

**A MAJOR PROJECT-II REPORT**  
**ON**  
**Unveiling the Mirage & Truth Seeker: A Machine Learning Approach to Combatting Fake News**

**Submitted in Partial Fulfillment of the Requirement  
for the Degree of  
Master of Technology**

**In  
COMPUTER SCIENCE & ENGINEERING  
By**

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Under the Guidance of**

**Prof. Shailender Kumar  
(Professor)**



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**CANDIDATE'S DECLARATION**

I , Ananya Mukhopadhyay, student of M.Tech Computer Science Engineering (CSE), hereby declares that the project Dissertation titled “Unveiling the Mirage & Truth Seeker: A Machine Learning Approach to Combatting Fake News” which is submitted by me to the Department of Computer Science Engineering, Delhi Technological University, Delhi in partial fulfillment of the requirement for the award of the degree of Master of Technology is original and not copied from any source without proper citation. This work has not previously formed the basis for the award of any Degree, Diploma Associateship, Fellowship, or other similar title or recognition.

**Place:** Delhi

Ananya Mukhopadhyay

**Date:** 31<sup>st</sup> May  
2024

**DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING**

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Bawana Road, Delhi-110042

**CERTIFICATE**

I hereby certify that the Project Dissertation titled “Unveiling the Mirage & Truth Seeker: A Machine Learning Approach to Combatting Fake News” which is submitted by Ananya Mukhopadhyay, 2K22/CSE/04 from the Department of Computer Science Engineering, Delhi Technological University, Delhi in partial fulfillment of the requirement for the award of the Degree of Master of Technology, is a record of the project work carried out by the students under my supervision. To the best of my knowledge, this work has not been submitted in part or full for any Degree or Diploma to this University or elsewhere.

**Place:** Delhi

**Date:** 31th May 2024

**Prof. Shailender Kumar**

*(Professor)*

**Department of Computer Science Engineering**

## **ACKNOWLEDGEMENT**

We would like to express our heartfelt gratitude to all the individuals who have supported and assisted us throughout our M.Tech Major Project. First and foremost, we would like to thank our project supervisor, “ **Prof. Shailender Kumar**”, *Professor*, Department of Computer Science Engineering, Delhi Technological University for his constant guidance, support, and encouragement throughout the project. We are indebted to him for sharing his knowledge, expertise, and valuable feedback that helped us in shaping the project.

We would like to extend our sincere thanks to the **Vice Chancellor** of Delhi Technological University, “**Prof. Jai Prakash Saini**” and the faculty members of the Department of Computer Science Engineering for their support and encouragement throughout our academic journey. We are grateful to “**Dr. Vinod Kumar**”, *Head of Department*, Department of Computer Engineering, Delhi Technological University, Delhi for his valuable suggestions and feedback on our project work.

We are also thankful to our parents for their constant support and motivation, which has been our driving force throughout our academic pursuits. We would like to express our gratitude to our friends and classmates who have been a constant source of inspiration and motivation.

Finally, I would like to thank all the participants who participated in the study, without whom this research would not have been possible. I express my sincere gratitude to all the individuals who have directly or indirectly contributed to the success of my project.

**Ananya Mukhopadhyay**

**(2K22/CSE/04)**

## ABSTRACT:

Fake News detection is a big challenge in today's world , which favors the human from prevent spreading misinformation. For detection of incorrect news and truth seeking eyes has hunger of real news , we created a Machine Learning model on Fake News Detection. Identifying and combating fake news is a critical endeavor, involving the differentiation between harmful misinformation and genuine information. These misleading articles might contain malicious links aimed at compromising users' personal data through deceptive tactics. A simple and fast technique to detect fake news is proposed here. This paper employes a combination of machine learning, deep learning and NLP technique. Machine Learning is used to find relation between different kind of data. Deep Learning is used to find the relationship between different kind of data including image recognition in natural language processing, speech recognition etc. Thus different learning algorithm is used for correct output details of different kind of input data.

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## Chapter 1

# Introduction

### INTRODUCTION:

The latest hot topic, Fake News is misleading news articles in the society and task of **data scientist** to detect it in its viral spread. Fake news is the term, which is misleading the generation hiding real truth for some reason. Fake news is a new term but not new phenomenon. Since 19th century fake news came into picture. With the advancement in technology, the news published in different news paper, news channels is the main cause of rapidly increase of fake news.

The most common opinion of increasing fake news, is to increase public comment. Secondly, some fake news increase business policy for rapid money. Thirdly, fake news creates to satire the society. This criticism may also affect a bunch of public. The machine is used to detect the fake news very fast. With Machine Learning algorithm we can detect fake news with some scientific way. Also machine able to detect correctly than human can do. So, human depend on machine to detect accurately and creating path for correct advancement towards the modern society.



## **METHOD OF DETERMINATION:**

Fake news detection taking significant importance in today's world. It creates deliberately misinformation among the readers. Fake news comes in different forms like video, text, audio etc. Creation in different form of fake news make it difficult to detect . That is why , to combat fake news technologists created various rules for detection .

### **How To Detect Fake News?**

As a human being, when we read something, we read the whole sentence and interpret it's meaning. Same thing we try to implement in a machine too by various ML algorithm . In this project we teach a computer how to understand difference between real news and fake news by Natural Language Processing(NLP). For that we use many algorithm like logistic regression, SVM and also do word-to-vector conversion, TF-IDF vectorization.

TF-IDF determines importance of a word in the whole corpus . **Term Frequency** determines the relative frequency of a term in a document. It is calculated by , number of times the term came in document by total number of terms in the document. **Document Frequency** is how frequently a term comes in the document, while the **Inverse Document Frequency** checks if the term is really relevant for the document. TF-IDF is used to fast calculation in Machine Learning technique. It also has another advantage, that it works well for long text. So, performance improvement is the main reason that we use TF-IDF in Fake News Detection technique.

Word-to-Vector conversion is similar technique as TF-IDF. Word2Vec is a NLP process to map a word in vector space. Vector Space represents every word as a unique number. So, similar type of words has same type of vector representation. Difference in TF-IDF and Word2Vec is TF-IDF works for high dimensional data while Word2Vec work for low dimensional data.

TF-IDF and Word2Vec both has importance in Fake News detection. Different LSVM classifier is used for detecting Fake news with different methods and in some case first one give better result , while second one give accurate result in some other cases.

Also in fake news detection we can use **Bag-of-Words**. Bag-of-Words count the number of occurrences of a word. Means while doing representation of vector format , it counts number of occurrences of that word, while TF-IDF also collect information about the most important words and less important words.

Now first reading a news , how a user can determine, if the news is real or not? As a news reader, we also run behind original news which has some importance in society.

So before reading a news must aware of the following:

1) **Consider the Source:** Before read a news, consider from which source it is coming. If source is trusted, then information inside also should be valuable. Otherwise , untrusted source might give lots of misinformation. Like, if you read in a good school, you will be impacted with values. Like that trusted source know the value of faith of human.

2)**Read beyond the headline:** Before read an article read it's headline first. If headlines are relevant to today's world or you are interested in it then only go for further details.

3)**Check the Author:** In a magazine or news article reading, check the author of the news. Author plays an important role in spreading news. A good author also have the intention to prevent misinformation to make a healthy society intact.

4)**Check the Date:** Check date to know, if the news still valid in recent world. Relevance matters for a news article reading from any source.

The Machine Learning technique, Artificial Intelligence and Natural Language Processing indeed take a major role in Fake News Detection . Some techniques to use fake news detection:

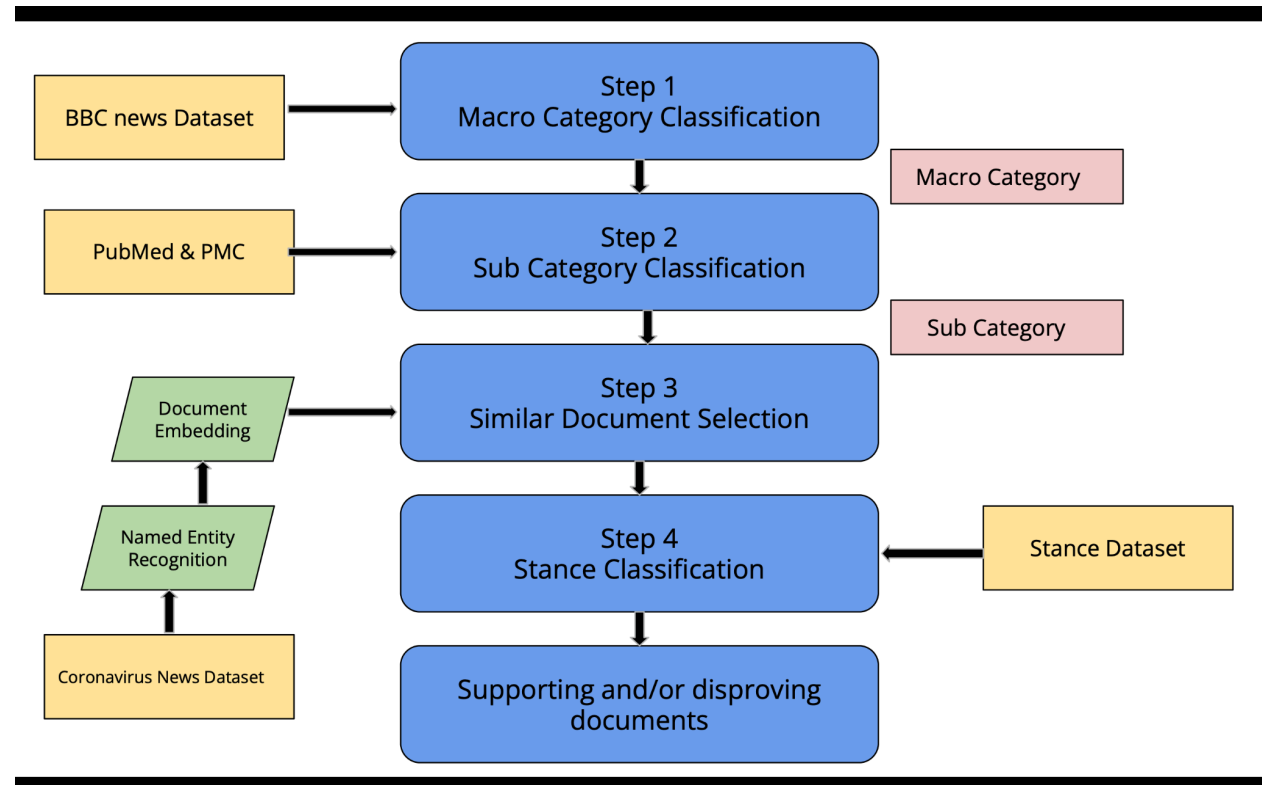
1. **Supervised Learning**: In this model we use labeled dataset to find if the dataset is real or fake. Algorithm includes Support Vector Machines, Random Forests or Neural Network for classification.

2. **Natural Language Processing**: NLP technique is crucial technique to find fake news from news article. Methods like

(i) **Sentiment Analysis**: Before reading a news, reader also can assume authors sentiment about that article. Totally positive or negative sentiment might spread misinformation towards the society.

(ii) **Topic Modeling**: How the topic need to be modeled and which technique (like BERT etc.) works well for news detection plays important role in any model.

(iii) **Named Entity Recognition**: We divide an article in subcategory like macro-category. Next we find how many documents are contributed in that document category, that is called named-entity, which helps in identifying suspicious and misleading content.



3.**Deep Learning:** For complex patterns of textual data we use CNN and RNN methods.

4.**Graph Based Model:** Fake news spread through social media. Graph based modeling analyze suspicious sources or find cluster of account which is spreading misinformation.

5.**Feature Engineering:** Crafting meaningful feature from raw data will significantly improve performance. Feature includes historical data, news sources, user engagement matrices etc.

6.**Ensemble Method:** Ensemble method is used for bagging and boosting technique.

7.**Active Learning:** Since large dataset is time consuming, active learning intelligently select the informative instances to get maximum efficiency.

# Related Work

## **SPAM DETECTION:**

In spam detection , we do feature extraction . Spam detection is a machine learning algorithm, where we deletes unwanted mails, messages etc. Spam will detected with sender reputation or other factor with a Machine Learning algorithm to locate untrusted or unwanted messages from a unknown person. It is observed that reading an article or messages you detect it as a spam. The algorithm check the content and for future emails if a content has some match with the pattern of previous emails , then mark it also spam. Like that spam detection algorithm works.

The algorithm for spam detection is unsupervised machine learning algorithm which operates on unleveled data.The spam detection is a feature detection technique, where we could use Naive Bias, TF-IDF , Support Vector Machine type algorithm . To detect a dataset as spam or ham we can do following steps:

- 1) Check the detail of dataset , when we received a mail.
- 2) Collect spam dataset and classify them as spam.
- 3) Collect user information regarding spam dataset.
- 4) According above information decide which dataset is spam and which is not spam.

## **STANCE DETECTION:**

In the year 2016, there was a contest to find stance in a sentence. Stance detection involves a particular text to a specific target. In sentiment analysis we do detect sentiment of an author, like the sentiment is positive, negative or neutral. In stance analysis, we go further and find, if the author is supporting or not supporting the statement.

Stance Detection divided in following parts:

1. Task Definition: At first, we need to define task. Task Definition is an important part to define clearly what task we are going to perform, which we need to do as the first step of fake news detection.
2. Data Collection: Here we collect data from various sources, Like LIAR datasets. It collect data from various resources and try to figure out, which information is true and which one is false.
3. Preprocessing: In this state of model we do data cleaning, means we do lowering the text, remove punctuation,
4. Feature Extraction: Three feature extraction technique is used can be used in fake news detection. TF-IDF, Count-Vectorizer, Hash-Vectorizer. By these technique we can do feature extraction for this model.

5. Modeling: For proper evaluation we run the model on three algorithms-Logistic Regression, SVM and Random Forest.

6. Training: Then we send 80% of collected data for training and 20% for testing.

7. Evaluation: Finally evaluate the result in the confusion matrix. We find Accuracy, Precision, recall, predict by the model. And at last we represent them in the form of line graphs and bar graphs.

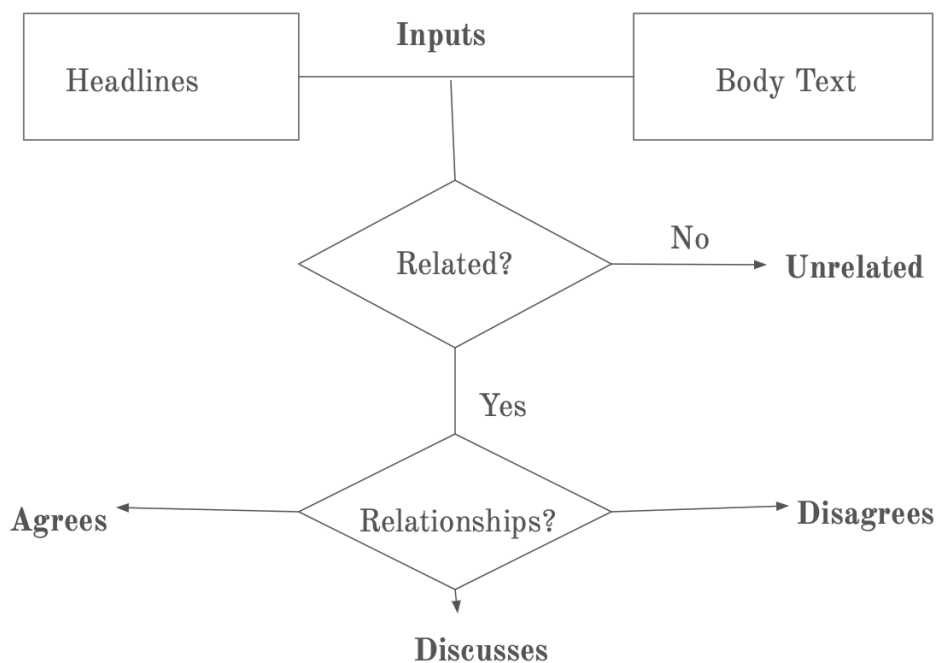
## Benchmark Dataset:

Author creates a benchmark dataset to get fine tuned data , which could be able to avoid any kind of fake news . Below flow chart is a simple diagram , about all the techniques we discussed above. In all ML algorithms almost gone through a similar approach.

In the following flowchart we have seen, first take input from headline and body of text. Then with the relevant algorithm , we check if it is related or not. If relevant we check it's relationship with the main news. Otherwise we just put it as irrelevant news.

If the news has a good relationship with the main news, we go into further discussion of that news. We can do further discussion by agreeing with the news , or we can disagree with the main statement of the news. That means every reader must able to accomplish their own view on that news.

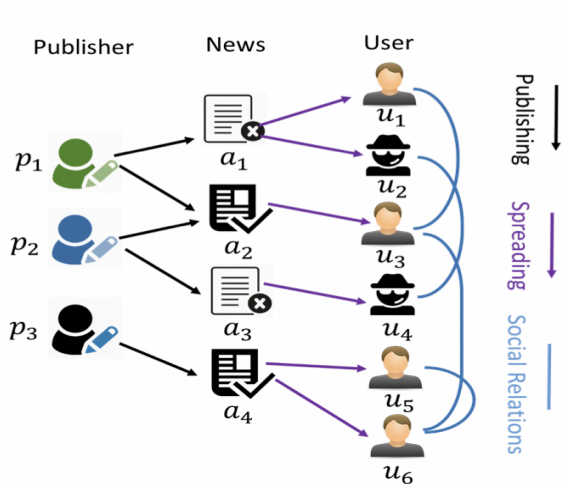
This discussion will be a step for better society in the near future.



This flowchart will give clear visualization and relationship of how fake news detection algorithm works.

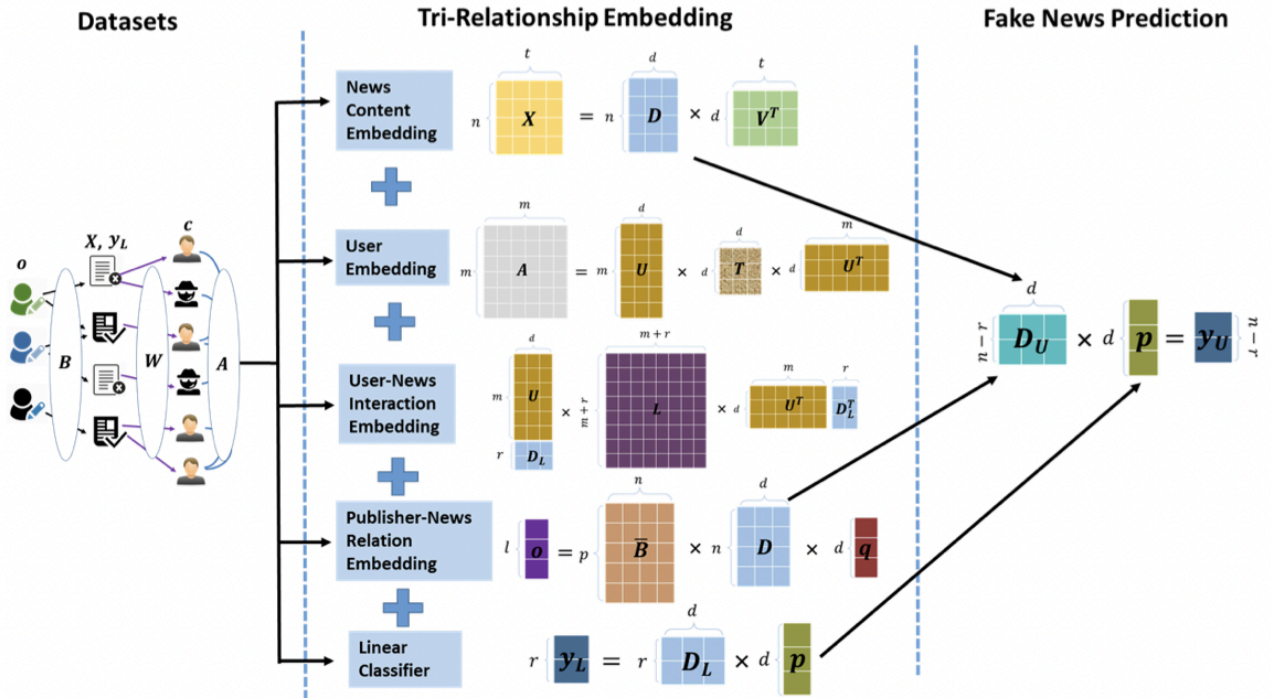
### Tri-relationship Embedding:

This is three dimensional embedding to show relations between news, publisher and user. Some publisher produces some news, that news read by certain kind of users.





Here  $p_i$  is the publisher  $p$  for news item  $a_i$  ( $p \rightarrow a$ ) and this news item  $a_i$  is spread among user  $u_i$  ( $a \rightarrow u$ ).



This tri-relationship embedding framework, we presented with a matrix format, which has five rows News Content embedding, User Embedding, User News Interaction Embedding, Publisher-News Relation Embedding and Linear Classifier.

## Chapter 3

# Datasets

In every model , we divide the documents in subparts and classify them as a dataset. Like for detection of news we divide them as disease in one subcategory, natural disaster in another like that. Again we divide , among disease we also divide them in some macro category. Like ‘heart disease’, ‘COVID-19’ macro categories of diseases. Partition of dataset is necessary to classification part of a model and keep them in a certain cluster.

LIAR datasets: LIAR dataset contains two types of file like True.csv and Fake.csv. In liar dataset there are 1282 unique values.

ISOT datasets: It also contains true and fake news datasets. Characteristics of ISOT dataset, that it contains world news , politics news , government news etc.

<i>Label of News</i>	<i>Number of articles</i>	<i>Article type</i>	<i>Articles</i>
True	21,415	World news	10,145
		Politics news	11,272
		Government news	1,570
Fake	23,481	Middle east	778
		Left news	4,459
		Politics	6,841
		News	9,050

The characteristics of the ISOT fake news dataset

Total number of datas in ISOT dataset.

## Describing Neurons

We know in human neuron connects every cell of human body. In dataset too neuron connects multiple datasets . In fake news vs. real news dataset, we numbers the dataset as 0 and 1. Neural Net is similar pattern words , send in the category of same news.

## Sentence Level

It includes Support Vector Machines, CNN, LSTM, Logistic Regression etc.

## Document Level

There is no dataset like Liar dataset for fake news detection. Suppose Gene has a dataset from Kaggle which is restricted to business, politics, sports news, weather. But no date level constraint has taken to take extra care of these dataset, which will put an extra layer in the dataset, which is biased may be more or less popular in the dataset.

## Fake News Sample:

Trump is getting support from every leader, and that's the support that will make him grow great and strong. These elections will bring an immense change in our country.

→ Fake news content

Real News Sample:

<b>Raw information</b>	<b>Fake</b> There is a broken egg on the road.	<b>Real</b> The chicken has crossed the road.
	<b>Desirable</b>	
<b>Politically processed information</b>	<b>Fake, but Desirable</b> A chicken is a chicken even while it is in the egg. The broken egg on the road was a sign that the chicken had never crossed it.	<b>Real and Desirable</b> The chicken has crossed the road. This is an important milestone many were waiting for.
	<b>Fake and Undesirable</b> Those who ignore that the chicken has crossed the road, dream of broken eggs on the road.	<b>Real, but Undesirable</b> Due to the ongoing investigation, we are unable to tell whether the chicken has crossed the road or not.
	<b>Undesirable</b>	

## Chapter 4

### Methods:

I have run TF-IDF in the above model. The model used here is True and False datasets. From Kaggle I downloaded the datasets . In the preprocessing phase , the data gets cleaned. Here text got lowered, translated, tokenized . TF-IDF stands for **Term Frequency and Inverse Document Frequency**. It is important to measure how a term is important to a document in a collection or corpus. After text cleaning TF-IDF vectorizer transforms the text matrix to a dataframe for a better visualization. After TF-IDF and Word2Vec conversion we could apply various algorithms on it . Like Logistic regression, SVM , Decision Tree etc .

### Word to Vector & TF- IDF:

Term Frequency denotes how many times a word comes in a document and Inverse Document Frequency total number of documents by the documents . As a feature of it we have done stop word removal (like ‘and’, ‘the’), lowercasing , removal of punctuation, stemming

### Topic Dependency:

We have jumbled all the news article and Then put them into algorithm for evaluation.

Sentence Level Baselines: TF-IDF is used to sentence level differentiate between words.

Document Level: We are not going to build a big model rather build a simple and small model which will understandable with correct output. That is why we took some True csv file and tried to make some trigrams.

This model will create a deep neural network to find true news among many other news. Fake news spread as a viral speed. So, our aim is to correct detection of fake news for separate it from real news.

WASHINGTON (Reuters) - The head of a conservative Republican faction in the U.S. Congress, who voted this month for a huge expansion of the national debt to pay f
WASHINGTON (Reuters) - Transgender people will be allowed for the first time to enlist in the U.S. military starting on Monday as ordered by federal courts, the Pentag
WASHINGTON (Reuters) - The special counsel investigation of links between Russia and President Trump's 2016 election campaign should continue without interferenc
WASHINGTON (Reuters) - Trump campaign adviser George Papadopoulos told an Australian diplomat in May 2016 that Russia had political dirt on Democratic preside
SEATTLE/WASHINGTON (Reuters) - President Donald Trump called on the U.S. Postal Service on Friday to charge "much more" to ship packages for Amazon (AMZN.C
WEST PALM BEACH, Fla./WASHINGTON (Reuters) - The White House said on Friday it was set to kick off talks next week with Republican and Democratic congressior
WEST PALM BEACH, Fla (Reuters) - President Donald Trump said on Thursday he believes he will be fairly treated in a special counsel investigation into Russian meddl
The following statements were posted to the verified Twitter accounts of U.S. President Donald Trump, @realDonaldTrump and @POTUS. The opinions expressed are h
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WASHINGTON (Reuters) - Alabama Secretary of State John Merrill said he will certify Democratic Senator-elect Doug Jones as winner on Thursday despite opponent R

## Cleaning:

Cleaning is the normal way of preprocessing the data before training and evaluating. ML algorithm depends on which data we are feeding them. Cleaning is a first step of preprocessing.

## Lower Case the words:

In text cleaning we convert all letter of the text in lower case letter . This lower case approach increase sentence efficiency and improve model to get a high level accuracy.

## Non-English word removal:

In a news article there are some non-english words which appears frequently. The non-english term some foreign words may appear in article . First we have to remove those words from an article. We have to check True fact and False fact from the document. So, no need of any unnecessary word will be there in the document. If there are any dictionary word , called English word. Other than those any *non english word* have to remove from the article . Like ‘Donald Trump’ , a name is never required to understand if the news is real or fake.

So we are removing these term from our dictionary pattern. It also removes digit from source code. Because digits are not valuable information to identify if a news is real or not.

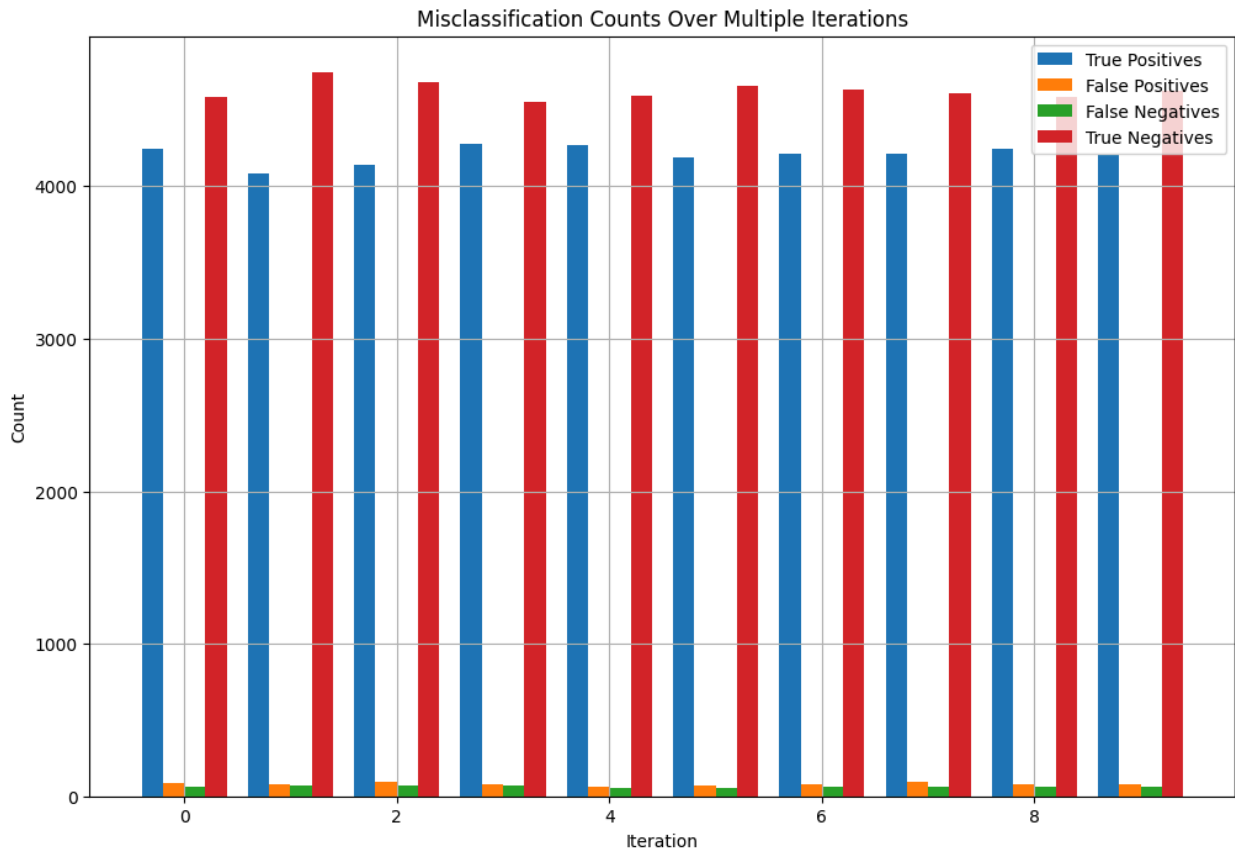
## Source Pattern Removal:

In a real and fake news detection source pattern plays a crucial role. Some news article contain some repeated word which are written in italics . So, we remove italics words directly from article. Some news source contains words like ‘follow us’ like in twitter we see written like follow for more which has no relation with real or fake news. So, remove these words from source for better output. ‘Follow’,’like’, ‘share’ these words are used to catch viewers eye and their liking about the article. So, True or False news fact has no dependency on these keywords. Therefore we remove these words for more specific way to find fake and real news .

## Neurons:

Though accuracy of this model is quite high, still getting more accurate model we use Neural Network. CNN is the technique to find neurons in a model.

Neuron is mainly used to identify a pattern. We generally create some neuron to check how frequently a word comes in a pattern. If the pattern is matching with some previous news, we detect it as a real or fake news with that similar pattern.



**TF-IDF:** The first part of the text contains cleaned text.

```
cleaned_text
0    donald trump white hous chao tri cover russia ...
1    donald trump presumpt gop nomine time rememb c...
2    mike penc huge homophob support exgay convers ...
3    san francisco reuter california attorney gener...
4    twist reason come pelosi day especi promin dem...
```



### TF-IDF Matrix:

The second part of the output shows TF-IDF scores for each term in the cleaned text.

Rows: Corresponds to each document.

Column: Represent unique term extracted from cleaned text.

Values: Corresponding to importance of each term in document.

### Example Terms and their TF-IDF score:

Suppose we assign document as

d0='Ananya1'

d1='Ananya2'

d2='Ananya3'

d4='Ananya4'

Word Indexes: {'Ananya1':0, 'Ananya2':1, 'Ananya3':2, 'Ananya4':3}

Tf-idf values:

(0,0) 1.0

(1,1) 1.0

(2,2) 1.0

(3,3) 1.0

## Chapter 5

# Experiment Results

The accuracy of this model depends on how correctly the algorithm is working. For that we run some algorithms on it like Logistic Regression, SVM , Decision Tree etc.

**Logistic Regression:** Logistic Regression is a Supervised Machine Learning algorithm , to find if a word is in a given class or not. Logistic regression we use binary classification where we use sigmoid function to classify a news.

**Support Vector Machine(SVM):** Support Vector Machine is a Machine Learning algorithm, which is used for text classification, spam detection etc.

**Decision Tree:** Decision Tree is a Supervised Learning Technique where each branch predicts a value and each leaf goes to a decision. Decision tree is a classification model, where classification is done by branching like a tree.

## Tracking Important Trigrams:

We tracked some important trigrams for better visualization. In trigram three words blended . It is a part of a N-gram model . Trigram used for improvement of performance of our model.

## Describing Neurons:

By removing stopwords from the trigram we get some unique neurons. Neuron mainly used to check accuracy and pattern of csv files.

Here after applying all algorithm, we find the precision, recall, accuracy and F1 score for the model.

We saw for Logistic Regression model there,

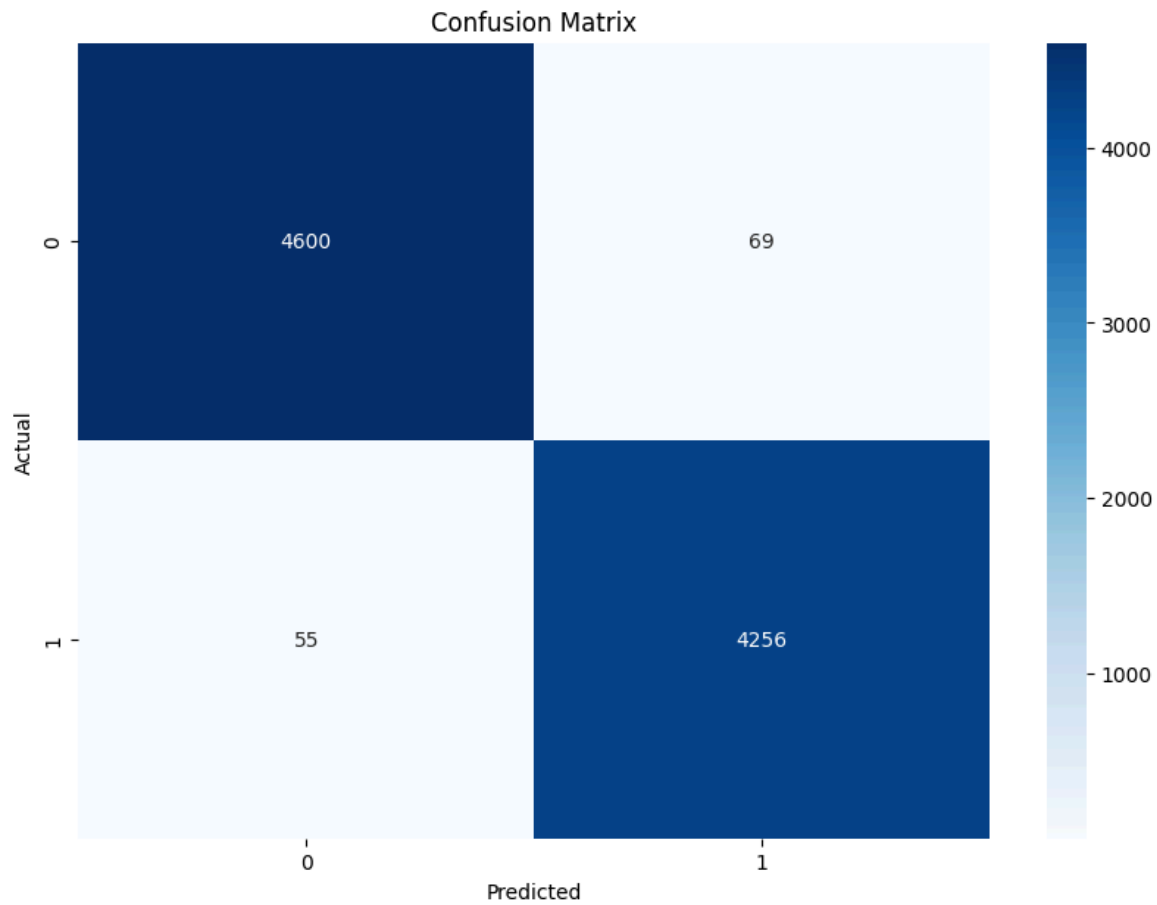
Accuracy=0.99

Precision=0.99

Recall=0.99

F1-Score=0.99

Accuracy using logistic regression is quite high. In confusion matrix shown below, no. of item in true positive=4256, true negative=55, false positive=4600, false negative=69.



(i)Confusion matrix for logistic regression model

## Classification Report for above Logistic Regression Model:

Classification Report:

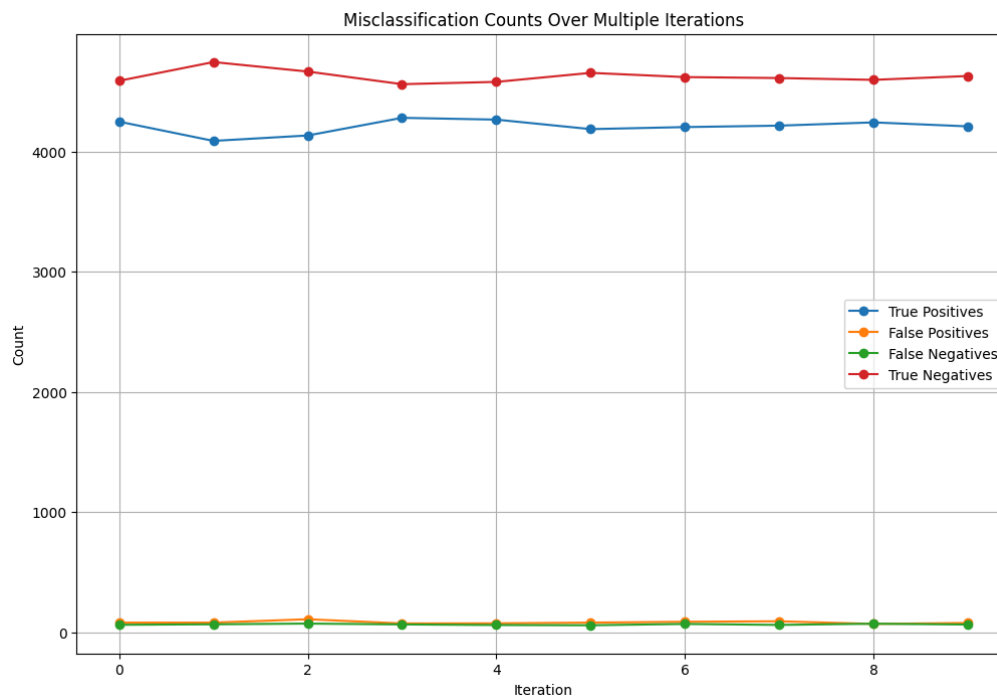
	precision	recall	f1-score	support
0	0.99	0.98	0.99	4669
1	0.98	0.99	0.98	4311
accuracy			0.99	8980
macro avg	0.99	0.99	0.99	8980
weighted avg	0.99	0.99	0.99	8980

Accuracy: 0.99

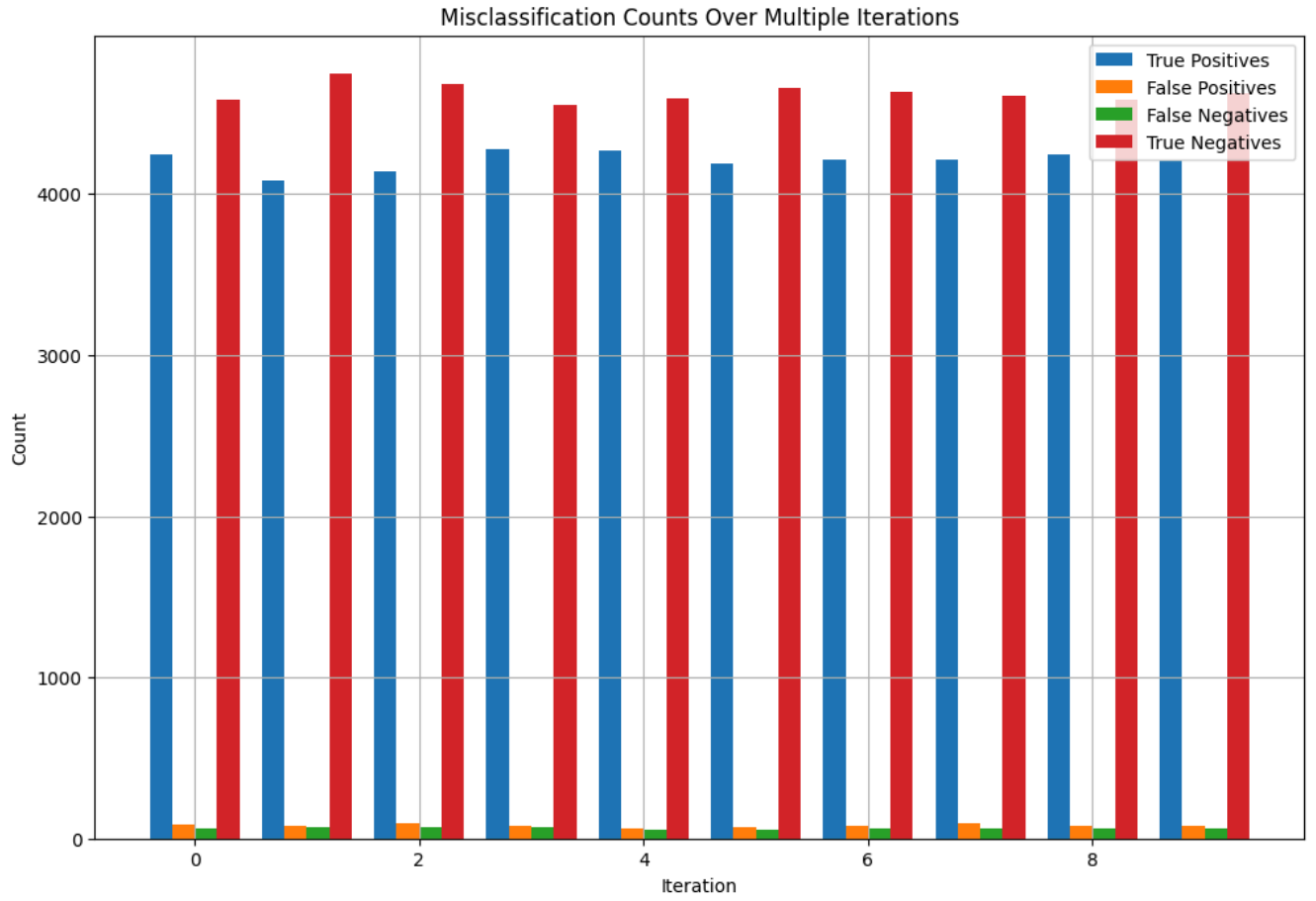
Precision: 0.99

Recall: 0.99

F1 Score: 0.99



(ii) Line graph for logistic regression model



(iii) Bar graph for logistic regression model

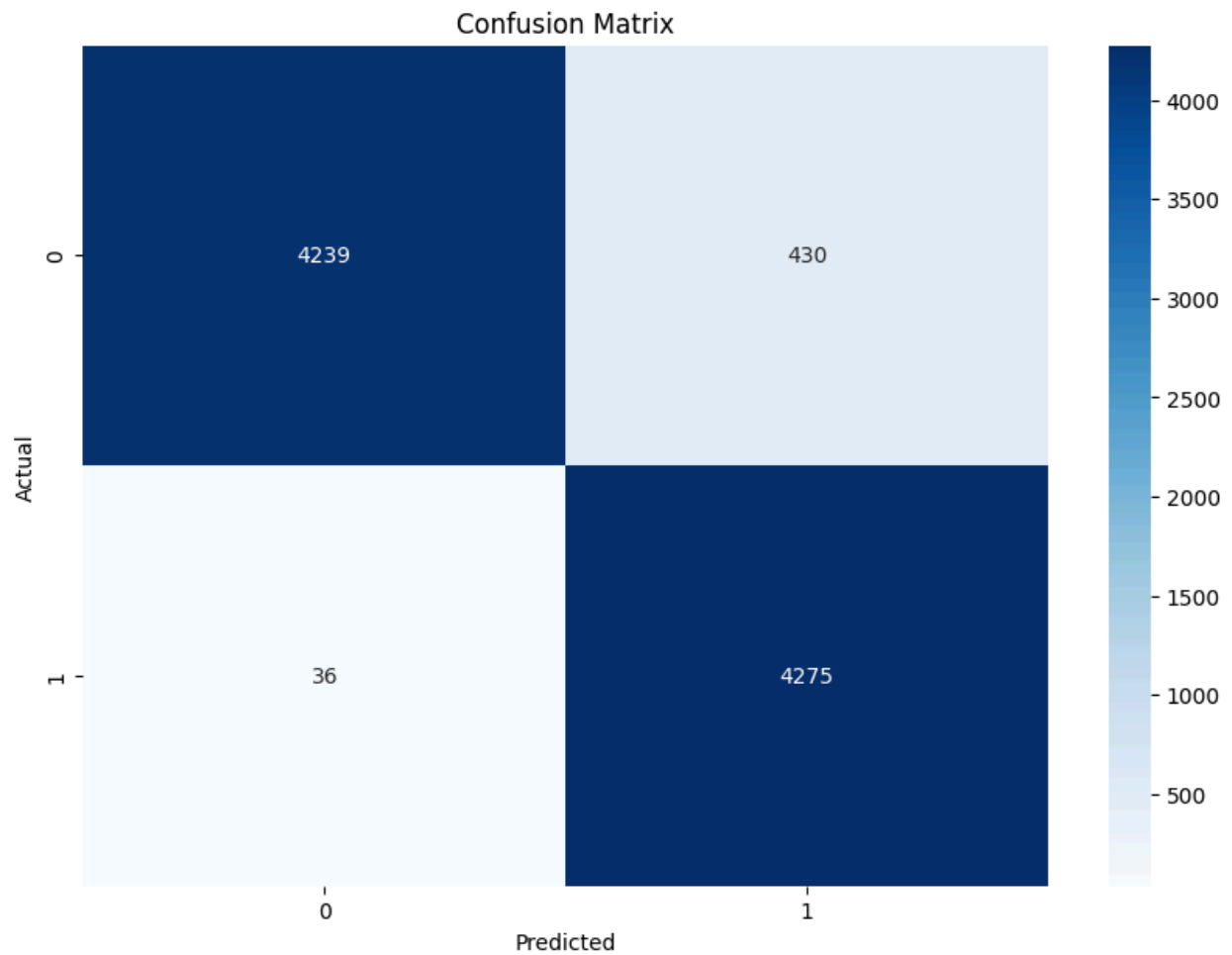
We saw for SVM model there confusion matrix is,

Accuracy=0.95

Precision=0.95

Recall=0.95

F1-Score=0.95



## Classification Report for above SVM Model:

### Classification Report:

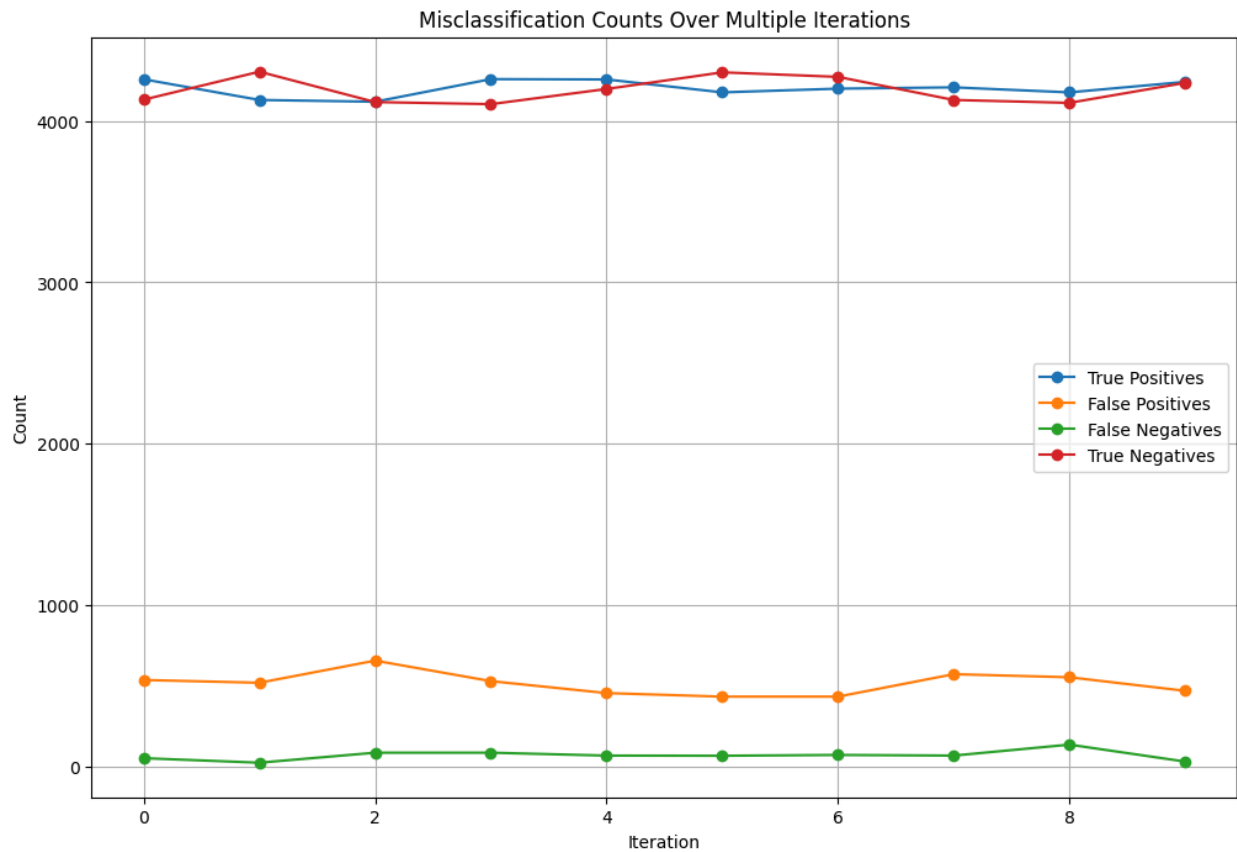
	precision	recall	f1-score	support
0	0.98	0.91	0.94	4669
1	0.91	0.98	0.94	4311
accuracy			0.94	8980
macro avg	0.95	0.95	0.94	8980
weighted avg	0.95	0.94	0.94	8980

Accuracy: 0.94

Precision: 0.95

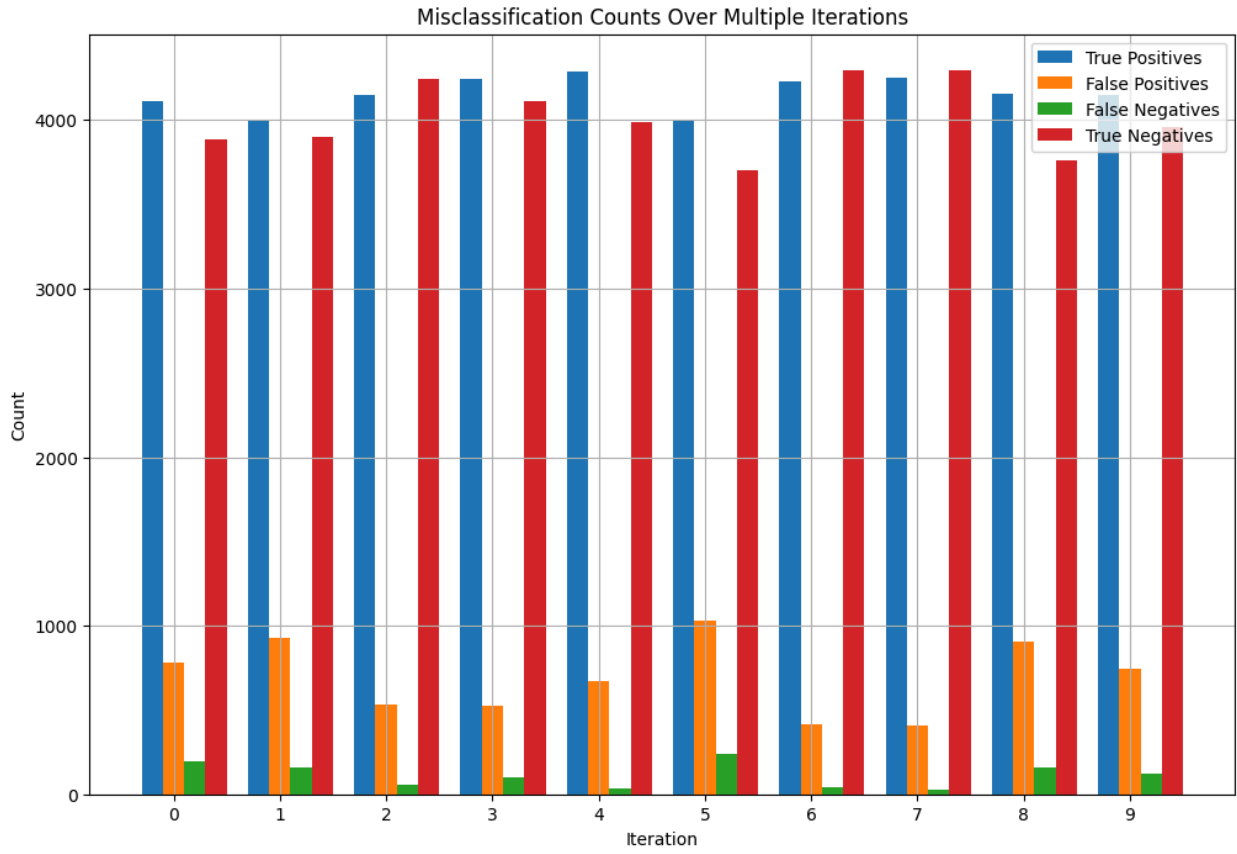
Recall: 0.94

F1 Score: 0.94



(i) Line graph for SVM model





(ii) Bar graph for SVM model

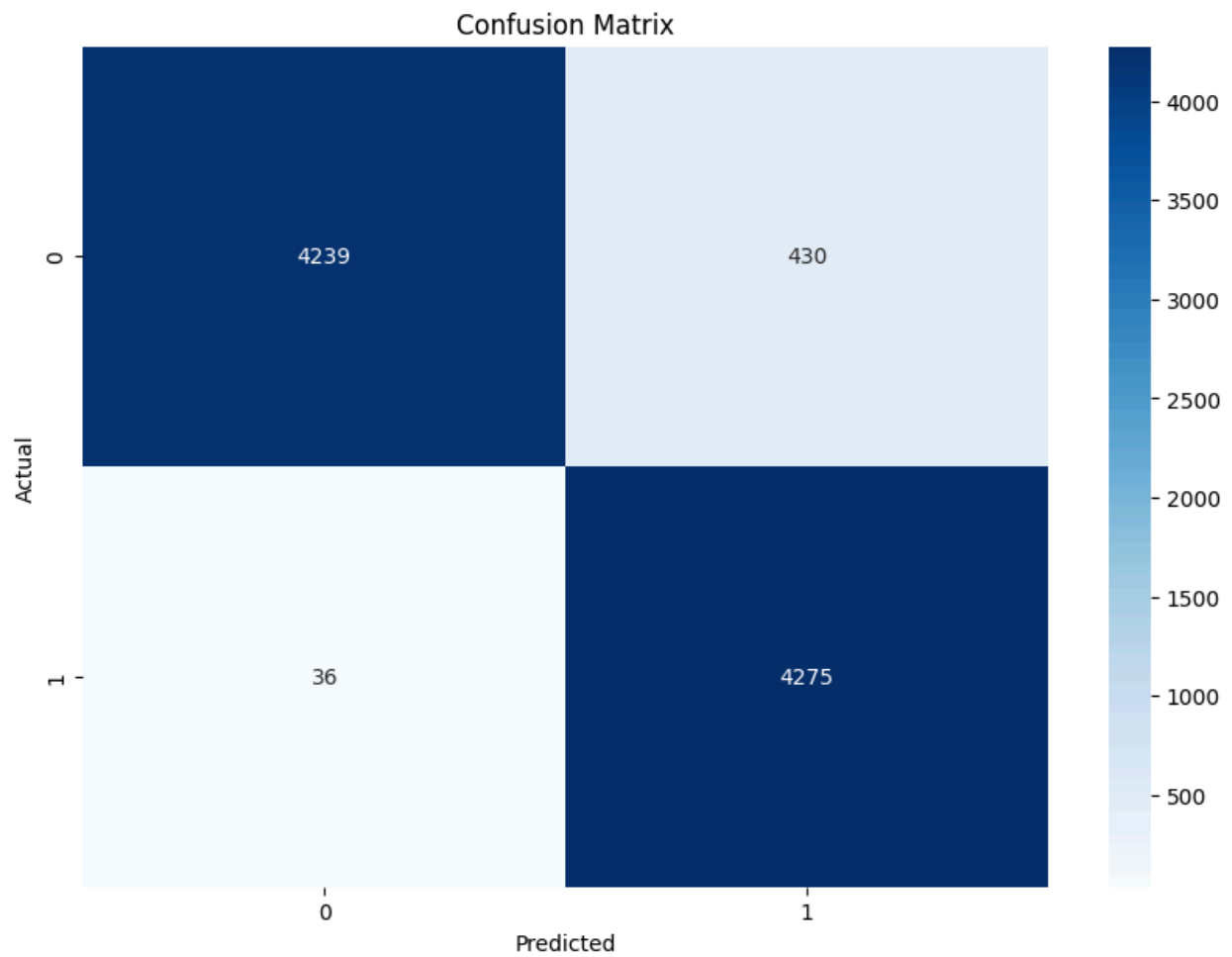
We saw for Random Forest Decision Tree model there confusion matrix is,

Accuracy=0.98

Precision=0.98

Recall=0.98

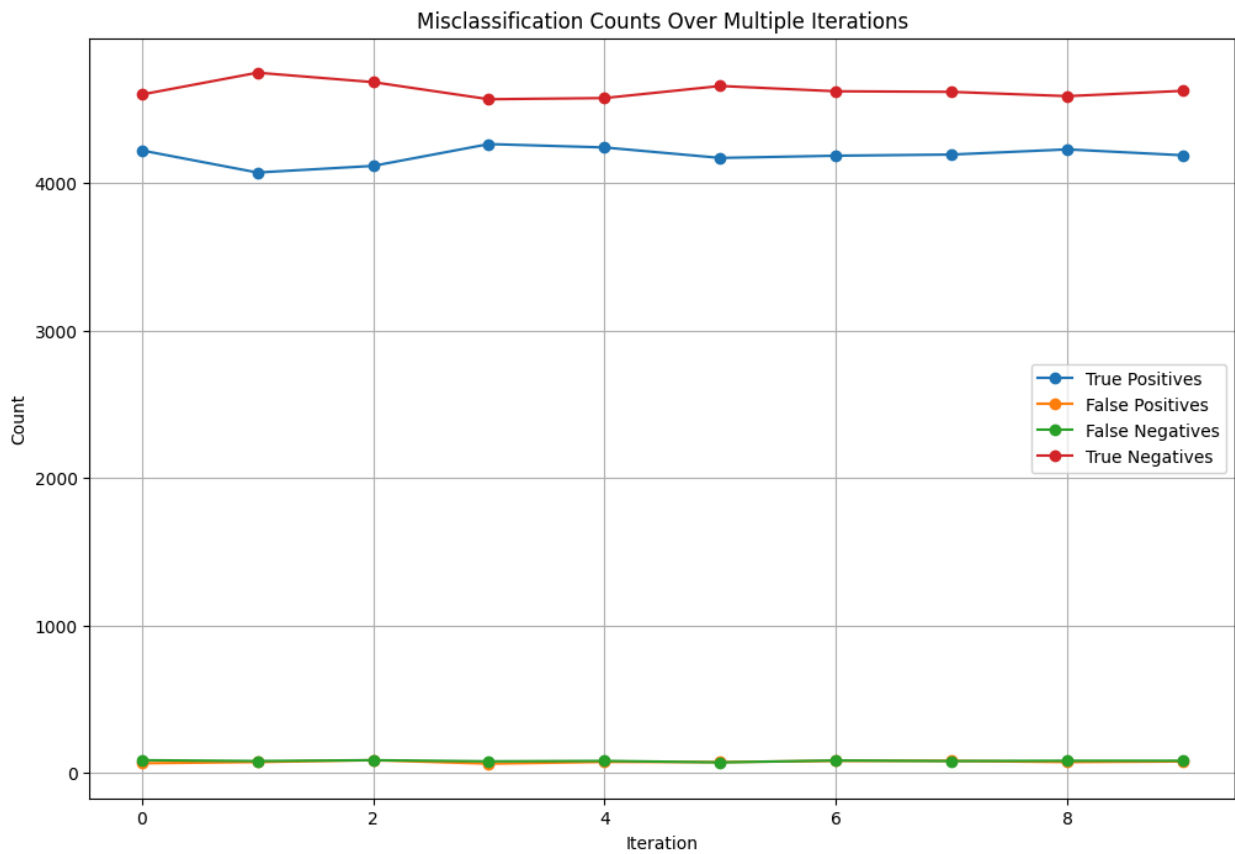
F1-Score=0.98



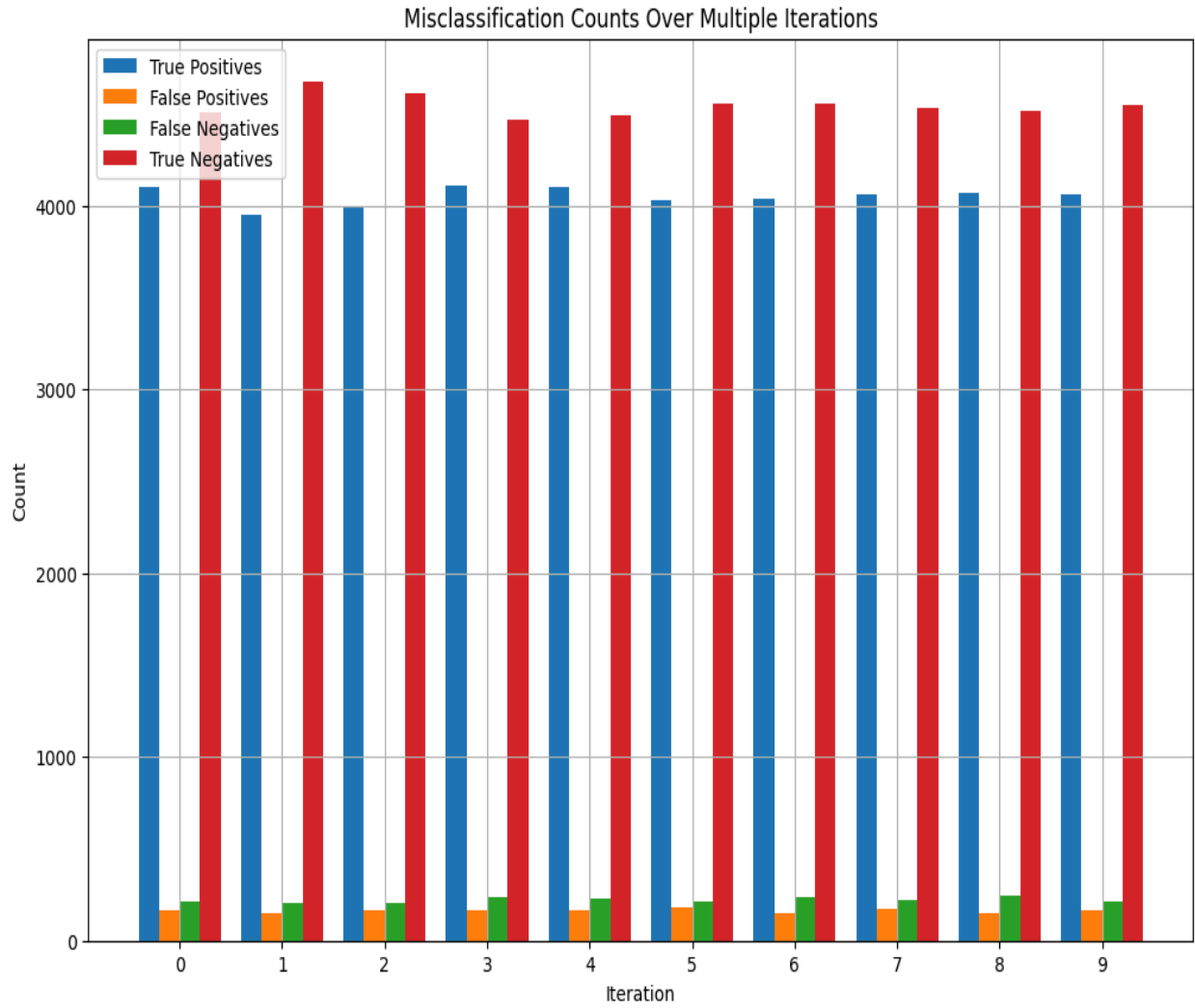
**Classification Report:**

	precision	recall	f1-score	support
0	0.98	0.98	0.98	4669
1	0.98	0.98	0.98	4311
accuracy			0.98	8980
macro avg	0.98	0.98	0.98	8980
weighted avg	0.98	0.98	0.98	8980

Accuracy: 0.98  
Precision: 0.98  
Recall: 0.98  
F1 Score: 0.98



(i) Line graph for random forest model



(ii) Bar graph for random forest model

In every model we got  $>80\%$  F1 score which is great with this experiment. So, I am happy to share the results.

## APPLICATIONS:

We use deep neural networks for classification of words. The trigram method we use like to find “most real”, “least real”, “more fake”, “least fake” words. Trigram method is used here where we divide the text in three blocks of words for better interpretation. Then applied model for finding rate of True Positive, False Positive, True Negative, False Negative. Now rate of these four values used to create confusion matrix. Now for each algorithm different confusion matrix has been created. Confusion matrix shows the accuracy of the classification model.

If accuracy of confusion matrix is more, means the news is more reliable. We can categorize the news as true news and if the accuracy is less, categorize it as fake news. So, confusion matrix takes a major part to determine a news is true or false . We also do here Word to Vector transformation. It converts each word in some vectorized numerical form. In alter , we can also use TF-IDF . TF is Term Frequency, how many times a term comes in a document. IDF is Inverse Document Frequency is the count of that term in whole region. TF-IDF also used for numerical conversion of a word.

Finally we draw some line graph and bar graph to show how much correct the model is. Bar graph plot shows with all three algorithm how the algorithm works. In line graph, the line is drawn to show where the actual data value is lying.

This small model is a Machine Learning model to predict a news is Fake or not. Though we can say, better accuracy tells that model is going to predict more accurate. Three algorithms of the model gives accuracy of 0.99, 0.95 and 0.98 , which assumes to be a better accurate model .

## Chapter 6

# Discussion

### Tracking Important neurons:

In our LIAR dataset there are total 44898 rows , which divided in two parts.

(i) True.csv

(ii) False.csv

For better understanding we divide neuron in some category.

1)Noun Category- All names belongs to this category. Like  
"Washington", "George" etc.

2)Verb Category-In verb category we used some verb like "got", "done" like  
conclusive verb used to create trigrams.

3)Adverb Category-For conclusion purposes in adverb category , we used to  
some soft conclusion like "partly", "slightly" etc.

With this we can find important neurons in the model. Next we create some  
bigram, trigram words , which can be created from N-gram models. These models  
and category will try to detect which word is important in the context and which is  
not important in the context.

## Conclusion:

Fake news is growing rapidly in modern society. It creates confusion among general public. Sometimes Fake news created intentionally to create attention a bunch of public. Sometimes it created by the mistake of author.

The model will be depend on CNN model. Where we make important conclusion that some advanced machine learning technique can detect the fake news correctly.

This model is a way out that the future researcher could think about if better model could proposed , so that no fake news could come out publicly, therefore that people any way could get confused.

## Future Development:

Though the model is good enough for a small picture of how a technique can be used for fake news detection, still we can work out for big dataset in future and check how a work can proceed errorlessly for large amounts of data. The output could be more accurate. It could be done on more specific algorithm , which can be done minimal time and can do more stance detection. This development will be revolutionary for fake news detection technique in near future.

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