this supervised machine learning algorithm different types of fake review detection systems have been discovered by using a large-scale dataset. As a result, people get much benefited because of these detection systems. But we cannot say that these fake review detection systems are fully giving good detection. But people now can understand and see which review is best and which review is fake. A part of work is distributed in a diverse way to distinguish this kind of spam/fake review. On the off chance that a review is composed most extreme time in a short period at that point, it is considered spam or fake survey. Able to say that a part of working forms is found to detect this kind of spam/fake audits. The approach which has been done to identify the fake survey is by utilizing supervised machine learning algorithms. In our

inquiry, we experiment with different models of directed machine learning algorithms and compare their accuracy.

2.2 View Related Works

The working process to detect fake reviews has been started since 2007[5]. Here to detect the fake review author used the dataset of amazon. The review has been labeled manually which led the author to face a difficult challenge. To meet up the challenge the author create a model which can identify duplicate reviews as spam/fake[5].

Different approaches have been made on online social media platforms to detect fake reviews by using supervised machine learning techniques and also on distinct characteristics for example features, which are directly connected to the reviews or reviewers who created them. Their working framework leads to suspicious content of identification and has much more misinformation[15].

A lot of work is published differently to detect this kind of spam/fake review. If a review is written maximum time in a short period then it is considered spam or a fake review. A fake review can also be detected by monitoring its writing style, grammar, and spelling[2].

Many researchers also made this attempt to detect fake reviews by comparing the textual style of a fake and non-fake text[9,13,16]. Most researchers also used logistic regression and SVM. Great efforts have also been made in deep learning models[14].

Fake review detection is commonly regarded as a classification issue.[3,12]. Supervised text classification algorithms are another prominent option.[3,4,9,12,18]. If substantial datasets of labeled cases from both classes, misleading and truthful opinions, are used in the training, these strategies are robust. In practice, however, obtaining such vast and accurate training sets is difficult.

Ott et al.[12]. Explained that detecting fake reviews frequently depends on prior human knowledge, which raises the risk of mislabeled reviews due to the possibility of subjectivity during the labeling process.

As a result, research such as those of[1,10–12]. Fake review databases are created artificially. The classification of reviews is done in these methods by looking at the psycholinguistic and structural variations between false and actual reviews.

As a result of the enormous quantity of unlabeled reviews, semi-supervised approaches are a plausible option.

For example, Li et al.[6] combined review and reviewer features to build a two-view semi-supervised technique for detecting spam reviews, using the framework of the co-training algorithm[8]

In this technique, the co-training algorithm is trained using a large number of unlabeled inputs[7].

In 2016, Zhang et al.[17] presented Co-training for Spam Review Identification (CoSpa), a co-training approach for detecting spam reviews.

2.3 Research Summary

In today's world review plays an imperative part in obtaining any product physically or obtaining any item online. Because of these reviews, customers decide whether they buy the product or not. In our paper, we have developed a system that not only detects the fake review but also gives us the chance to compare the detection accuracy rate between different types of classifiers, first we have to upload the dataset. The dataset has been downloaded from Kaggle. The dataset we have downloaded has a total of 800000 reviews. This large dataset can not be handled by our system. So we reduce 700000 data and begin to work on the first 100000 data of our dataset. After that, we have deleted all the unnecessary columns. After that, we used data pre-processing which is stop words. There are lots of data preprocessing techniques but we have chosen these techniques because of our large dataset. After that, we split the dataset into training and testing. Then we have used TF-IDF vectorizer for tokenization. TF-IDF is a shortened form for Term Recurrence Converse Report Recurrence. This is an exceptionally common calculation to convert content into an important representation of numbers which is utilized to fit machine calculation for the forecast. After that, we have used different types of supervised machine learning algorithms. The algorithms we used are support vector machine (SVM), Logistic Regression, Passive Aggressive Classifier, Random Forest, K-Neighbor, Decision Tree. After training the dataset model with different types of classifiers we used manual testing to become sure our model is capable enough to detect the fake

review.

2.4 Scope of the problem

In the past, A lot of work has been done to detect fake reviews but little work has been done according to our country's environment. It is completely new to us because of the lack of sources. We have faced a lot of problems when doing the work. Our working problems are as follows:

2.4.1 Time Management

It was a source of uncertainty whether or not we would be able to complete the project on schedule. Since data collection and analysis takes a long time.

2.4.2 Data collection

As our main goal is connected to detecting the fake review, so we applied algorithms and gathered data from social sites.

2.4.3 Data analysis

We analyzed our data, made predictions, and got the expected result. We also got our most accurate algorithm.

2.4.4 Data Sorting

We sort our whole data into two categories: Positive and negative reviews.

2.5 Challenges

We faced the main challenges for labeling our data. A lot of time has been wasted on labeling.

CHAPTER 3 Research Methodology

Our main goal is not only to detect the fake review but also to do the comparison between different classifiers and check which classifier is giving the best detection accuracy rate. It was comparatively difficult to reach our goal because of our large dataset. It took a lot of effort to create our dataset of 100000 out of 800000. The dataset we talking about is being downloaded from Kaggle. Because of this large dataset, it is quite hard to label our dataset perfectly. This is the hardest part of the dataset. Because of 100k data, a huge time is needed to label the data. After labeling the data we have created our dataset. After completing the work of labeling the dataset we again preprocess the dataset to get more accurate detection and accurate result. The data preprocess technique we have used in our system is stop words. Another technique we have used is the TF-IDF vectorizer which is feature extraction. TF-IDF was concocted for archive look and data recovery. It works by expanding relative to the number of times a word shows up in an archive but is counterbalanced by the number of records that contain the word. So, words that are common in each report, such as this, what, and in case, rank more indeed although they may show up numerous times since they don't relate much to that record in specific. It has numerous employments, most vitally in a robotized content examination, and is exceptionally valuable for scoring words in machine learning calculations for Natural Language Process (NLP). Machine learning calculations cannot work with crude content specifically. Or maybe, the content must be changed over into vectors of numbers. In characteristic dialect preparing, a common method for extracting highlights from content is to put all of the words that happen within the content in a bucket. That's why we have used the above two techniques. After that, machine learning algorithms such as decision tree, random forest, support vector machine(SVM), logistic regression, etc. Their detection accuracy is quite remarkable. It gives us an accuracy of above eighty-four percent. After that, we took an input text manually testing the text if it is giving us an accurate result or not.

3.1 Introduction

The most important part of our project is all about machine learning. Machine learning (ML) may be a sort of Artificial Intelligence (AI) that permits computer program applications to be more

precise at foreseeing results without being unequivocally modified to do so. Machine learning calculations utilize verifiable information as input to anticipate unused yield values. Machine learning is imperative since it gives endeavors a see of patterns in client behavior and commerce operational designs, as well as bolsters the advancement of modern items. Classical machine learning is regularly categorized by how a machine learns to get more precise in its forecasts. There are four essential approaches: supervised learning, unsupervised learning, semi-supervised learning, and fortification learning. The sort of calculation information researchers select to utilize depends on what sort of information they need to foresee. In our project, we have used a supervised machine learning algorithm.

In this sort of machine learning, information researchers supply calculations with labeled preparing information and characterize the factors they need the calculation to evaluate for relationships. Both the input and the yield of the calculation are indicated. The algorithms we have used in our system are Passive Aggressive classifier, Decision Tree, Logistic Regression, SVM, Random forest classifier, K-Neighbor algorithm. In administered learning, the ML calculation is given a little preparing dataset to work with. This preparing dataset could be a little portion of the greater dataset and serves to deliver the calculation a fundamental thought of the issue, arrangement, and information focuses to be managed with. The training dataset is additionally exceptionally comparative to the ultimate dataset in its characteristics and gives the calculation with the labeled parameters required for the problem. The calculation at that point finds relationships between the parameters given, basically setting up a cause and impact relationship between the factors within the dataset. After the preparation, the calculation has thought of how the data works and the relationship between the input and the output. This arrangement is at that point conveyed for utilizing with the ultimate dataset, which it learns from within the same way as the preparing dataset. This implies that administered machine learning calculations will proceed to move forward indeed after being sent, finding modern designs and connections.

Present-day information mining methods can analyze millions of information with the help of current computers, saving hundreds of hours in a brief time. Furthermore, the establishment and utilization of such frameworks cost much less than enlisting proficient staff. With these information mining strategies appropriately optimized, idealization can be ensured without error than a person, especially one who works a long time.

3.2 Research's Area and Constructions

In today's modern world if you want to buy something online or go to the market to buy something you take the information about that particular product or discuss with other people that the product you want to buy is bad or good. You also check the review before buying something. So we can say that these reviews play a vital role to purchase something. It also helps to decide whether you want to buy or not to buy the product. But there is a huge problem with these reviews. When you are checking reviews of a product there are lots of reviews. In these massive amounts of reviews, there are some fake reviews present.

Fake reviews could be of two types. There are fake reviews and real reviews. As composing fake/fraudulent reviews comes with financial pickup, there has been a gigantic increment in beguiling conclusion spam on online survey websites. Fundamentally fake reviews or false audit or supposition spam is an untruthful survey. In any case, due to the reason of benefit or acclaim, individuals attempt to control the framework by concluding spamming to advance or downgrade some target items. real reviews of a targeted protest may pull in more clients and increment deals; a fake review of a targeted protest may lead to lesser demand and diminish in deals. These fake/fraudulent surveys are purposely composed to trap potential customers to promote/hype them or malign their notorieties. For surveys to reflect veritable client encounters and conclusions, such spam reviews ought to be recognized. Our work is focused on recognizing whether a review is fake or real. Also checking the detection accuracy rate of each classifier. After getting chosen a dataset we began collecting information and overseen to gather one lakh information and we labeled the data after facing a lot of difficulties.

3.3 Data Collection Procedure

Since our project and the main goal is to detect fake reviews on online sites so a lot of searching we selected a dataset that meets our requirements. The dataset we are working on has a huge level

of dataset of 800000 data. So this huge dataset is quite hard to maintain. so we reduce 700000 data and started working on 100000 datasets. After that, the hardest part of the project came. That is data labeling. It takes one month and seventeen days to label these. We also do extra work alongside dataset labeling. We have deleted all the unnecessary columns. So our dataset contains only two-column review text and label column. In the label column, we have written only real and fake reviews manually against the review text column. After that, we pre-process the dataset by using stop words. We preprocess the dataset because in a review people use some symbols which are not related to the text. So to remove these and have clean text we use these pre-processing techniques. After that, we added a new column which is data clean. Then after that, we split the dataset into training and testing. 80% of data is for training data and 20% of data is for testing purposes.

After that, we use TF-IDF vectorizer feature extraction. TF-IDF is a truncation for Term Recurrence Reverse Report Recurrence. Typically exceptionally common calculation to convert content into a significant representation of numbers which is utilized to fit machine calculation for the forecast. In TF-IDF Vectorizer we generally consider the archive weightage of a word. It makes a difference for us in managing most visit words. Utilizing it is ready to penalize them. TF-IDF Vectorizer weights the word counts by the degree of how regularly they show up within the records. After that, we use the classifier in the dataset and get the accuracy of each classifier. Here is the image of our label dataset of real and fake reviews.

After all the working processes are, done we have shown a graphical representation of our dataset that contains real and fake review Bar charts. We found that real reviews are extremely higher than fake reviews.

Reviews Ratio Graph:
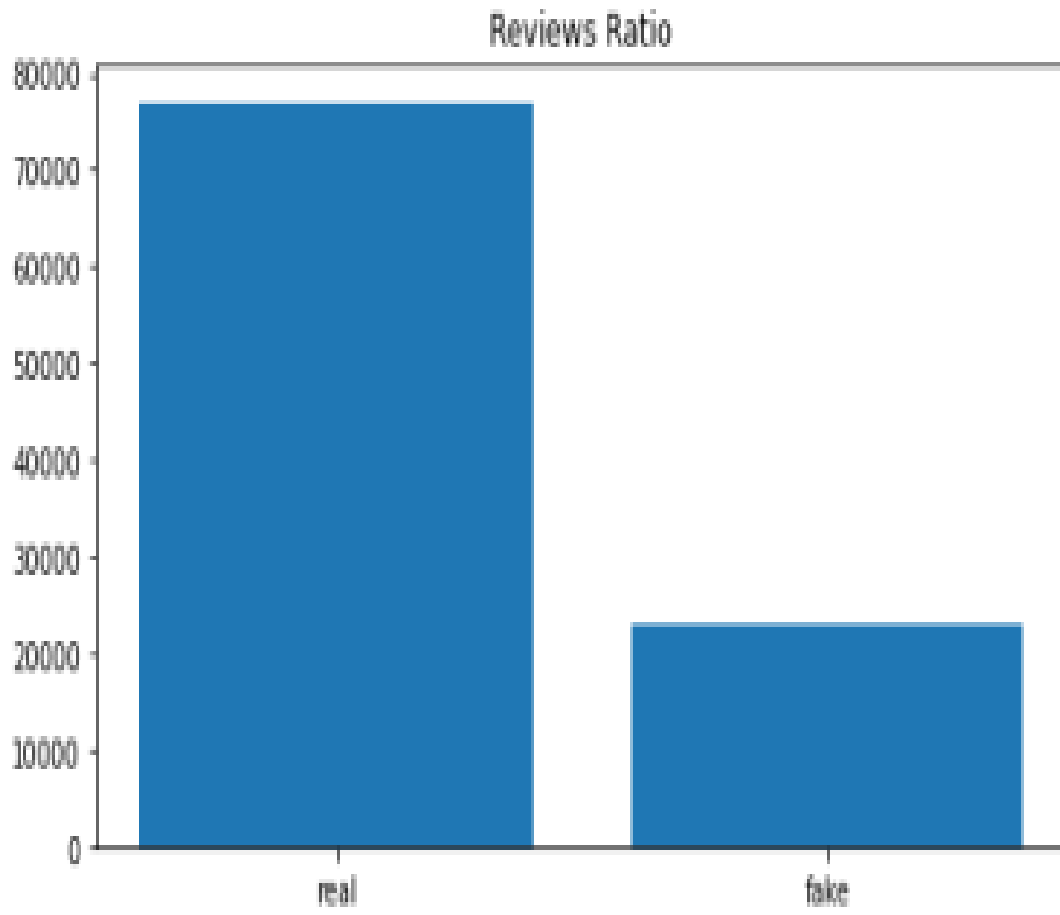
Figure 1: Real and Fake Review Ratio

3.4 Analysis of Different Data Mining Algorithms

In our project, we have used several techniques and machine learning algorithms to achieve our main goal. We have also used NLP in our system. That is tokenization and feature extraction. Our main work is based on text data. Tokenization is one of the foremost common errands when it comes to working with content information. But what does the term 'tokenization' really mean? Tokenization is part of a phrase, sentence, passage, or a whole content report into littler units, such as person words or terms. Each of these little units is called a token. The tokens may be words, numbers, or accentuation marks. In tokenization, littler units are made by finding word boundaries. These are the finishing point of a word and the starting of another word. These tokens are considered to begin with steps for stemming and lemmatization. Before preparing a normal dialect, we have to distinguish the words that constitute a string of characters. That's why tokenization is the foremost essential step to continue with NLP (text data). This is often imperative since the meaning of the content may effortlessly be translated by analyzing the words displayed within the content. Several tokenization techniques are used for data preprocessing, but here we have used stop word as a tokenization technique. For feature extraction, we have used TF-IDF vectorizer. TF-IDF is an abbreviated frame for Term Repeat Talk Document Repeat. A regularly uncommonly common calculation to change over substance into a vital representation of numbers is utilized to fit machine calculation for an estimate.

After that, we used a machine-learning algorithm. There are several parts using machine learning algorithms. Here we have used supervised machine learning algorithm. In this sort of machine learning, data analysts supply calculations with labeled planning data and characterize the variables they require the calculation to study for connections. Both the input and the abdicate of the calculation are demonstrated. First, we have used logistic regression. Calculated relapse is one of the foremost prevalent Machine Learning calculations, which comes beneath the Administered Learning strategy. It is utilized for foreseeing the categorical subordinate variable employing a given set of autonomous variables. Logistic Relapse may be a critical machine learning calculation since it can supply probabilities and classify modern information utilizing nonstop and discrete datasets. Logistic Relapse can be utilized to classify the perceptions utilizing diverse sorts of

information and can effortlessly decide the foremost viable factors utilized for the classification. Its accuracy rate is above 80%.

As our dataset is huge so we used passive-aggressive classifier. Passive-Aggressive calculations are for the most part utilized for large-scale learning. machine-learning calculations, the input information comes in consecutive arrange, and the machine learning show is upgraded step-by-step, as contradicted to group learning, where the complete preparing dataset is used at once. This can be exceptionally valuable in circumstances where there's a colossal sum of information and it is computationally infeasible to prepare the complete dataset because of the sheer estimate of the information. This classifier is mainly used for the detection of any fake reviews/news, that's why we have used these algorithms. Its accuracy rate is above 80% also.

decision Tree could be a Directed learning strategy that can be utilized for both classification and Relapse issues, but generally, it is preferred for tackling Classification issues. It may be a tree-structured classifier, where inner hubs speak to the highlights of a dataset, branches represent the choice rules and each leaf hub speaks to the result. Random Forest classifier that contains several decision trees on different subsets of the given dataset and takes the normal to move forward the prescient precision of that dataset.

Machine learning (ML) could be a sort of manufactured insights (AI) that permits program applications to gotten to be more precise at foreseeing results without being expressly modified to do so. Machine learning calculations utilize verifiable information as input to anticipate modern yield values. That's Why in our project we have used machine learning algorithm. As our dataset is based on text data so our main focus will be using supervised machine learning algorithms.

3.5 Data Flow-Work
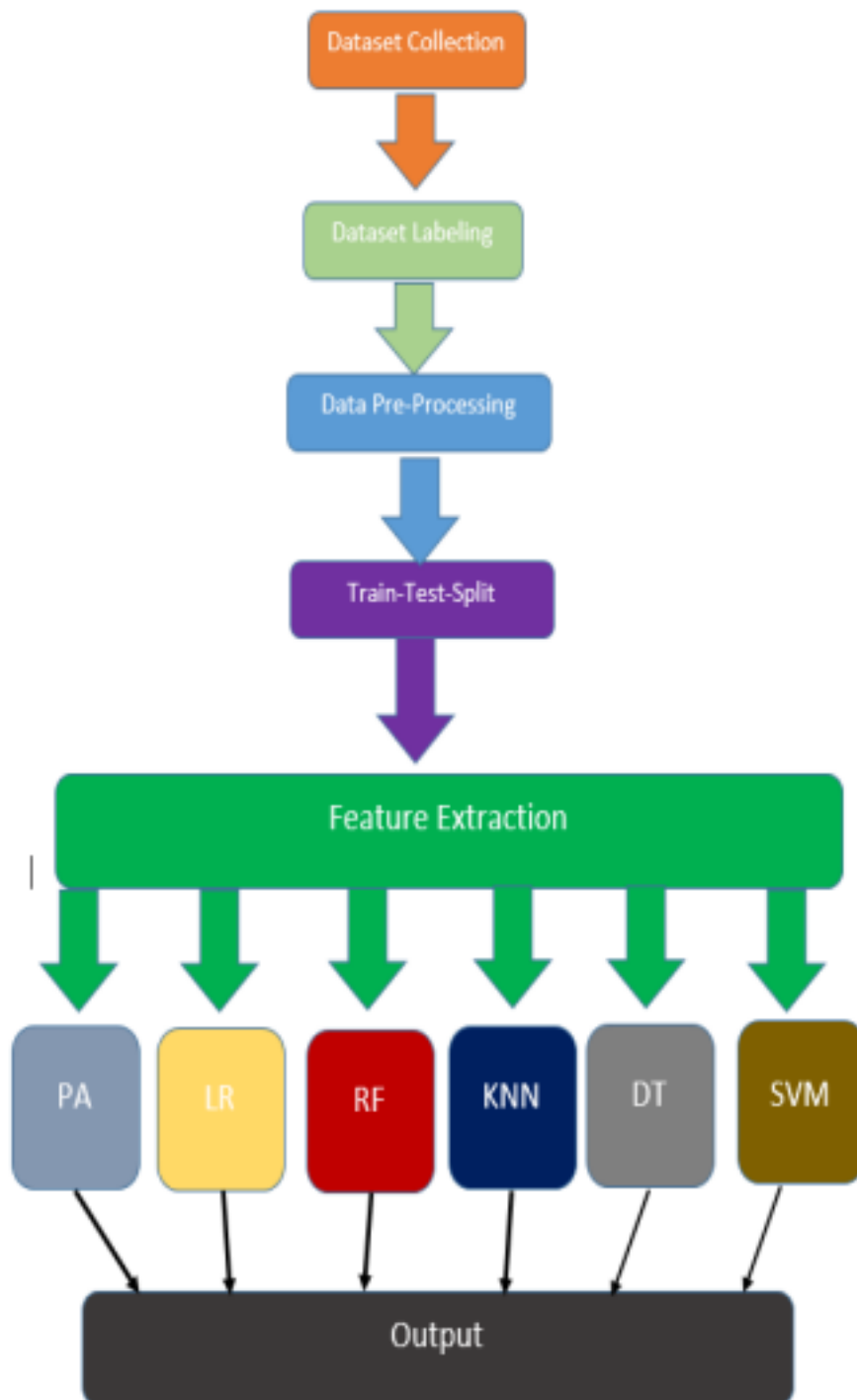
Figure 2: workflow of model

CHAPTER 4: Experiments Result and Discussions

4.1 Experimental Setup

A lot of research papers have been discovered for fake review detection. We have gone through several research papers and we got to know that one research paper is different from another research paper. The main difference is the experiment result. The way they do the experiments and do the experimental setup and detect the fake review make their research paper unique. The most interesting part of the research paper is the experiment result. It is different in all the research papers. So that's why we want to do this research and make the system of fake review detection.

first, we search for suitable datasets which meet our requirements. After a lot of searching, we have found a suitable dataset that meets our needs. After that difficult part has come. We have labeled the data set as fake or real. We have taken much time to label this dataset. after that, we must pre-process the data. If we want to have a great accurate result then we have to preprocess the data, because there are some unnecessary symbols. So to remove this unnecessary symbol we must preprocess the data. after that, we split the dataset into training and testing. then we used TF_IDF vectorizer. After that, we have to use machine algorithms. In machine algorithms, we have used supervised machine learning algorithm. From the machine learning algorithm, we have found different accuracy result for each classifier. after that we manually test the dataset and check it detects fake reviews or not. We also added a confusion matrix so that we can find out how many are truly positive and how many are true negative. And we also found how many are false-positive and how many are false negative.

The summary of the whole experimental setup is in this novel work we actualized ml algorithm and by utilizing different visualizing apparatuses we analyzed the fake review data scenario and at last distinguished the fake review on the given information.

4.2 Experimental Results & Analysis

Within the last chapter, we went through the information collection methods as well as the measurable analysis. The instrument for recognizing fake reviews has moreover been expressed. Since our whole handle is part of that framework, we'll start with the information handling portion. Information handling means data processing. first, we have done data pre-processing for the data pre-processing preprocessing used technique we have used stop words.

<u>Before data preprocess</u>

Before preprocess dataset looks like :

	label	reviewText
0	real	I enjoy vintage books and movies so I enjoyed ...
1	real	This book is a reissue of an old one; the auth...
2	real	This was a fairly interesting read. It had ol...
3	real	I'd never read any of the Amy Brewster mysteri...
4	real	If you like period pieces - clothing, lingo, y...

Table 1: Before Pre-process Dataset

After Data Preprocess

After preprocess dataset looks like:

	overall	reviewText	data_clean
0	real	I enjoy vintage books and movies so I enjoyed ...	enjoy vintage books movies enjoyed reading boo...
1	real	This book is a reissue of an old one; the auth...	book reissue old one author born 1910 era say ...
2	real	This was a fairly interesting read. It had ol...	fairly interesting read old style terminology ...
3	real	I'd never read any of the Amy Brewster mysteri...	never read amy brewster mysteries one really h...
4	real	If you like period pieces - clothing, lingo, y...	like period pieces clothing lingo enjoy myster...

Table 2: After Pre-process Dataset

After preprocessing the data we have used the TF_IDF vectorizer. Vectorizer could be a function extraction instrument and with a customary expression, we evacuated those uncommon characters.

a) **<u>True With Positive</u>**: It took the sum of writings having a place to the information for assessment reason and measured adjust name information concerning to that certain targets.

b) **<u>True With Negative:</u>** It took the sum of writings having a place to the information for assessment reason and measured redress name information with not concerning to that certain targets.

c) **<u>False With Positive:</u>** It indicates the amount of information from the assessment sets which isn't adjusted name for that information, which has been experienced with the algorithm compared to that target.

d) **<u>False With Negative:</u>** It signifies the amount of information from the assessment sets which isn't adjusted name for the information experienced with the algorithm and not compared to that target.

Confusion matrix

Confusion may be an m*m metric that is utilized for assessing the classification model's output and m are the numbers of targets bunch. The framework differentiates the genuine exact esteem from the ML models. Now we will show you the confusion matrix for different machine learning algorithms that we have used in our system.
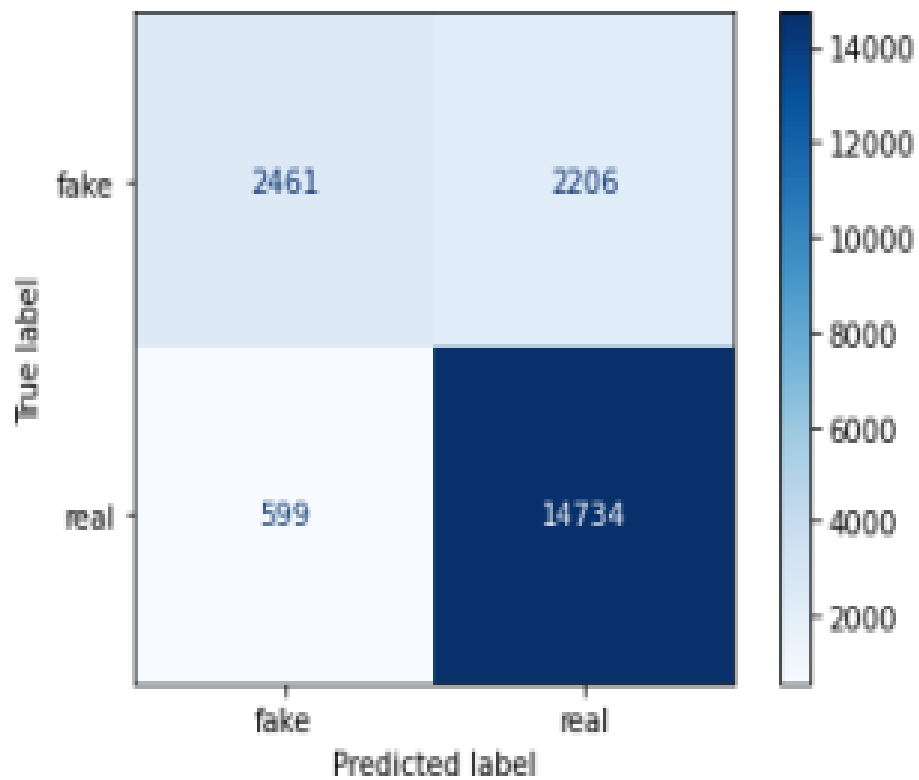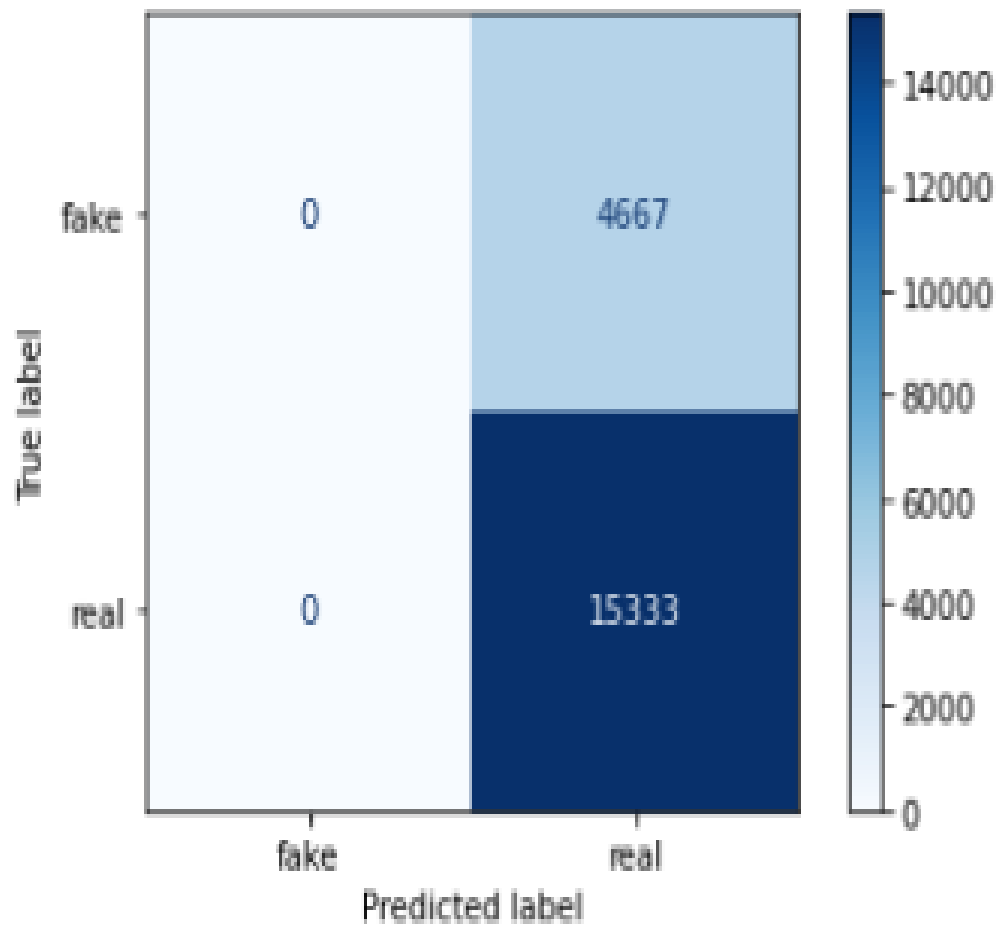
Passive Aggressive Classifier Confusion Matrix
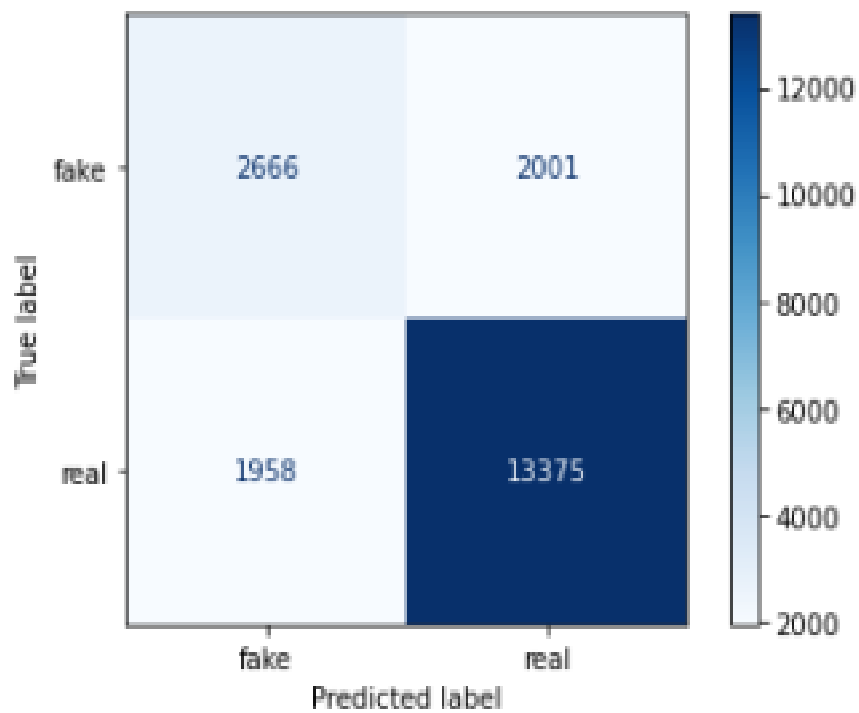
Figure 3: Confusion Matrix of Passive Aggressive
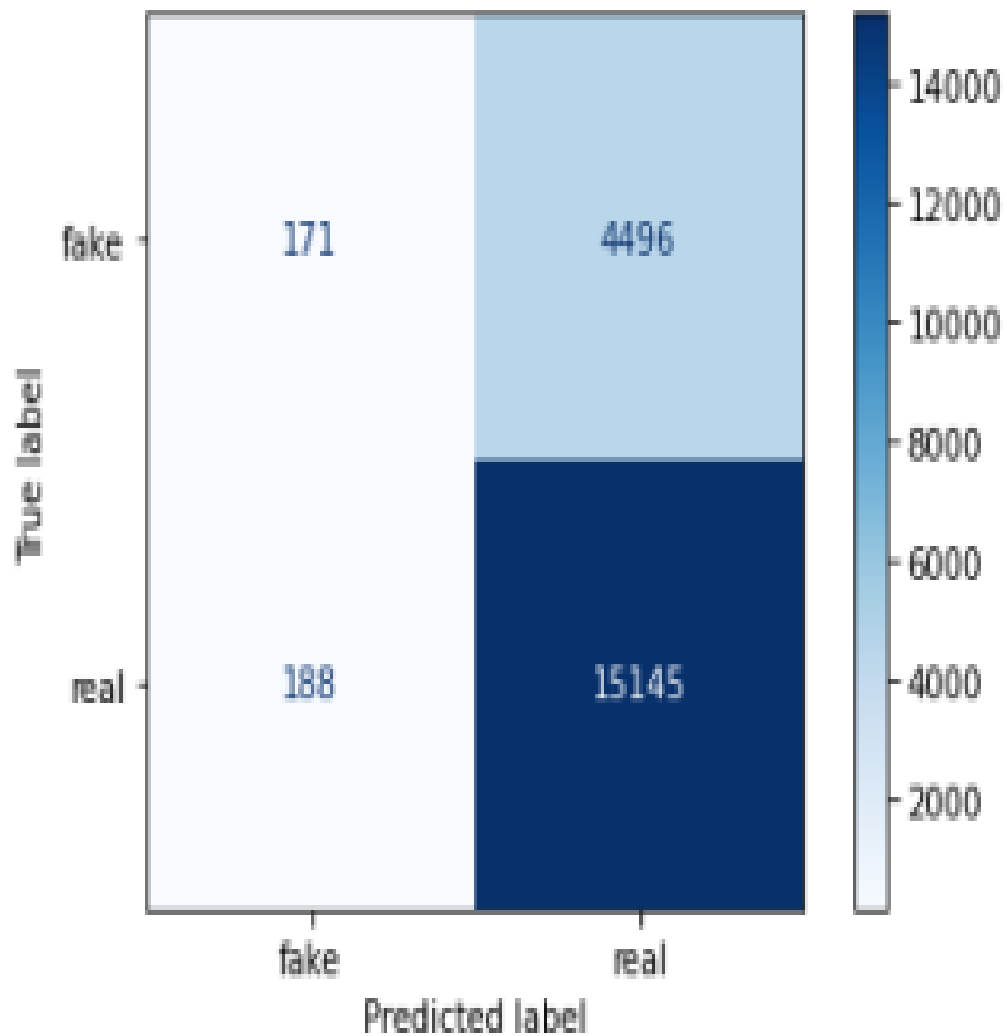
Logistic Regression Confusion Matrix

Figure 4: Confusion Matrix of Logistic Regression
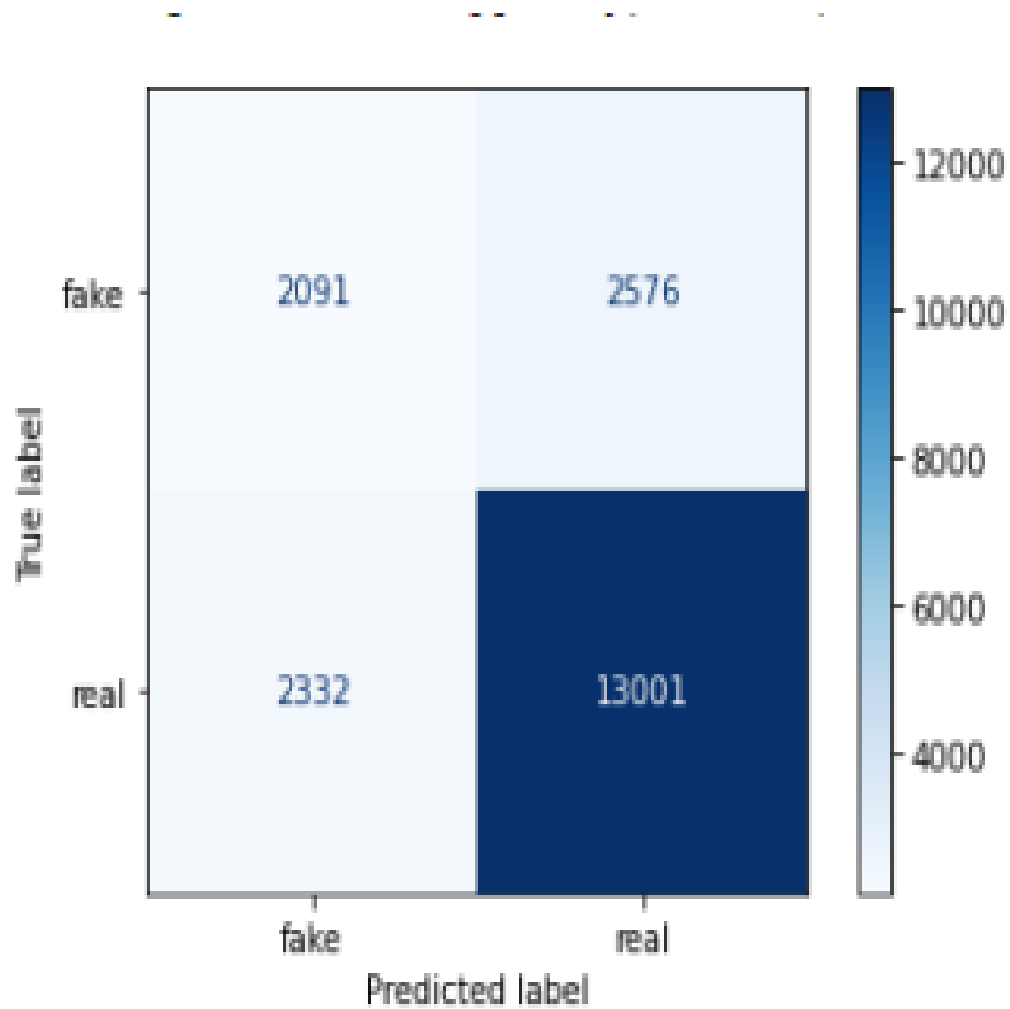
Random Forest Confusion Matrix

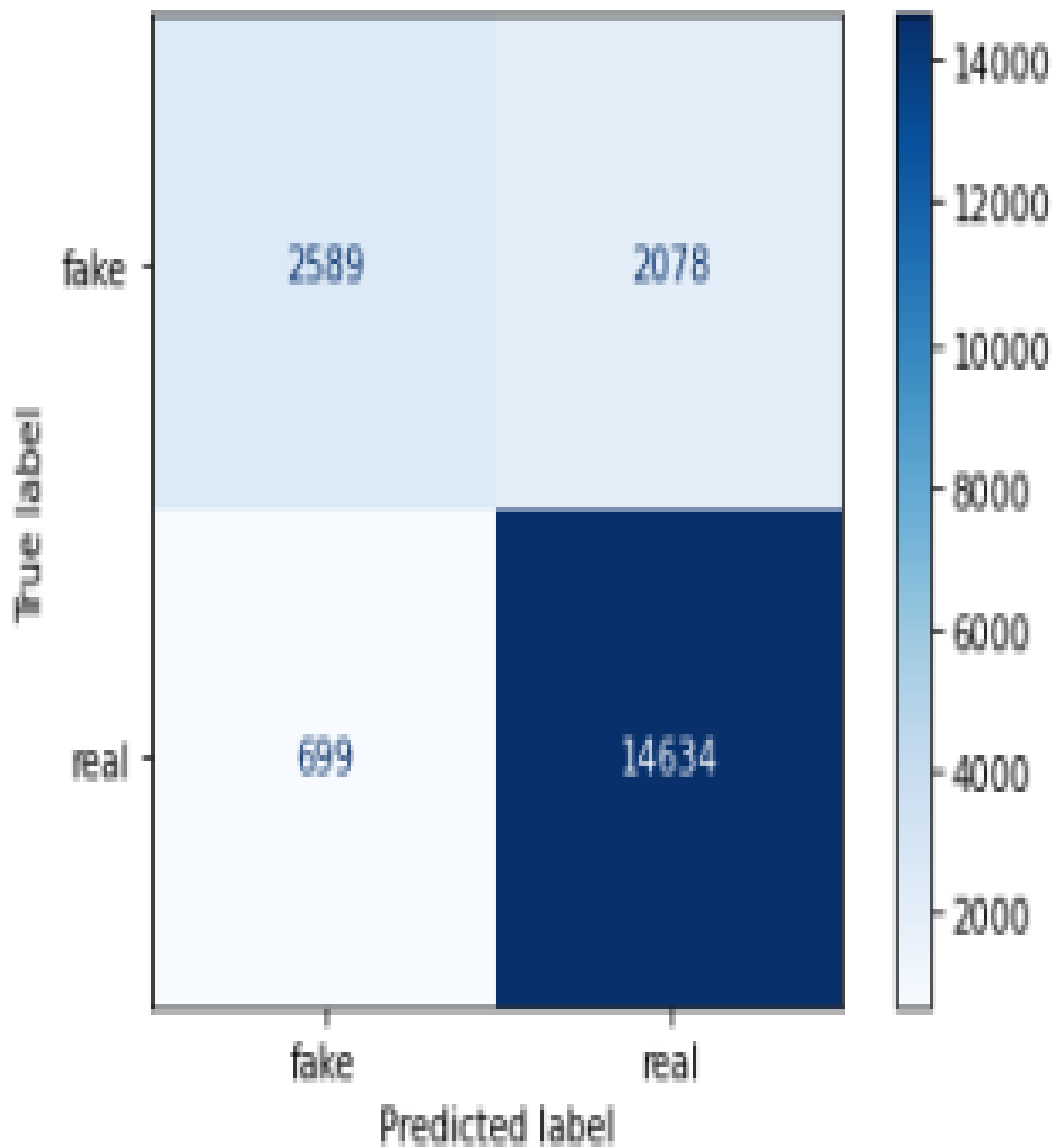**Figure 5: Confusion Matrix of Random Forest**

K-Neighbors Confusion Matrix

Figure 6: Confusion Matrix of K-Neighbors

Decision Tree Confusion Matrix

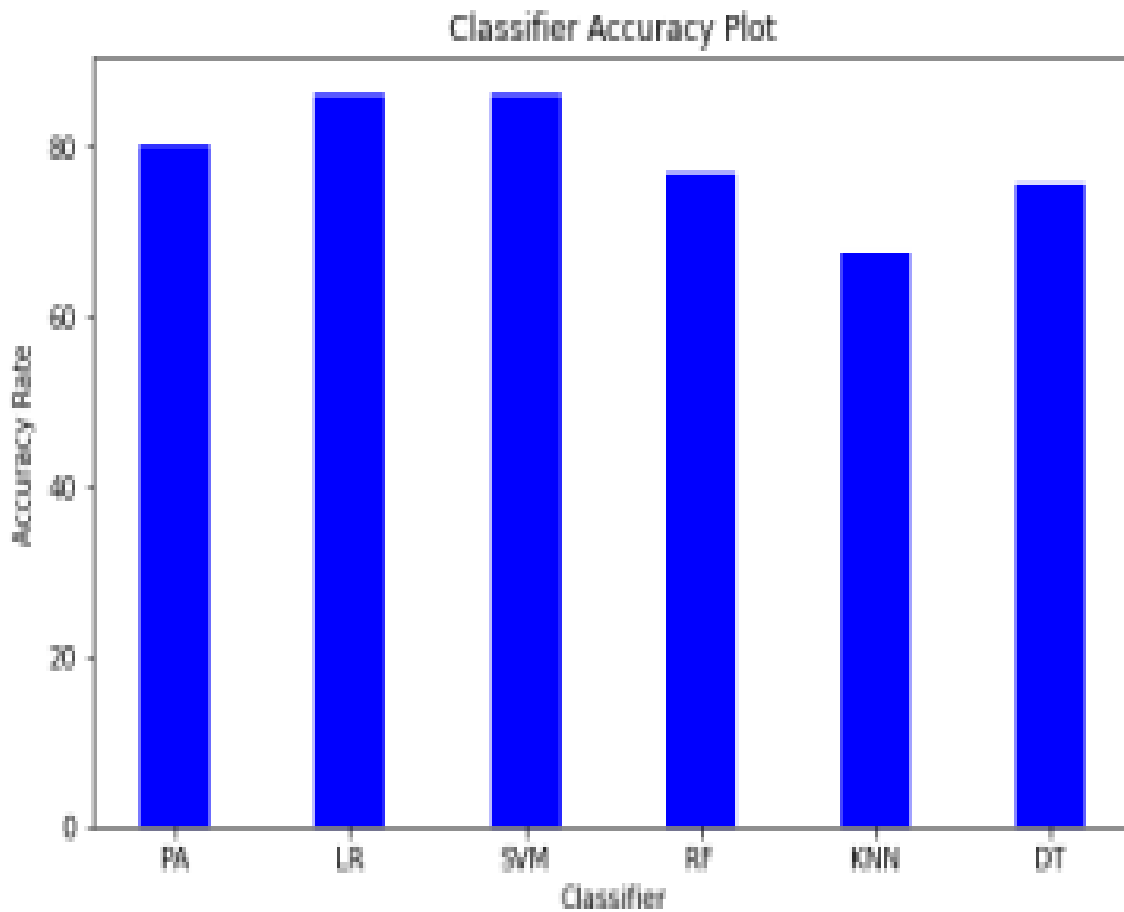**Figure 7: Confusion Matrix of Decision Tree**

<u>Support Vector Machine Confusion Matrix</u>

Figure 8: Confusion Matrix of Support Vector Machine

Accuracy graph of Classifier

Now we will show a graph of the accuracy rate of each algorithm we have used in our system. Almost all ML algorithms shoes an accuracy rate of 80%.

Figure 9: Classifier Accuracy Bar Chart

Comparative table

Classifier	Accuracy
Passive Aggressive	80.2%
Logistic Regression	85.98%
Random Forest	76.67%
K-Neighbors	76.58%
Decision Tree	75.46%
Support Vector Machine	86.12%

Table 3: Comparative Table of Classifier

4.3 Discussion

In this paper, reviews have been categorized into 2 divisions fake and genuine. We prepared models with six calculations and each classifier donate the most excellent result and we got more than 90% scores from test information. To take after the system and to recognize fake survey we utilized a few calculations with Pandas, sklearn, matplotlib, nltk, disarray lattice, etc. With these discoveries, it is presently conceivable to decide fake reviews by text.

Chapter 5: Summary, Conclusion, Recommendation and Implication for Future Research

5.1 Summary

In our research, we have collected our data from online sites and labeled them into two categories. One is real review and the other is fake review. After that, we have preprocessed the data to get a nice and clean text so that we can get a better result. Then we have to use the TF_IDF vectorizer to convert these data into numeric values so that we can use machine algorithms to get better and accurate results. After that, we have used 6 supervised machine learning algorithms and these algorithms gave us an almost 80% -85% accuracy rate.

5.2 Conclusion

The fake review has a great impact on online sites. It can make a product famous which is not good and can make any product face loss. As a result, some bad people gain much profit from these techniques. For these purposes, customers who are buying products from online site get cheated in the middle. So these kinds of fake reviews must be detected. To detect these fake review many research paper has been published. More system has been developed. But the main concern is how to detect fake review detection more accurately and also do the comparison between all classifiers which is given the best accurate result against the one dataset. Deciding and comparing the exactness rate of different classifiers is exceptionally critical and very challenging as well. We have used TF-IDF vectorizer to construct the show and discover the precision rate of different classifiers. After fruitful usage and doing the comparison between diverse classifiers we concluded that the back vector machine logistic regression classifier is giving the finest exactness rate among the other classifiers.

5.3 Recommendation

The dataset we are using for research paper purposes cannot be further categorized. We use machine-learning algorithm in our dataset and we get about almost 80 to 85 percent detection accuracy rate. In our dataset most quantifiable data is was positive data. So our recommendation is if we make the detection accuracy rate above 90 percent then our model will detect fake reviews more accurately.

5.4 Future Scope Of Work

We want to do more work and more research about fake review detection. We want to construct up a web framework where on the off chance that a fake comment is given the admin can physically see their IP address and piece it too. In the future, we will select a classifier so it can increment its efficiency and precision rate. Now today everyone has a smartphone. We also want to build up chatbots offline app for fake review detection. So that anyone can anytime do fake review detection when they see any review.

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APPENDIX

The appendix describes the afterthoughts of our project. We believe that our group work was exceptionally strong and challenging. We have made a system of fake review detection which is very beneficial for customers or users. They can use our system and easily select fake reviews. In our work, we also reflect on which classifier is best for our system by comparing supervised machine learning algorithms. If we could fund more features for our research project then we will build more constructive software systems for detecting these fake reviews.

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