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Fake News Detection Using Ensemble Classifiers

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Abstract

In today's world, when the internet is pervasive, everyone relies on a variety of online outlets for news. As the use of social media platforms such as Facebook, twitter, and others has risen, information has spread quickly among tens of thousands of customers in a short amount of time. The spread of false information has far-reaching implications, ranging from affecting election results in favor of good candidates to forming skewed beliefs. Furthermore, spammers profit from click-bait advertisements by using tempting content headlines. We want to do binary categorization of a variety of information items available online in this work using artificial intelligence principles. For this project, we employed machine learning and natural language processing, and we wanted to give users the ability to classify material as false or true, as well as validate the legitimacy of the website that published it. Gradient booster, Support Vector Machines (SVM), and Ada Boost (AB)are some of the ensemble and boosting techniques we used in our project.

Keywords: Gradient Boosting, AdaBoost, Support Vector Machine, Ensemble learners, boosting, bagging.

Introduction

In our modern era where the internet is found everywhere, everyone relies on various online resources for news along with the increase in the use of social media platforms like Facebook, Twitter, Instagram, WhatsApp and other online media stages news spread rapidly among millions of users within a very short period. The spread of Fake news has far-reaching consequences like spammers using appealing news headlines to generate revenue using advertisements via click-bait. We want to do binary categorization of a variety of information items available online in this work using artificial intelligence principles. This fake news can be widely spread in different forms. Some are only to increase the number of clicks and visitors on a site, and others to influence public opinion on political decisions or financial markets. For that, they used a novel method and tools like Text preprocessing, Encoding of the text, Extraction of characteristics, and SVM methods[1] Due to recent advancements in computer science, it is easier nowadays to create and spread fake news but it is considerably hard to distinguish the information as true or false. This fake news can affect some products, and businesses if fake news is spread about the products. For this SVM, the Naive Bayes classifier, and passive-aggressive classifier are used[2]. Fake news detection is made to stop the rumors that are being spread through the various platforms whether it be social media or messaging platforms this is done to stop spreading fake news which leads to activities like mob lynching this has been a great reason for motivating to work [3]. Classification of any news item /post/blog into fake or real one has generated great interest from researchers around the globe.

Several research studies have been carried out to find the effect of falsified and fabricated news on the masses and reactions of people upon coming across such news items[6] Lie gets traveled around us quicker, and more extensively than reality in all spheres of information

and the effects were more dangerous and horrifying. There are several kinds of tweets like issues on a government, trending topics around the world, mental abuse, urban legends, and occasions in calamities[7].

One of the initial challenges we faced while embarking on our journey to solve the problems is that there does not yet exist a definite and unifies definition of fake news and the markers needed to determine an articles legitimacy or flag a news as fake[11]. Reuters Institute Digital News Report 2017 reveals a relentless growth of news accessed via social media compared to the significant decline in printed newspaper readership between 2012 and 2017 [13]. In the previous work, they used the process of the Natural Language Processing (NLP) technique. This technique is one of the forms of Artificial Intelligence that give machines the ability to read and interpret human language. With Natural Language Processing, machines can sense written or spoken text. The next method they used is the Naïve Bayes classification for the detection of fake news, it is mainly used in text classification that includes high dimensional training datasets. With these two methods, they got an accuracy of the 90 % which is less. Its estimation can be wrong in some cases so we couldn't take its outputs very seriously for the detection of fake news. This project describes a simple fake news detection method based on the machine learning algorithms namely AdaBoost, SVM, Gradient Booster methods which are Ensemble methods. Thus, Fake news may be a global issue and also a worldwide challenge. Many scientists believe that Fake news issues could also be addressed using machine learning.

Literature Survey
The author proposed a fake news detection model using the methods like Support Vector Machine algorithm (SVM) and they determine the best features and techniques to detect fake news. To detect fake news text they used Sentimental analysis and N-gram method and Term Frequency-Inverse Document Frequency(TF- IDF) methods[1]. This author proposed a fake news detection model using some of the machine learning methods like Support Vector Machine (SVM) for the fake news which was shared on Twitter. Social Media is the major source model for Fake news spreading throughout the world and got an accuracy of 92.05%[2]. In this author proposed a smart system for detecting fake news. Mindfulness that not all the fake news will propagate via web- based Networking media. To test out the proposed method Naïve Bayes classifier, SVM and NLP are used. The main objective of detecting fake news is text classification[3]. In this paper, they proposed an automated framework for the detection of fake political speech using the SVM model and achieved 74% detection accuracy after the optimization by Auto-Weka. The impact of all the features on the classification performance was also presented [4]. In this, they used stylometric features set that contain 70 features where few features are added that were not used by any authors in their models. So they used basic machine learning models like Random forest (RF), Naïve Bayes (NB), Support Vector Machine (SVM) which are well on Stylometric features set[5].

The fake news in social media networks is taken as an experiment and it is posing a challenge in the categorization of fake news. Deep learning's main characteristic is to compute hierarchical features and the used methods are Convolutional Neural Networks (CNN), Deep autoencoder model[6]. Detecting the fake news using the machine learning Naïve Bayes classifier and that AUX scores have improved when the amount of data existing under a particular tag as seen in the title and text. The next model they used is the N-grams method which improves the accuracy more than the before model[7]. In this paper, they worked on the fake news of the Twitter strings. The dataset in this examination is relied upon to be utilized for arrangements that utilized machine learning-based statistical calculations, for example Logistic Regression (LR), Long Short Term Memory (LSTM), and SVM in this SVM got better accuracy[8]. To detect the fake news they used dataset like Horne and Adali which is accessible to the public. In this they used the N-gram method through the lenses of different

features extraction techniques and other methods used is the SVM which gives an accuracy of the 92% which is better than the N- gram method[9]. This presented a new sentence-matching model for fake news detection which can efficiently perform the sentence matching by using key sentence retrieval based on the International Bureau of weights and Measures (BiMPM) model and the model of LSTM and the average LSTM model got more accuracy compared to the BiMPM model[10].

In this work, they developed the method using Computational Linguistics implementations used to perform the linguistic analysis on tweets observe patterns exhibited to legitimate and fake or ambiguous news and constructed the comprehensive Bag Of Words(BoW) model based on categorized labelled tweets[11]. In this, they have translated the theories of humour, irony, and satire into a predictive method for satire detection that reaches relatively high accuracy rates and they showed complex language patterns, for example, deep syntax and the ordering of grammatical patterns[12]. In this work, they used the methods which are deception detection techniques presented in the categories such as content-based, social context-based, and hybrid-based methods. The fact that fake news characteristics are not fully comprehended by many thus fake news problem continues to grow faster causing more damage every time[13]. In this, they presented the Deep learning model which is the GRU model used for discourse segment analysis and constructing the dependency tree that offered distinguishable features for real and fake news and this model achieved a 0.76 F1 score and 74.62% accuracy[14]. In this paper, they used the deep diffusive neural network model for the fake news articles which are presented in the textual information of news articles, creators, and subjects. In this, they also proposed a new diffusive unit model namely GDU, and the contents of forget and adjust gates[15]. In this paper, at first, they have shown a new model which can detect fake news with high accuracy by exploiting the proposition and they tested the model with two types of datasets using the Convolutional Neural Network(CNN) by using the DeepMind and created various propositions[16].

In this, they have used the Semantic model for the detection of fake news on social media by taking all the challenges as primary work. The semantic model defines classes and their hierarchical structure for the description of diverse entities related to news on social media[17]. In this, they have presented a model of a novel automatic fake news detection method that combines social and content signals. They built on the work by combining their social-based method that uses the source of information, the ID of the users who socially interacted with a news item[18]. In this experiment, they worked on the Korean news dataset for detecting the system of fake news using the fact DB which is built and updated by the human's direct judgment. To achieve this they used the BiMPM model which is a deep-learning model that works more on Korean datasets[19]. In this, they tried to solve problems in the early detection of fake news. We focussed on the fact that although users' comments might provide important information to evaluate news documents there are few comments in the early stage of news propagation for that they used the neural network model to extend the process[20]. The summary of the literature is shown in the following Table 1.

Table 1. Literature Survey

Reference	Method	Results	Limitations
[1]	(TF-IDF)SVM n-grams	News is real or fake at 100% according to degree of confidence	Disinformation overload spread of uncertainty fear , anxiety and racism
[2]	Naïve Bayes, Passive Aggressive Classifier.	SVM model gives accuracy of 87%.	Fake News Detection

	TF-IDF, SVM Classifier	They have used predictive features like negative absurd, grammar,	becomes complicated when it comes to resources. Resources like datasets are limited.
[3]	Naive Based Classifier, News, Prediction, Recommendation, GAN, CNN	It is proven that this classifier itself provides pretty good results.	Ensuing algorithm may provide better results with hybrid approaches for the same purpose fulfilment.
[4]	SVM Multi Layer Perception (MLP) CNN	The evaluation results show that our framework is effective in the detection of fake political speech. The result of the extra tree classifier is a set of scaled scores (from 0 to 1) for all the features, respectively.	Due to the space limitation, the authors only presented and analysed the evaluation results based on SVM classifier.
[5]	(BOW) TF, BOW TF-I	Within experiment python library RF Classifier used with n estimators=200, criterion= entropy, random state=42 apply on both feature sets. These attributes obtain good results.	To perform machine learning models on combined both features set stylometric features and word vector features to achieve better results rather than proposed work.
[6]	Linguistic Cue approaches with machine learning.	The results show 15 percent fake tweets, 45 % real tweets, rest posts were undecided.	Accuracy can be improved by using other algorithms
[7]	Naïve Bayes Classifier; Web Scrapping.	Received results suggest, that fake news detection problem can be addressed with machine learning methods.	The results may be improved by applying several techniques
[8]	SVM Naïve Bayes Method, Logistic	Our experimental result showed that SVM and Naïve Bayes classifier	Learning rate can be increased and to converge in the horizontal

	Regression	outperforms the other algorithms	direction, any algorithm can take more steps more quickly. Beta indicates the momentum value and is usually set to 0.9
[9]	TF-IDFLSVM	N-gram features achieved 87% accuracy.	Focused on news articles that revolve around the 2016 US elections and the articles that discuss topics around it.
[10]	(BiMPM)	69% of accuracy for BIMPM.	More advanced model can be applied.
[11]	K-Nearest Neighbor(KNN)	Accuracy=66.6%	Performing in-depth stance detection analysis on top of the BoW Models.
[12]	SVM and NLP	Got detection of 90% precision and 84% recall.	Translate more complex characteristics of anatomy of satire into linguistic cues.
[13]	Content Based (1)Linguistic-cue	83.6%	To explore on visual features and network features that are nor widely covered.
[14]	GRU	0.71% ,FI=74.62%	Further can be developed and applied for real time detection using Intra document and Inter document.
[15]	Diffusive Unit Model GDU	Credibility score 0.28	Connection with the news articles, creator and new subjects has to be improved by deep diffusive methods.
[16]			Use of this

	CNN	Size of attributes had increased with the CNN process.	model to other languages with larger Dataset.
[17]	Semantic Model NLP	The results show that they do better than other advanced clustering techniques.	Aggregation of datasets for social media news based on the semantic model to form a knowledge graph would provide additional opportunities for analysis making in signs and draw automated inference towards curbing the emergence and spread of Fake News on social media.
[18]	Model of novel automatic fake news detection method.	Accuracy=81.7%	Focusing on cases harder to classify, in particular when the content of the news is true but the title or the comment to the content is misleading.
[19]	BiMPM Model	Accuracy=80%	Longer the length of the in input sentence, the lower its performance in various Dataset
[20]	Gover's Method.	F1 score is 71.4%	Results suggested that process of generating comments may help the classifiers in fact checking to decide real or fake.

Dataset description

We got this data set from online free sources. It is a hybrid dataset which have both the true and fake news[21]. This data set contains more than 10000 rows and 2 columns where the two columns are "headlines" and "outcome". Headline column is having all the news headlines as data and Outcome column has "0" and "1" where 0 means the news is a Fake news and 1 means the news is Real news.

This data set doesn't have any unwanted features so we didn't need to do any feature extraction and we have clean the

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raw data for that we have to do text pre-processing and remove all the unwanted terms or symbols so that an ML Algorithm can understand the data easily. The sample fake news in the dataset is represented in Table 2.

Table 2. Sample dataset

HEADLINES	OUTCOMES
A doctor claims most Belgians are immune to COVID-19	0
A photo of a young man with a swollen face. Allegedly, he was a volunteer for Coronavac, a Chinese vaccine against COVID-19 being tested in Brazil	0
Says Joe Biden has said 150 million Americans died from guns and another 120 million from COVID-19	1
North Carolina is one of four states that hasn't opened gyms.	1
Significantly more people died of Covid-19 in two months than died of overdoses all of last year or the year before.	1

Proposed Methodology
In this we are using three algorithms for the process of Ensemble learners. They are: Gradient Booster Algorithm, AdaBoost Algorithm and Support Vector Machine Algorithm.

Gradient Booster Algorithm
One of the most popular Machine Learning algorithms used in regression and classification task among others. It gives the best method when combines with the previous models and minimizes the overall prediction error. In gradient boosting, each predictor corrects its Predecessor's error. There is a technique called the Gradient boosted Trees whose base learner is CART(Classification and Regression Trees). Gradient boosting algorithm build first weak learner and calculates the loss function and it then builds the second learner to predict the loss after the first step. The step continues for the third learner and then the fourth learner so on until the certain threshold is reached and find appropriate solutions to the additive modelling problem.

AdaBoost Algorithm
The first really successful algorithm developed for the product of Binary Classification. AdaBoost is short for Adaptive Boosting and is a very popular boosting technique that combines multiple "weak classifier" into a single "strong classifier". AdaBoost or Adaptive Boosting is one of the ensemble boosting classifier proposed by Yoav Freund and Robert Schapire in 1996. It combines multiple weak classifiers to increase the accuracy of classifiers. AdaBoost is an iterative ensemble method. AdaBoost classifier builds a strong classifier by combining multiple poorly performing classifiers so that you will get high accuracy strong classifier. The basic concept behind AdaBoost is to set the weights of classifiers and training the data sample in each iteration such that it ensures the accurate predictions of unusual observations.

Support Vector Machine (SVM)
It is possibly the most notable Supervised Learning computation, which is utilized for Classification comparably as Regression issues. Regardless, generally, it is utilized for Classification issues in Machine Learning. The objective of the SVM calculation is to make the best line or choice breaking point that can isolate n-layered space into classes so we can undoubtedly put the new part in the right course of action later on . This most ideal choice breaking point is known as a hyperplane. SVM picks the crazy communities/vectors that assistance with making the hyperplane. These unbelievable cases are called help vectors, and in this manner computation is named as Support Vector Machine.

Ensemble learners Approach:

We proposed using existing ensemble techniques along with textual characteristics as feature input to improve the overall accuracy for the purpose of classification between a truthful and a false article. Ensemble learners tend to have higher accuracies, as more than one model is trained using a particular technique to reduce the overall error rate and improve the performance of the model. The intuition behind the ensemble modelling is synonymous to the one we are already used to in our daily life such as requesting opinions of multiple experts before taking a particular decision in order to minimize the chance of a bad decision or an undesirable outcome. For example, a classification algorithm can be trained on a particular dataset with a unique set of parameters that can produce a decision boundary which fits the data to some extent.)e outcome of that particular algorithm depends not only on the parameters that were provided to train the model, but also on the type of training data. If the training data contains less variance or uniform data, then the model might overfit and produce biased results over unseen data. Therefore, approaches like cross validation are used to minimize the risk of overfitting. A number of models can be trained on different set of parameters to create multiple decision boundaries on randomly chosen data points as training data. Hence, using ensemble learning techniques, these problems can be addressed and mitigated by training multiple algorithms, and their results can be combined for near optimum outcome. One such technique is using voting classifiers where the final classification depends on the major votes provided by all algorithms. However, there are other ensemble techniques as well that can be used in different scenarios such as the following.

Bagging Ensemble Classifiers

Bootstrap aggregating, or in short bagging classifier, is an early ensemble method mainly used to reduce the variance (overfitting) over a training set. Support vector machine(SVM) model is one of the most frequently used as a variant of bagging classifier. Intuitively,

for a classification problem, the bagging model selects the class on the basis of major votes estimated by the sample of data to reduce the overall variance within a noisy dataset. For regression problems, however, the bagging model averages over multiple estimates.

Boosting Ensemble Classifiers

Boosting is another widely used ensemble method to train weak models to become strong learners. This method allows wea learners to correctly classify data points in an incremental approach that are usually misclassified. Initially equal weighted coefficients are used for all data points classify a given problem. In the successive rounds, the weighted coefficients are decreased for data points that are correctly classified and are increased for data points that are misclassified .There are multiple boosting algorithms available that can be used for both the purposes of classification and regression. In our experiments we used Gradient Boosting and AdaBoost algorithms for classification purpose. Our proposed methodology is voting ensemble classifiers which is generally used for classification problems as It allows the combination of two or more learning models on the whole datasets .Each model predicts an outcome for a sample data point which is considered a "vote" in favour of the class that the model has predicted. Once each model predicts the outcome, the final prediction is based on the majority for a specific class. voting ensemble, as compared to bagging and boosting algorithms, is simpler in terms of implementation. So here we are combing all three algorithms which we are using in this project. They are Gradient Boosting, AdaBoost and Support Vector Machine (SVM).

Experimental Results

The result of our project is to find whether the news is Fake or Real which is given by the user. The whole analysis of the project is to how to detect a fake news from the given data in the world wide web. In this project we are using Python for the coding purpose. We imported so many libraries for the functionality of the project. We use machine learning booster algorithms for finding the accuracy of the dataset and

find out whether the data is usable for the manual testing or not. And finally, we do manual testing and find out what user want. Here the Table 3 consists of the overall accuracies for the machine learning algorithms namely GB, AB, SVM, Random Forest(RF), Logistic Regression(LR), Decision Tree(DT) for the covid-19 dataset.

Table 3. performance measures

Algorithm	Recall	Precision	F1-Score	Accuracy
GB	0.85	0.92	0.937	0.956
AB	0.87	0.93	0.938	0.966
SVM	0.82	0.926	0.92	0.964
RF	0.79	0.914	0.85	0.962
LR	0.77	0.90	0.816	0.94
DT	0.83	0.92	0.856	0.943

To evaluate the performance of algorithms, we used different metrics. Most of them are based on the confusion matrix. Confusion matrix is a tabular representation of a classification model performance on the test set, which consists of four parameters: true positive, false positive, true negative, and false negative. Precision score represents the ratio of true positives to all events predicted as true. In our case, precision shows the number of articles that are marked as true out of all the positively predicted (true) articles.

$$\text{Precision} = \frac{TP}{TP+FP}$$

F1-score represents the trade-off between precision and recall. It calculates the harmonic mean between each of the two us, it takes both the false positive and the false negative observations into account. F1-score can be calculated using the following formula.

$$F1-\text{score} = 2X\frac{Precision*Recall}{Precision+Recall}$$

Accuracy is often the most used metric representing the percentage of correctly predicted observations, either true or false. To calculate the accuracy of a model performance, the following equation can be used:

$$\text{Accuracy} = \frac{TP+TN}{TP+TN+FP+FN}$$

In most cases, high accuracy value represents a good model, but considering the fact that we are training a classification model in our case, an article that was predicted as true while it was actually false (false positive) can have negative consequences; similarly, if an article was predicted as false while it contained factual data, this can create trust issues. Therefore, we have used three other metrics that take into account the incorrectly classified observation, i.e., precision, recall, and F1-score.

Conclusion

As a future generation of the present society it is our responsibility to make sure that only the Real news should spread across as now a days lots of fake news is spreading rapidly than the real news it is our part to show the news is fake or not, for that this is our part of idea which can be improved more. As our part of idea have the predefined dataset which is used for manual testing where

user gives an input of the news and check whether the input is Real news or the fake news. And this project has lots of scope for future work, by using WebCrawler method we can directly import a data set by just giving the website link and we can run the dataset and find accuracy among the different types of ML Models. For getting the better accuracy we can add two or more ML Models make them as a single algorithm.

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