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FAKE NEWS DETECTION SYSTEM USING MACHINE LEARNING ALGORITHMS

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Abstract: Fake news is defined as a misleading news stories that comes from the non-reputable sources. The fake news on social media and various other media is wide spreading and is a matter of serious concern due to its ability to cause a lot of social and national damage with destructive impacts. As a result of this a lot of research is already focused on detecting it. This paper makes research and implementation of fake news detection system to create a model of a product with supervised machine learning algorithm. Basically in this paper will employ a Naive Bayes classifier in order to create a model to classify an article into fake or real based on its words and phrases., that can classify fake news as true or false, by using tools like a count vectorizer (using word tallies) or a (Term Frequency Inverse Document Frequency) tfidf matrix It is very possible that two articles that are similar in their word count will be completely different in their meaning.

I. INTRODUCTION

Fake news has created different issues from abusive articles to a fabricated news and such as planned government propaganda in some outlets. Fake news and lack of trust in the media are growing problems with huge ramifications in our society. Obviously, a purposely misleading story is fake news but lately disturbance of social media's discourse is changing its definition. Some of them now use the term to dismiss the facts counter to their preferred viewpoints. The importance of disinformation within American political discourse was the subject of weighty attention, particularly following the American presidential election. The term 'fake news' became common jargon for the issue, particularly to describe candidly incorrect and misleading articles published mostly for the purpose of making money through page views. In this paper, it implies to produce a model that can accurately predict the likelihood that a given article is fake news. Facebook has been at a core of much critique following media attention. They have already implemented a feature to flag fake news on the site when a user sees's it; they have also said publicly they are working on to to distinguish these articles in an automated way. For a fact, it is not an easy task. A given algorithm must be politically unbiased – since fake news exists on both ends of the spectrum – and also give equal balance to legitimate news sources on either end of the spectrum. In addition, the question of legitimacy is a difficult one. However, in order to solve this problem, it is necessary to have an understanding on what Fake News is. Later, it is needed to look into how the techniques in the fields of machine learning, natural language processing helps us to detect fake news.

This paper proposes a methodology to create a model that will detect if an article is real or fake

based on its words, phrases, sources and titles, by applying supervised machine learning algorithms on an annotated (labeled) dataset, that are manually classified and guaranteed. The product model will test the unseen data, the results will be plotted, and accordingly, the product will be a model that detects and classifies fake articles and can be used and integrated with any system for future use.

2. RELATED WORK

2.1 Data Mining

Data mining techniques are categorized into two main methods; supervised and unsupervised. The supervised method makes use of the training information in order to foresee the hidden activities while Unsupervised Data Mining on the other hand is a try to recognize hidden data models provided without providing training data to illustrate, pairs of input labels and categories. A model example for unsupervised data mining is aggregate mines and a syndicate base [12].

2.2 Machine Learning Classification

Machine Learning (ML) is a class of algorithms that aid software systems accomplish more accurate results without having to reprogram them directly. Data scientists characterize changes or characteristics that the model needs to analyze and utilize to develop predictions. When the training is completed, the algorithm splits the learned levels into new data [13].

2.3 Random Forest

Random Forest are created on the abstraction of building many decision tree algorithms, after which the decision trees get a separate result. Then the results are predicted by large number of decision tree, which are taken up by the random forest. To ensure a variation of the decision trees, the random forest randomly selects a subcategory of properties from each group [14]

The applicability of Random forest is best when used on different decision trees. If applied on similar trees, the overall result will be more or less similar to a single decision tree. Different decision trees can be obtained by bootstrapping and feature randomness. [15]

Random Forest Pseudo-code [18]

To make *n* classifiers:
For *i* = 1 to *n* **do**
Sample the training data T randomly with replacement for Ti output
Build a Ti-containing root node, Ni
Call BuildTree (*Ni*)
end For
BuildTree (N):
If N includes instances of only one class, then returns
else
Select z% of the possible splitting characteristics at random in N
Select the feature *F* with the highest information gain to split on
Create f child nodes of *N*, *Ni* ,..., *Nf* , where *F* has *f* possible values (*F*1, ... , *Ff*)
For *i* = 1 to *f* **do**
Set the contents of *Ni* to *Ti*, where *Ti* is all instances in *N* that match *Fi*
Call Buildtree (*Ni*)
end for
end if

2.4 Naive Bayes

This algorithm operates on Bayes theory under the assuming that its free from predictors and is used in multiple machine learning problems [16]. In simple terms, Naive Bayes assumes that one function in the category has nothing to do with another. For example, the fruit will be classified as an orange when it's of yellow color, swirls, and the diameter is close to 3 inches. Regardless of whether these functions depend on each other or on different functions, and even if these functions depend on each other or on other functions, Naive Bayes assumes that all these functions share a separate proof of the oranges [17]

Naive Bayes Equation [18]

$$P(c \mid x) = \frac{P(x \mid c)P(c)}{P(x)}$$

$$P(c \mid X) = P(x1 \mid c) \times P(x2 \mid c) \times \ldots \times P(x2 \mid c) \times P(c)$$

Where:

$P(c \mid X)$ is the posterior Probability.
$P(x \mid c)$ is the Likelihood.
$P(c)$ is the Class Prior Probability.
$P(x)$ is the Predictor Prior Probability.

Naive Bayes Pseudo-code

Training dataset T,
F= (f1, f2, f3,..., fn) // value of the predictor variable in testing dataset.
Output:
A class of testing dataset.

Step:

1. Read Training Dataset T;

2. Calculate the mean and norm of each class's predictor variables;

3. Repeat

4. Calculating the likelihood of using the equation of gauss density in each class;

5. Until Pending the estimation of the likelihood of all predictor variables (f1, f2, f3,., fn).

6. Calculated the likelihood for respective class;

7. Get the highest likelihood;

8. (Researchgate.net, 2020)

2.5 Related Work on Fake News Detection

There exists a large body of research on the topic of machine learning methods for deception detection, most of it has been focusing on classifying online reviews and publicly available social media posts. Particularly since late 2016 during the American Presidential election, the question of determining 'fake news' has also been the subject of particular attention within the literature.

[6] *Deception Detection for News by Conroy, Rubin, and Chen*

This outlines several approaches that seem promising towards the aim of perfectly classify the misleading articles. They note that simple content-related n-grams and shallow parts-of-speech (POS) tagging have proven insufficient for the classification task, often failing to account for important context information. Rather, these methods have been shown useful only in tandem with more complex methods of analysis. Deep Syntax analysis using Probabilistic Context Free Grammars (PCFG) have been shown to be particularly valuable in combination with n-gram methods.

[1] *Fake news detection using naive Bayes classifier by Mykhailo Granik and Volodymyr Mesyura.*

In this paper we pointed out various sources of media and made the inclusion whether the submitted article is reliable or fake. The paper makes use of models based on speech characteristics and predictive models that do not fit with the other current models.

[2] *Evaluating machine learning algorithms for fake news detection by Gilda, S.*

In this paper they used naïve Bayes classifier to detect fake news by Naive Bayes. This method was implemented as a software framework and experimented it with various records from the Facebook. Their work produced output result with an accuracy of 74%. The paper neglected the punctuation errors, resulting in poor accuracy.

[3] *Fake News Detection by Akshay Jain and AmeyKasbe.*

This paper estimated various ML algorithms and made the researches on the percentage of the prediction. The accuracy of various predictive patterns included bounded decision trees, gradient enhancement, and also support vector machine were assorted. The patterns are estimated based on an unreliable probability threshold with 85-91% accuracy.

[4] *Predicting Future Rumours by Yumeng Qin et al.*

This research utilized the Naive Bayes classifier and discussed how to implement fake news discovery to different social media sites. They also used Facebook, Twitter and other social media applications as a data sources for news. Accuracy is very low because the information dataset on this site is not 100% credible.

[7] *Syntactic Stylometry for Deception Detection by Feng, Banerjee, and Choi*

They were able to achieve 85%-91% accuracy in deception related classification tasks using online review corpora.

Truth and Deception at the Rhetorical Structure Level by Rubin, Lukoianova and Tatiana

This analyze rhetorical structure using a vector space model with similar success. Ciampa glia et al. employ language pattern similarity networks requiring a pre-existing knowledge base.

Disadvantages:

- In existing system, they classify the news, only based on the content related n-grams and shallow part-of-speech.
- It's hard to prove that a news is fake or not by analyzing the tagging. Even if the news is genuine it is detected as fake news.
- It seems to be very complicated when a genuine news is published on the social media.

The above literature survey shows that there is still need to improve fake news detection systems as most system concentrated much on traditional media and accuracy is not good, however this has prompted this project to enhance the accuracy and the context of the dataset to be evaluated for real or fake news.

3. Methodology

Fake news detection for a fact, it is not an easy task. A given algorithm must be politically unbiased – since fake news exists on both ends of the spectrum – and also give equal balance to legitimate news sources on either end of the spectrum. [8][9] In addition, the question of legitimacy is a difficult one. However, in order to solve this problem, it is necessary to have an understanding on what Fake News is. Later, it is needed to look into how the techniques in the fields of machine learning, natural language processing helps us to detect fake news.

That ushers us to the important step the methodology will use for the classification. Using this model, a tool is implemented for detecting the fake articles. In this method supervised machine learning is used for classifying the dataset. [10] After the classification is achieved dataset are collection is next phase, followed by preprocessing of datasets, during this stage the text transformation (count vectorizer vs tfidf vectorizer) and choosing which type of text to use (headlines vs full text) is actualized. Then use the datasets to train the model and testing of dataset and finally running the classifiers. In summary the scope is collect data, clean data by processing it, then train the model and analyze the result then share the output with stakeholders.

3.1 Collecting Data:

So, there must be two parts to the data-acquisition process, "fake news" and "real news". Collecting the fake news was easy as Kaggle released a fake news dataset consisting of 13,000 articles published during the 2020 election cycle. Now the later part is very difficult. That is to get the real news for the fake news dataset. It requires huge work around many Sites because it was the only way to do web scraping thousands of articles from numerous websites. With the help of web scraping a total of 5279 articles, real news dataset was generated, mostly from media organizations (New York Times, WSJ, Bloomberg, NPR, and the Guardian) which were published around 2015 – 2020.

3.2 Data Pre-processing:

This file contains all the pre-processing functions needed to process all input documents and texts. First we read the train, test and validation data files then performed some pre-processing like tokenizing, stemming etc. There are some exploratory data analysis is performed like response variable distribution and data quality checks like null or missing values etc.

3.3 Feature Extraction:

In this file we have performed feature extraction and selection methods from sci-kit learn python libraries. For feature selection, we have used methods like simple bag-of-words and n-grams and then term frequency like tf-tdf weighting. We have also used word2vec and POS tagging to extract the features, though POS tagging and word2vec has not been used at this point in the project.

3.4 Classification:

Here we have built all the classifiers for predicting the fake news detection. The extracted features are fed into different classifiers. We have used Naive-bayes, Logistic Regression, Linear SVM, Stochastic gradient decent and Random forest classifiers from sklearn. Each of the extracted features were used in all of the classifiers. Once fitting the model, we compared the f1 score and checked the confusion matrix. After fitting all the classifiers, 2 best performing models were selected as candidate models for fake news classification. We have performed parameter tuning by implementing GridSearchCV methods on these candidate models and chosen best performing parameters for these classifier. Finally selected model was used for fake news detection with the probability of truth. In Addition to this, we have also extracted the top 50 features from our term-frequency tfidf vectorizer to see what words are most and important in each of the classes. We have also used Precision-Recall and learning curves to see how training and test set performs when we increase the amount of data in our classifiers.

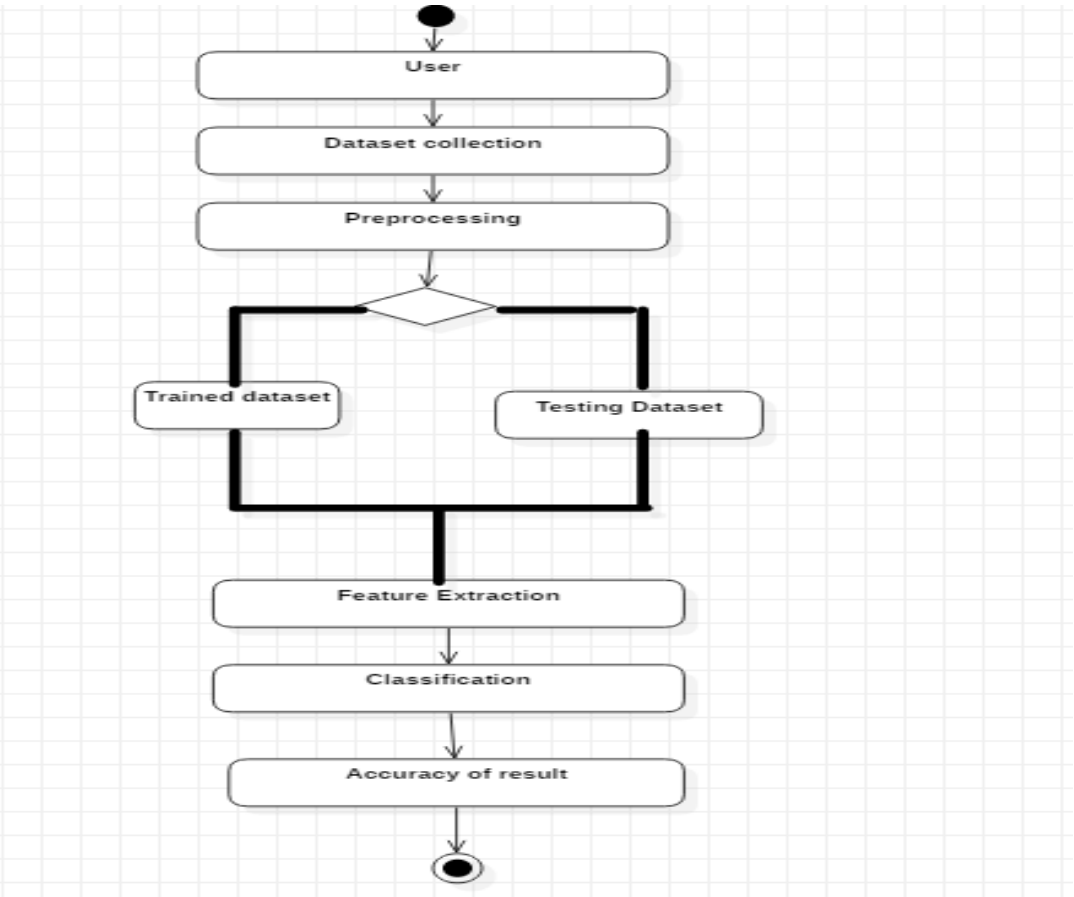

Figure 1. Describes the Proposed System Methodology

The subsequent process operates as illustrated in the diagram figure above. First step is collection of news dataset, perform preprocessing through rough noise removal.

The next step is to apply the NLTK (Natural Language Toolkit) to perform POS and features are selected. Next perform the dataset splitting apply ML algorithms (Naïve bays and Random forest) then create the proposed classifier model. [18] The next step after Dataset gets successfully preprocessed in the system is to start testing dataset, and the results are verified, then next step is to monitor the precision for acceptance. The model is then applied on unseen data selected by user. Full dataset is created with half of the data being fake and half with real articles, thus making the model's reset accuracy 50%. Random selection of 70% data is done from the fake and real dataset to be used in our complete dataset and leave the remaining 30% to be used as a testing set when our model is complete as shown in figure 2.

```
In [5]: df.head()
```

Out[5]:

Unnamed: 0	title	text	label
8476	You Can Smell Hillary's Fear	Daniel Greenfield, a Shillman Journalism Fello...	FAKE
10294	Watch The Exact Moment Paul Ryan Committed Pol...	Google Pinterest Digg Linkedin Reddit Stumbleu...	FAKE
3608	Kerry to go to Paris in gesture of sympathy	U.S. Secretary of State John F. Kerry said Mon...	REAL
10142	Bernie supporters on Twitter erupt in anger ag...	— Kaydee King (@KaydeeKing) November 9, 2016 T...	FAKE
875	The Battle of New York: Why This Primary Matters	It's primary day in New York and front-runners...	REAL

Figure 2. Fake and Real Datasets classified to Real and Fake

Text data requires preprocessing before applying classifier on it, so we will clean noise, using Stanford NLP (Natural language processing) for POS (Part of Speech) processing and tokenization of words, then we must encode the resulted data as integers and floating point values to be accepted as an input to ML algorithms. This process will result in feature extraction and vectorization as shown in figure 3.

```
In [6]: y = df.label

In [7]: df = df.drop('label', axis=1)

In [8]: X_train, X_test, y_train, y_test = train_test_split(df['text'], y, test_size=0.33, random_state=53)

In [9]: count_vectorizer = CountVectorizer(stop_words='english')
        count_train = count_vectorizer.fit_transform(X_train)
        count_test = count_vectorizer.transform(X_test)

        print(count_train)
        print(count_test)
```

```
  (1, 36831)    1
  (1, 47506)    1
  (1, 38823)    1
  (1, 25684)    1
  (1, 21568)    1
  (1, 36087)    1
  (1, 16814)    1
  (1, 49203)    2
  (1, 25686)    1
  (1, 15927)    2
  (1, 29531)    2
  (1, 8399)     1
  (1, 42534)    1
```

Figure 3. Count vectorizer of Words

The research using python scikit-learn library to perform tokenization and feature extraction of text data, because this library contains useful tools like Count Vectorizer and Tiff Vectorizer. Data is viewed in graphical presentation with confusion matrix. Refer figure 4. This section discusses the chosen dataset, that has been used for cleaning and extracting the data set, and the algorithms are applied. This dataset has automatically extracted proof sentences from the full-text verdict article published in Politifact by journalists. As shown in following figure 2 we used the features of Truth values, in addition we applied part of speech

on the statement to get another 4 features (nouns, verbs, preposition and sentences) and each record is labeled by class label as (0, 1, 2, 3) to be used in training the model.

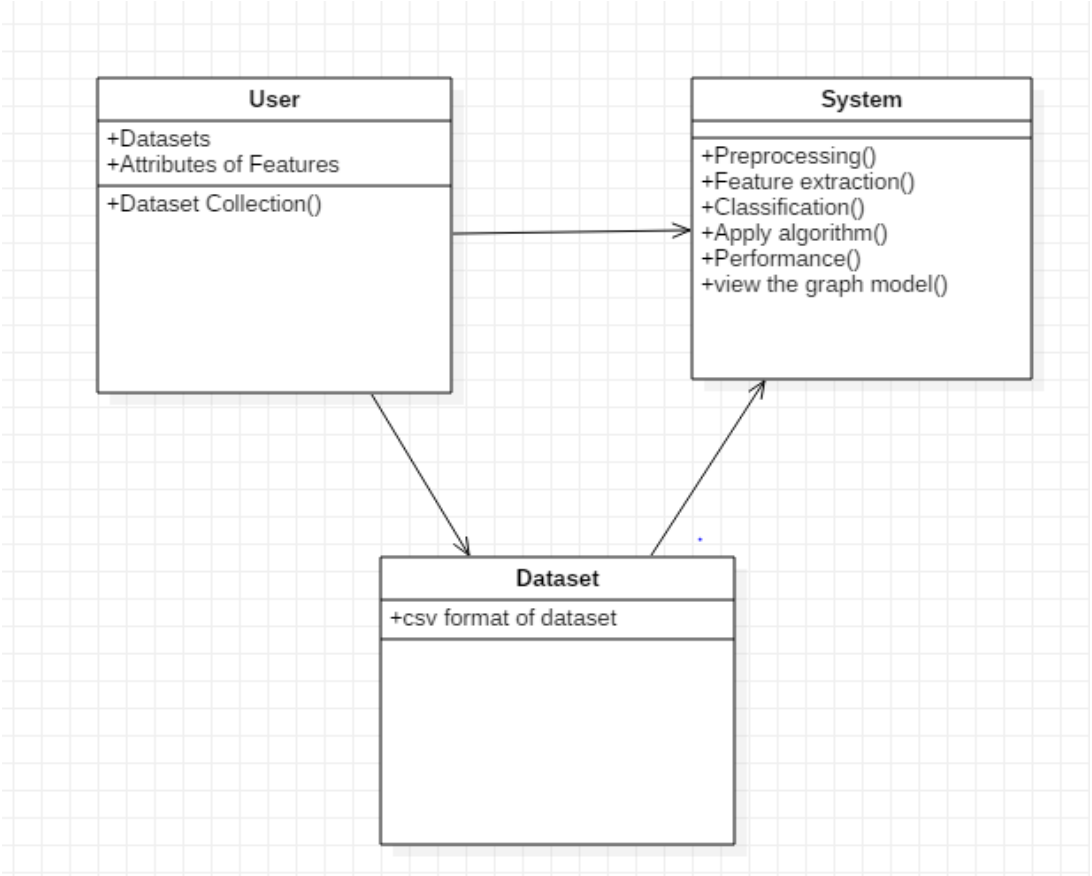

Figure 4. Fake Detector Model

4. Results

The actual goal or scope of this project is in developing a model which is the text transformation (count vectorizer vs tfidf vectorizer) and choosing which type of text to use (headlines vs full text). Then use the datasets to train the model. In summary the scope is collect data, clean data by processing it, then train the model and analyze the result then share the output with stakeholders. The results of the analysis of the datasets using algorithms have been depicted using the confusion matrix. The confusion matrix is automatically obtained by Python code using the cognitive learning library when running the algorithm code in Anaconda platform. The Confusion Matrix for all the algorithms are depicted below figures.

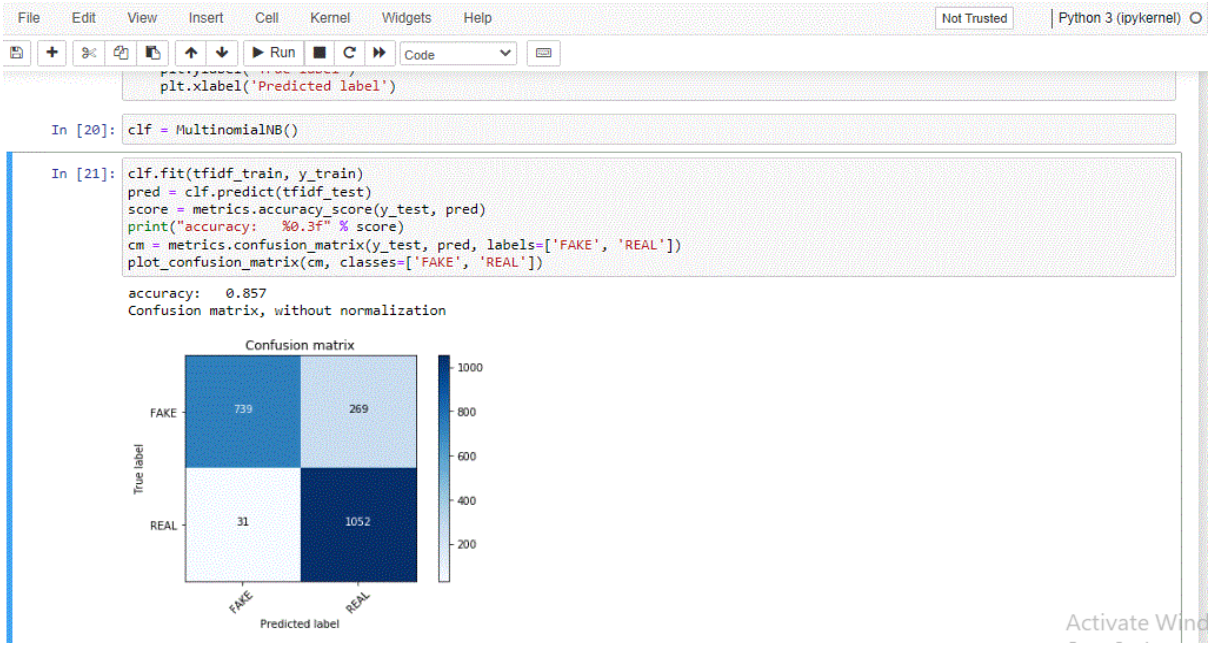

Figure 5.1 Confusion Matrix Results for the Algorithms

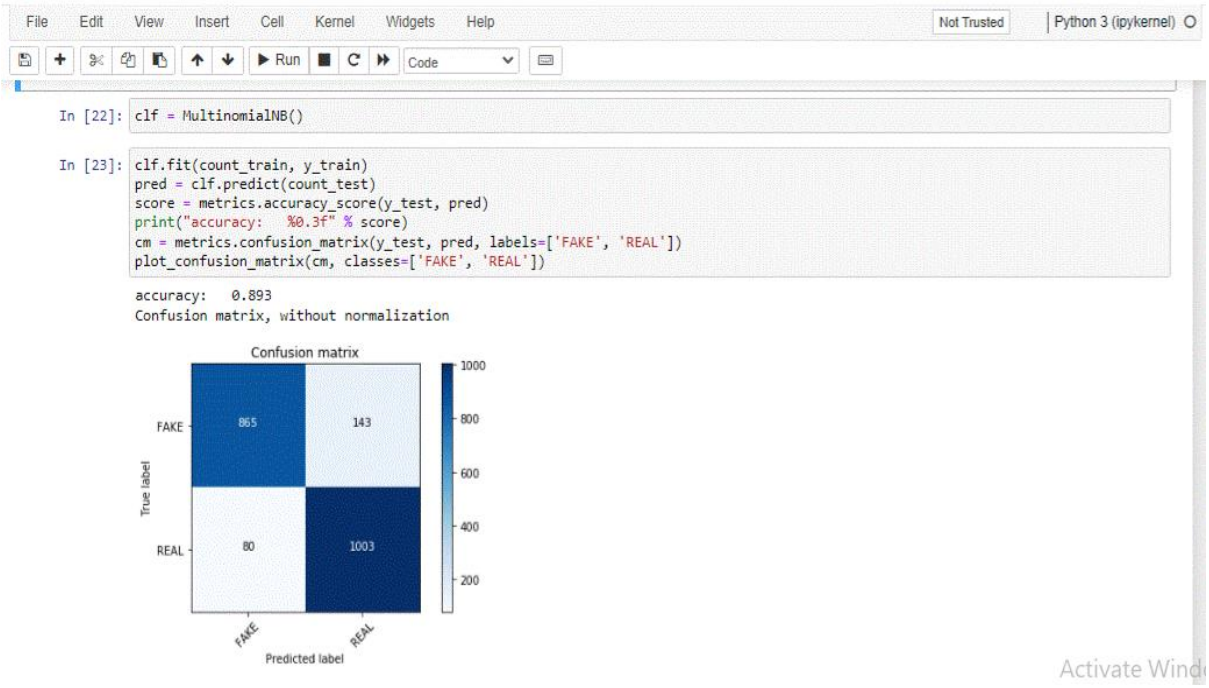

Figure 5.2 Confusion Matrix Results for the Algorithms

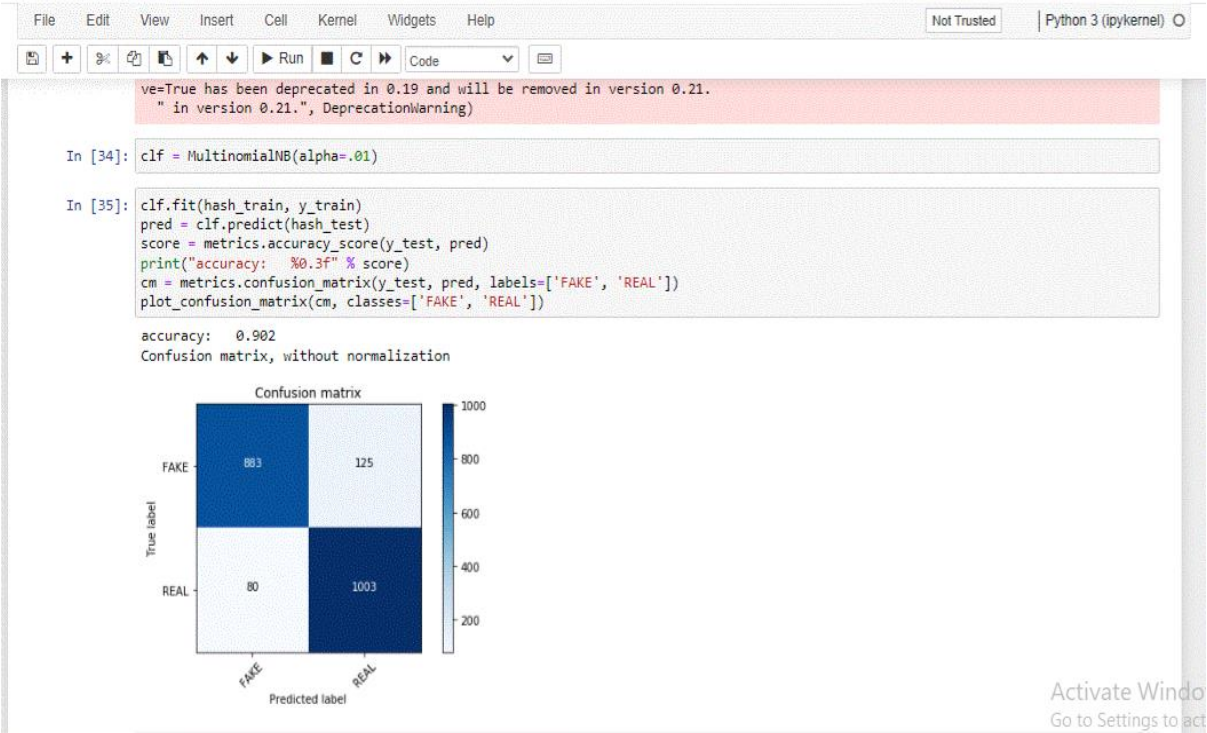

Figure 5.3 Confusion Matrix Results for the Algorithms

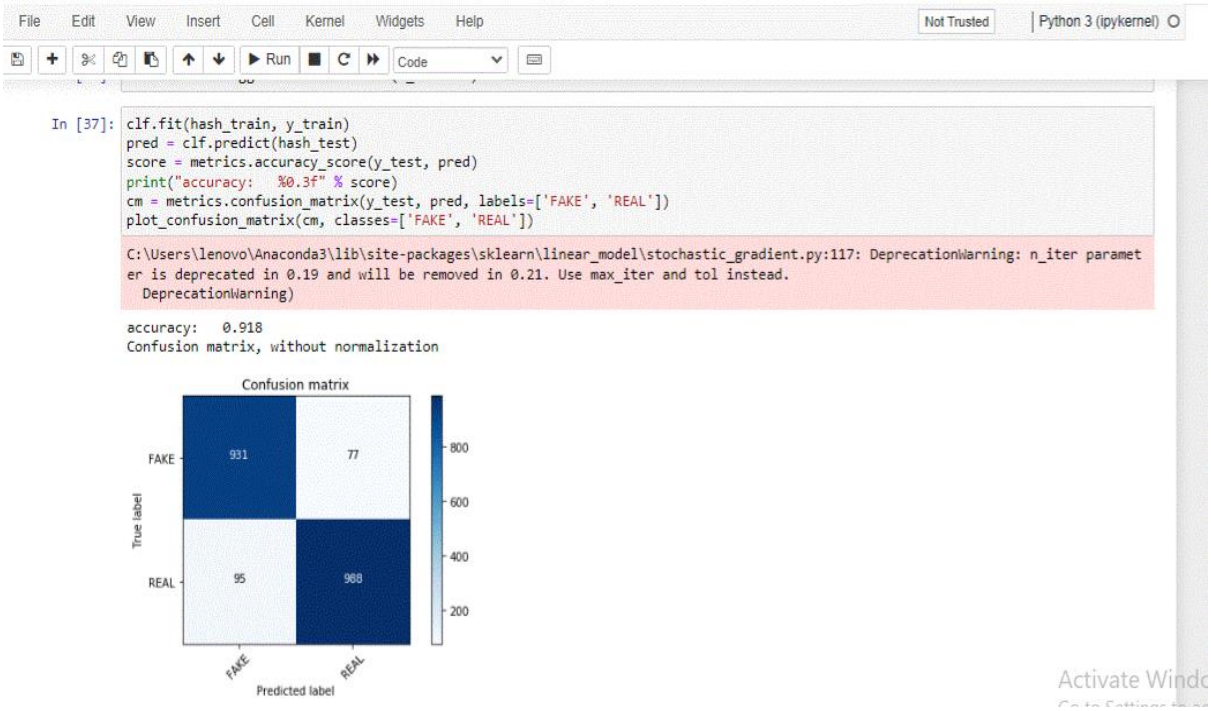

Figure 5.4 Confusion Matrix Results for the Algorithms

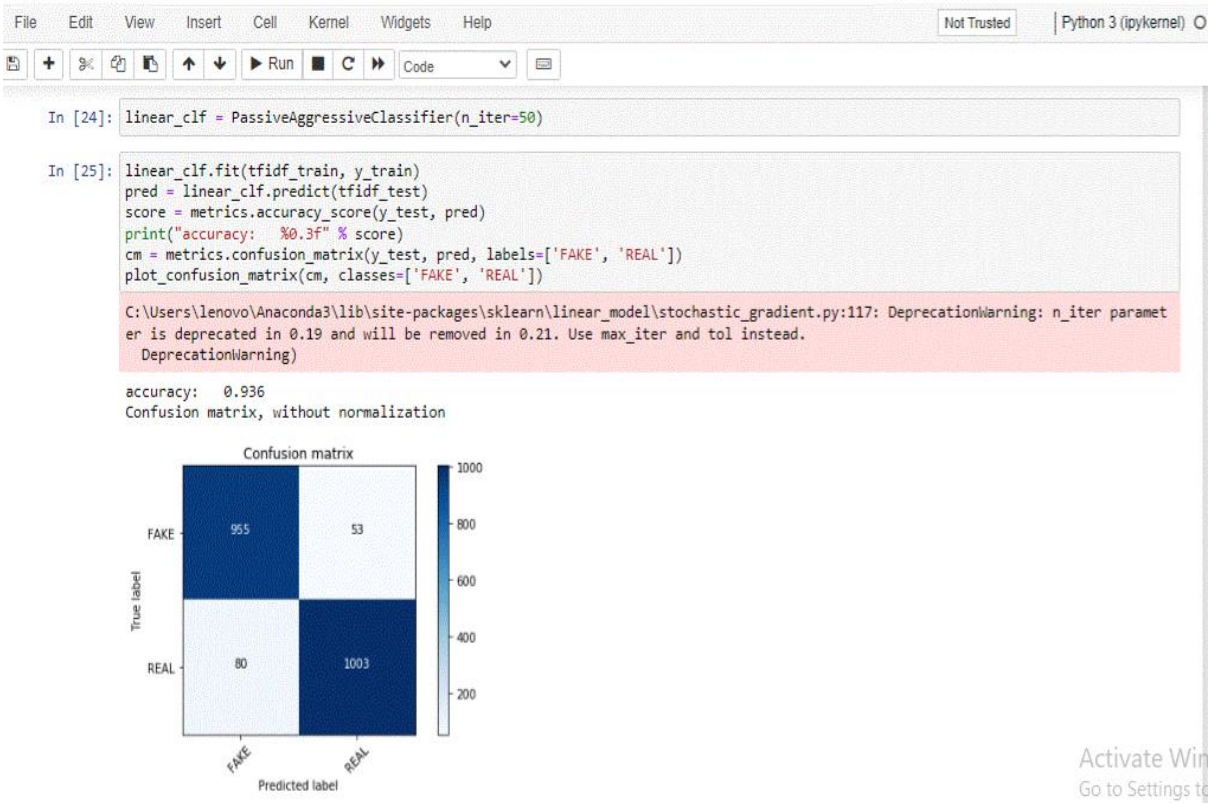

Figure 5.5 Confusion Matrix Results for the Algorithms

Figure 6 expresses the accuracies of these algorithms. As shown after training the model on different datasets depicting the accuracy of 85.7% on the first test, next test with 89.3% accuracy, and the other test 90.2% accuracy and 91.8% and lastly is highest accuracy of 93.6%. Despite doing more tests the results did not improve further from the score of 93.6%. As shown in figure 6 the accuracy results for all Algorithms testing datasets.

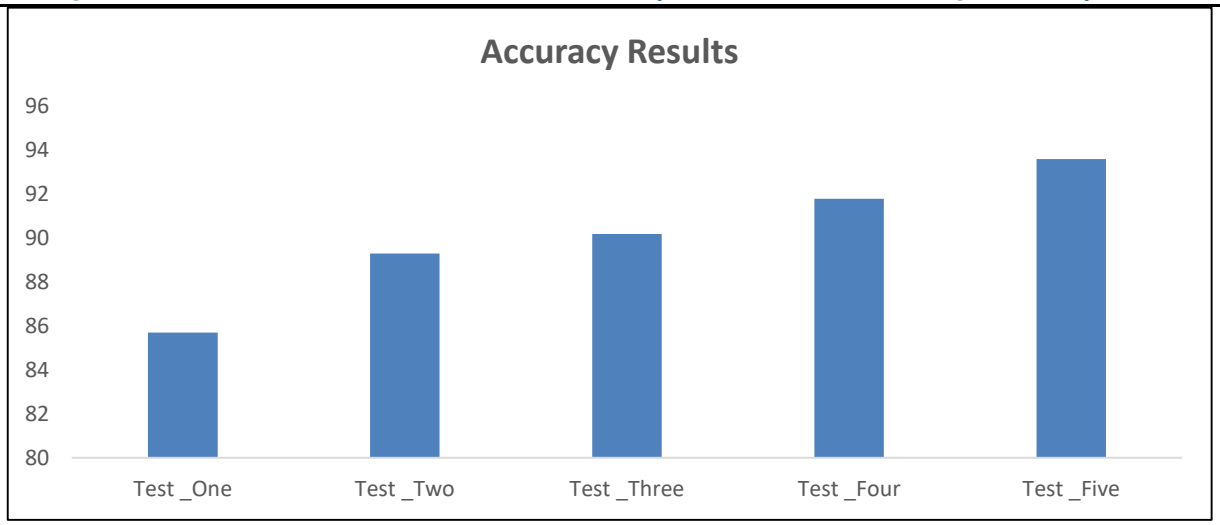

Figure 6. Accuracy Results of all the Algorithms

5. Conclusion

Thus, through this project, the news datasets are collected and various Machine learning techniques are employed in order to classify them as real News or fake news. CountVectorizer and Term Frequency Inverse Document Frequency vectorizer (TFIDF) are employed in order to extract the essential Features and classify them as real news or Fake news. Algorithms like Naïve Baiye's Classifiers are employed in order to classify the news and it is based On conditional probability.

5.1Future Enhancement:

Some more additional features can be added in the dataset and the model can be trained using those features in order to improve the accuracy of the model. Instead of Naïve Baye's algorithm, some other algorithms can be employed. For text classification and improve the efficiency of the overall system.

5.2 User Manual

Steps procedure

1) Put the code in documents folder
2) Open the code in Jupyter Notebook
3) Go to cells->Run All
4) The code will be executed and the output will be displayed

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