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Detection of False Statement from Social Media using Machine Learning Algorithms

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ABSTRACT

The proliferation of misleading information in everyday access media outlets such as social media feeds, news blogs, and newspapers has made it challenging to identify trustworthy news sources, thus increasing the need for computational tools able to provide insights into the reliability of online content. People intentionally spread these counterfeit statements with the help of web-based social networking sites. The fundamental objective of false statements is to influence the popular belief on specific issues. The main goal of false statements is to affect public opinion on certain matters. The aim of this paper is to find and detect false statements made by individual public figures using machine learning algorithms. A system is proposed in this paper that identifies whether a given statement is false or not by making use of a provided training dataset and the algorithms used. The results are concluding that Logistic Regression provides 98% the highest percentage of accuracy among various machine learning algorithms.

Keywords: Traditional News Media, Online Social Media, Machine Learning

I. INTRODUCTION

False Statements is a form of information consisting of deliberate disinformation spread via traditional news media or online social media. False statement has quickly become a society problem, being used to propagate false or rumour information to change people's behaviour. Digital news has brought back and increased the usage of false information. Mobile applications and social media platforms have over-thrown traditional print media in the dissemination of news and information [1]. It is only natural that with the convenience and speed that digital media offers, people express preference towards using it for their daily information needs. With the outburst of information, it is seemingly difficult for a layman to distinguish whether the information statement he/she consumes is true or false. False statement is typically published with an objective to mislead or create bias to acquire political or financial gains. The most common algorithms used by fake news detection systems include machine learning algorithms such as Support Vector Machines, Random Forests, Decision trees, Logistic Regression and so on. In this paper we

have attempted to implement these algorithms to train and test our results. We have used a combination of both off the shelf datasets as well as expanded it by crawling content on the web. The main challenge has been to build a set of uniform clean data and to tune parameters of our algorithms to attain the maximum accuracy [2].

The implementation of this paper can benefit our society and community in varies ways such as stopping the spread of false information among different groups and individuals in any medium, it will also prevent from acting on false information whether it be financial, health or any another aspect. Detecting and determining false statement and false information will also create an awareness and precaution among on society to always cross verify any piece of information with the source that it originates from. Implementing this method will also help us determine the frequent individuals or mediums that spread this false information thus avoiding them in the future.

II. RELATED WORK

The research for False Statement Detection has brought up development of various applications in the field of computer science. The contagion of false information has gripped the world in equal parts. Deeply interlinked with technological developments, “disinformation” and “misinformation” have become pervasive in our news bubbles. About 45% of the respondents about false information in the Indian media said they had seen stories that were completely made up for political or commercial reasons. False information is a pressing issue for today's socio-political environment and it is getting harder to differentiate between misleading information from the real facts.

The research for False Statement Detection has brought up development of various applications in the field of computer science. ‘Media-Rich Fake News Detection: A Survey[1]’, Identifies different media sources and analyses whether the given news article is credible or not. The paper provides with an insight on characterization of news article combined with different content types available. “[2] Fake News Detection Using Naive Bayes Classifier”, Predicted fake news through naïve Bayes classifier. This approach was implemented as a software system and tested against various data sets of Facebook etc. which provided an accuracy of 74%. ‘Evaluating Machine Learning Algorithms for Fake News Detection [3]’, evaluated different machine learning algorithms and analyzed the prediction percentage. The accuracy of different predictive models which included bounded decision trees, gradient boosting, and support vector machine were tabulated. ‘Fake News Detection [4]’, IEEE International Students' Conference on Electrical, Electronics and Computer Sciences Discussed about fake news detection and ways to apply them on various Social media sites using naïve Bayes classifier. The data sources for news article are Facebook, twitter etc. ‘Predicting Future Rumours [5]’, Chinese Journal of Electronics discussed about counteracting misinformation and rumour detection in real time. It uses novelty-based feature and attains its data source from Kaggle. The accuracy rate of the model is 74.5%.

III. FALSE STATEMENT DETECTION

The proposed system makes use of varies machine learning algorithms to predict whether the given input statement is true or false. The system uses algorithms such as Naïve Bayes Classifier, Random Forest Classifier etc to classify the statement into either true or false. The architecture for the proposed, as displayed in Figure 1, shows the flow & sequence of events that occur. The architecture shows the dependency and interconnectedness of each component in the proposed system.

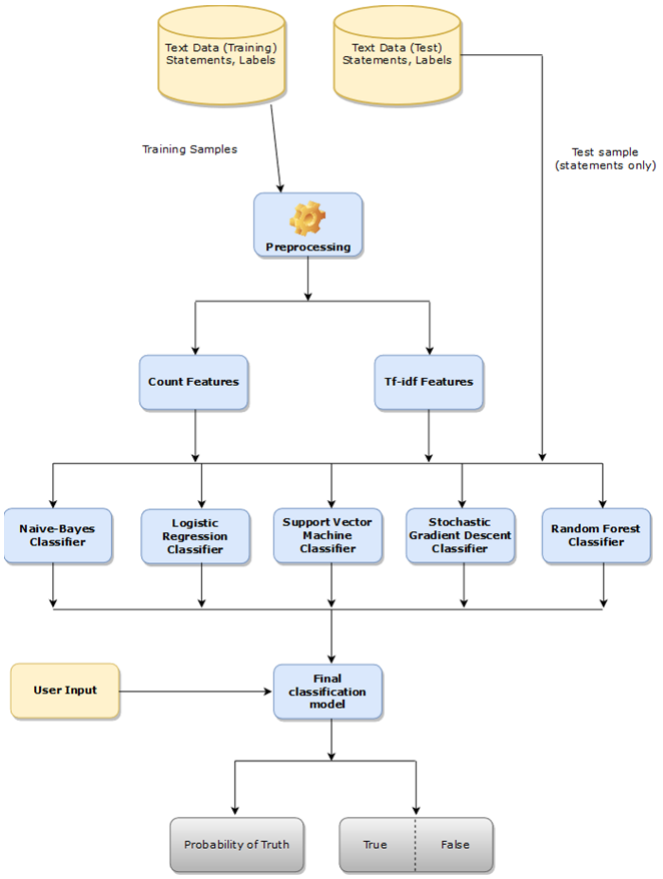


Figure 1: Architecture for False Statement Detection

3.1 Data Pre processing

The data source used for this work is LIAR dataset which contains three files with .csv format
for test, train, and validation. The dataset contained thirteen variables/columns for train, test and validation but to make things simple, only two variables are chosen from the original dataset for this classification [9]. The other variables can be added later to add some more complexity and enhance the features. Initially apply pre-processing techniques [6] like tokenizing, stemming etc on the data set then some exploratory data analysis is performed like response variable distribution and data quality checks like null or missing values etc.

3.2 Feature Selection

To extract features from dataset, the sci-kit learn python libraries have been used in this work.

The techniques like simple bag-of-word, n-grams and then term frequency tf-idf weighting are applied to select features from dataset.

3.2.1 Bag of Words (BOW)

The bag-of-words model is a simple NPL model. It is a way of extracting features from the text for use in machine learning algorithms. In this approach, we use the tokenized words for each observation and find out the frequency of each token. Bag of Words model is used to pre-process the text by converting it into a bag of words, which keeps a count of the total occurrences of most frequently used words. Figure 2 & Figure 3 depict the code and the
table created for each unique word in BOW.

```
import nltk
import re
import numpy as np

# execute the text here as :
# text = """ # place text here  """
dataset = nltk.sent_tokenize(text)
for i in range(len(dataset)):
    dataset[i] = dataset[i].lower()
    dataset[i] = re.sub(r'\W', ' ', dataset[i])
    dataset[i] = re.sub(r'\s+', ' ', dataset[i])
```

Figure 2: Bag of Word Code

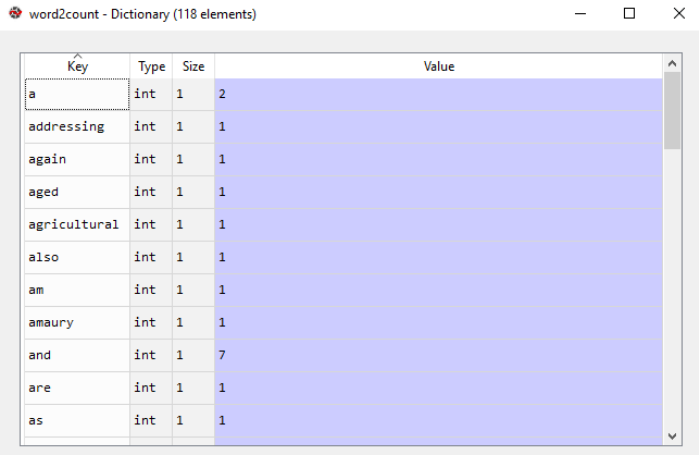


Figure 3: A Bag of Words Dictionary

3.2.2 N-Grams

N-grams of texts are extensively used in text mining and natural language processing tasks.
They are basically a set of co-occurring words within a given window and when computing the n-grams you typically move one-word forward. The basic use of N-grams is sequence
prediction [7]. This is applicable to situations such as predictive text. Figure.4 shows the

generalization of N-grams in python

```
import re

def generate_ngrams(text,n):

    # split sentences into tokens
    tokens=re.split("\\s+",text)
    ngrams=[]

    # collect the n-grams
    for i in range(len(tokens)-n+1):
        temp=[tokens[j] for j in range(i,i+n)]
        ngrams.append(" ".join(temp))

    return ngrams
```

Figure 4: N-gram Generation in Python

The formula used in N-gram where X=Num of words in a given sentence K, the number of ngrams for sentence K is

$$Ngrams_k=X-(N-1)$$

3.2.3 TD-IDF

TF-IDF is an information retrieval technique that weighs a term's frequency (TF) and its inverse document frequency (IDF). Each word or term has its respective TF and IDF score. The product of the TF and IDF scores of a term is called the TF-IDF weight of that term. The higher the TF-IDF score (weight), the rarer the term and vice versa. The TF-IDF algorithm is used to weigh a keyword in any content and assign the importance to that keyword based on the number of times it appears in the document. More importantly, it checks how relevant the keyword is throughout the document/file. For a term t in a document d, the weight Wt,d of term t in document d is given by:

Wt,d = TFt,d log (N/DFt),

Where,

- TFt,d is the number of occurrences of t in document d.
- DFt is the number of documents containing the term t.
- N is the total number of documents in the file.

3.3 Classifiers

The Naive-Bayes, Logistic Regression, Linear SVM, Stochastic gradient decent and Random Forest classifiers are used from sci-kit learn for predicting the false statement. The top fifty features are extracted from dataset and fed into different classifiers. After fitting all the classifiers, two best performing models were selected as candidate models for false statement classification [8]. We have performed parameter tuning by implementing Grid Search CV methods on these candidate models and chosen best performing parameters for these classifiers. Finally, selected model was used for false statement detection with the probability of truth. Precision & Recall, when combined generate the confusion matrix for each algorithm. Once fitting the model, compare the f1 score with confusion matrix. Next, generate Precision-Recall and Learning curves to observe performance of classifiers when amount of training and test dataset varies.

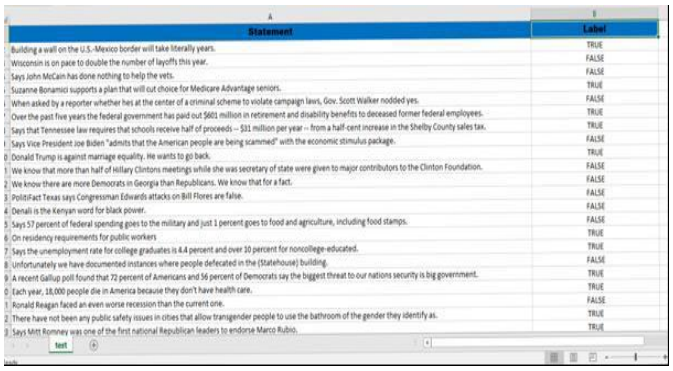
IV. RESULTS

4.1 Data set

The data source used for this paper is LIAR dataset which contains three files with .tsv format for test, train and validation. The original dataset contained thirteen variables/columns for train, test and validation but to make things simple, only two variables are chosen from the original dataset for this classification [9]. The other variables can be added later to add some more complexity and enhance the features.

Below are the columns used to create three datasets that have been in used in the work.

Column 1: Statement (News headline or text), Column 2: Label (Label class contains: True, False) Figure 5 illustrate the dataset files test, train & valid.



	Statement	Label
0	Building a wall on the U.S.-Mexico border will take literally years.	TRUE
1	Wisconsin is on pace to double the number of layoffs this year.	FALSE
2	Says John McCain has done nothing to help the vets.	FALSE
3	Suzanne Bonamici supports a plan that will cut choice for Medicare Advantage seniors.	TRUE
4	When asked by a reporter whether hes at the center of a criminal scheme to violate campaign laws, Gov. Scott Walker nodded yes.	FALSE
5	Over the past five years the federal government has paid out $601 million in retirement and disability benefits to deceased former federal employees.	TRUE
6	Says that Tennessee law requires that schools receive half of proceeds -- $31 million per year -- from a half-cent increase in the Shelby County sales tax.	TRUE
7	Says Vice President Joe Biden "admits that the American people are being scammed" with the economic stimulus package.	FALSE
8	Donald Trump is against marriage equality. He wants to go back.	TRUE
9	We know that more than half of Hillary Clintons meetings while she was secretary of state were given to major contributors to the Clinton Foundation.	FALSE
10	We know there are more Democrats in Georgia than Republicans. We know that for a fact.	FALSE
11	PolitiFact Texas says Congressman Edwards attacks on Bill Flores are false.	FALSE
12	Denali is the Kenyan word for black power.	FALSE
13	Says 57 percent of federal spending goes to the military and just 1 percent goes to food and agriculture, including food stamps.	TRUE
14	On residency requirements for public workers	TRUE
15	Says the unemployment rate for college graduates is 4.4 percent and over 10 percent for noncollege-educated.	FALSE
16	Unfortunately we have documented instances where people defecated in the (Statehouse) building.	TRUE
17	A recent Gallup poll found that 72 percent of Americans and 56 percent of Democrats say the biggest threat to our nations security is big government.	TRUE
18	Each year, 18,000 people die in America because they don't have health care.	FALSE
19	Ronald Reagan faced an even worse recession than the current one.	TRUE
20	There have not been any public safety issues in cities that allow transgender people to use the bathroom of the gender they identify as.	TRUE
21	Says Mitt Romney was one of the first national Republican leaders to endorse Marco Rubio.	TRUE

Figure 5: Test Dataset

4.2 Pre-processing the Data

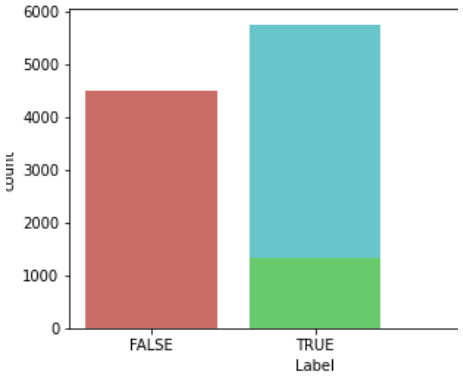


Figure 6: Count of False & True Statements after Data Pre-processing

Before the training dataset is introduced to the Feature Select & Classification modules of the system, it needs to be pre-processed to eliminate any missing values or noisy data. Figure 6 depicts a graph of the truth and false statements labelled in the training dataset after pre-processing is complete.

4.3 Feature Selection of Data

After Data Pre-processing, the training data is introduced to Feature Select module where methods like simple bag-of-words and n-grams and then term frequency like tf-idf weighting are implemented. Figure 7 depicts the execution of the Feature Selection module and classification of the training dataset.

```
  (10239, 799)  1
  (10239, 2568) 1
  (10239, 11622)        1
  (10239, 2549) 1
  (10239, 10660)        1
  (10239, 8996) 1
  (10239, 10918)        1
  (10239, 3989) 1
  (10239, 10594)        1
  (10239, 6853) 1
0        Says the Annies List political group supports ...
1        When did the decline of coal start? It started...
2        Hillary Clinton agrees with John McCain "by vo...
3        Health care reform legislation is likely to ma...
4        The economic turnaround started at the end of ...
                             ...
10235    There are a larger number of shark attacks in ...
10236    Democrats have now become the party of the [At...
10237    Says an alternative to Social Security that op...
10238    On lifting the U.S. Cuban embargo and allowing...
10239    The Department of Veterans Affairs has a manua...
Name: Statement, Length: 10240, dtype: object
```

Figure 7: Feature Select on Data

4.4 Classification

The results observed in terms of comparing the classifiers used in the proposed system are depicted in Table 1 below.

Table 1: Comparison of Classifiers

METRICS	Naïve Bayes	Logistic regression	SVM	Random Forest
Accuracy	57%	98%	97%	97%
Precision	59%	98%	98%	98%
Recall	70%	98%	97%	96%

As seen above, the statistics indicate that the Logistic Regression Classifier provides a 98 % accuracy when compared to Naïve Bayes, Support Vector Machine & Random Forest Classifier [10]. Scatter Plots for various classifiers on a small set of data i.e 1000 are shown. In each figure the first subplot shows the prediction value plotted in red, whereas the second subplot shows the actual values plotted in green.

4.5 Prediction

Our finally selected and best performing classifier was Logistic Regression which was then saved on disk with name final_model.sav. Logistic Regression provides more accuracy because it is a type of binomial relapse. Scientifically, a twofold calculated

model has a reliant variable with two conceivable qualities. Logistic Regression performs well when the dataset is linearly separable. Logistic Regression not only gives a measure of how relevant a predictor (coefficient size) is, but also its direction of association (positive or negative) & it is easier to implement, interpret and very efficient to train. Once you close this repository, this module will be copied to user's machine and will be used by prediction.py file to classify the false statement. It takes a dataset as input from user then model is used for final classification output that is shown to user along with probability of truth or false.

V. CONCLUSION

Information is the key element to shape our world view. We make important decisions based on information. We form an idea about people or a situation by obtaining information. The area that are affected due to the ongoing spread of false statement include financial impacts on individuals and on communities, possibilities of negatively impacting our health, false statements can inspire fear implementing concepts & racial ideas among our society and community as well as have significant effect on the democratic and political view of every individual exposed to any false piece of statement or information. The results of this work conclude that among the varies artificial intelligent algorithms used, Logistic Regression provides the highest percentage of accuracy at 98% followed by Support Vector Machine & Random Forest Classifier at 97% and Naïve Bayes at 58%. A lot of the results in regards for the future, circle back to the need for acquiring more accuracy on the data of statements or information given to the system to improve its efficiency, not just for small but for large datasets as well. The current and existing classifying algorithms must also be tweaked so as to they work better with varies volume of data.

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