



Fake News Classification Bimodal using Convolutional Neural Network and Long Short-Term Memory

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ABSTRACT: Fake news is a publicity or conspiracy that contains cautious or fake information having a social as well as political impact because it is spread through old fashioned media and gets the progression via social or news media. Some challenges during fake news are veracity of a news story and natural language processing. This article we are using multimodal approach with Convolutional Neural Network (CNN) and Long Short-Term memory (LSTM) to classify the fake news articles achieved significance performance. We worked on a database with 12 different categories of news articles and used linguistic cue approaches with machine learning. We classified a news based on its source and its previous history (such as domain name and/or author name) with bimodal CNN and LSTM. Through reputable news source, our model classifies reliable news articles with the accuracy of 99.7% on the training data and 97.5% on test data. However, as a fake news can still be published on a reputable domain, we still had to consider other parameter such as news headlines.

Keywords: Classification, CNN, Detection, Deep learning, Fake News, LSTM, social media.

I. INTRODUCTION

A fake news is nothing new. Availability of internet has made it easier than ever for fake news to spread in no time. Before the internet, most people used to get news from newspaper, radio or television as there were fewer sources providing news. But with the internet, news moved online suddenly as anyone could post information on places like Facebook or twitter. So due to a lot of information coming from different sources, it is more likely to get duped.

Fake news is created by different people for various reasons including financial and political gain. The fake news is the news article or content created with false information to mislead people and spread false claims. When talking about fake news we should know that misinformation falls into many different categories. For example some news articles may be completely false, some articles report a simple real event but give a completely fake explanations. Similarly, some articles are simply pseudoscientific which are falsely or mistakenly claimed articles while some are satirical, based on posts and tweets. Studies show that 75% of people who see fake news consider it real [1].

More recently, through "weaponizing information" and "deploying state-run media outlets to plant fake stories" [1], British Prime Minister Theresa May publicly denounced Russia for undermining the free society of the West [2]. Spain has also accused Russia of using similar policies to split Spanish community with disinformation [3].

The ability to screen out manipulative material written by offenders would be one property of a successful system. For instance, one of the most popular fake news authors, Paul Horner, wrote his work only to show how simple minded the public was [4].

In this article, we used Kaggle's cloud to execute our code and training our model. Our model needs lots of

resources to train because of Embedding layer, LSTM layer and with 2 CNN and 2 dense layers.

The main goal is to identify fake news with a simple proposition, which is a classic text classification problem. We conclude our paper in VII sections. Section I is introduction, section II contains the literature review, section III contains all the details of datasets that we are going to use. Section IV is about methodology used in this research while section V contains results.

II. LITERATURE REVIEW

This research topic is not new and some other research articles have also addressed this problem. Most common method of handling such problem is to do it manually. Some organizations rely on manual filtering, either by informing people how to identify reliable sources of information or employ professionals to verify claims manually. These kinds of methods either attempt to verify content independently or block out articles after the complaints. But due to the speed at which news travel in current digital era, it is not possible to stop fake news quickly. Even Facebook switched to third party reality-checking services, such as Snopes and PolitiFact, in an attempt to reduce the flow of fake news articles [5].

Open-Source uses caption, domain, writer name, quoted source (if any), style of writing, webpage functionality and the social media presence of the source. For instance, if the title or domain name looks like a parody of a real news or some public figure or the web pages look like a distorted blog, the website is extremely likely not to be a legitimate source of real information. If the style of writing is ambiguous, or ungrammatical, or includes a lot of capital words or punctuation marks, then the article may be clickbait and purposely offensive to evoke intense emotions in the audience. Manual verification is very useful because we cannot just look at the text when classifying the news [6].

There are also some automatic ways to filter such contents, such as NLP (Natural Language Processing) to understand the meaning behind the words, using that to categorize if the news is real or not, with models of machine learning like Decision tree, Naïve Bayes, ANN (Artificial Neural Network), CNN (Convolutional Neural Network), LSTM (Long Short-Term Memory) [7]. These Models either find similarity of one article with another article or they look at linguistic cue using NLP (Natural Language Processing). But still the main problem lies in the accuracy of such model which automatically classify news. Reason being the language used in such news is made to bypass such automatic model as news writers can easily change their pattern of writing fake news by learning the pattern in which real news are written.

Conroy, Rubin, and Chen used several methods which are very useful when classifying fake news. By using PCFG (Probabilistic Context Free Grammar) with combination of n-gram methods, they provide Deep Syntax analysis which is very useful method in their work [8].

Using the online review organization, Feng, Banerjee and Choi obtained 85% to 91% precision in fraud based classification tasks [9].

For further clarification, Feng and Hirst carried out a linguistic study looking at 'object: descriptor' pairs for inconsistencies with the text on top of Feng's initial deep-syntax model [4]. Rubin, Lukoianova and Tatiana used a vector-space framework with similar results to examine the conceptual structure [10]. Ciampaglia used similarity networks of language patterns which require a pre-existing base of knowledge [11].

Rubin, Victoria used different features combination to detect satirical news and their top forecasting feature grouping (Punctuation, Grammar and Absurdity) discover satirical news with the 84% recall, 90% precision with total F-score of 87%. Their work in automatically detecting satirical news [12].

Granik, Mykhailo, Mesyura and Volodymyr used naive Bayes classification method for detection of fake news. This naive Bayes model tested against a Facebook news-posts of dataset. They managed to get approximately 74% of accuracy on the test-set [13].

Helmstetter, Stefan, Paulheim and Heiko used tweets from twitter as the dataset, and labeled them as fake or not, they were able to classify fake news with the score of 0.9, even when some of the training data samples were not properly labeled [14].

Granik and Mykhailo used Artificial Intelligence to classify statements made by the public figure as true or false, they achieved the accuracy of about 86% at best [5].

III. MATERIAL

We are using Fake news dataset from Kaggle [15] website. The news in the dataset is categorized in to 12 different categories as shown in Table 1. In our research, we extracted 3 features for our model. Two of them are "Domain" and "Authors", because these features are easy to classify news based on their source. The third feature that we used is "Title" of the news. The reason for which is that it is most important feature because news reader focuses on title more than anything else. It is the first thing that people see and based on the title, people decide if they should read the article or not.

The output parameter of our dataset is the news type which has 12 distinct values. Our aim is to train our model on this dataset to predict which type our article belongs to. As shown in Table 1, most of the columns have null values which we can skip. But some null values are useful, like in case of authors if there is none, it means the news is not reliable. Different types of news categories are mentioned in this dataset as shown in Table 2 and classifying all of them accurately is our real goal.

Table 1: Dataset Features Description.

Columns Name	Description
id	Unique id for each news
domain	Domain at which news was published
type	Type of news
URL	Unique URL of news
scraped_at	Date at which it was scraped
inserted_at	Date at which it was inserted into dataset
updated_at	Date at which it was last updated in dataset
content	Content of news article
Title	Title of the article (1% null)
authors	Names of news authors (44% null)
keywords	Keywords for news article (100% null)
Meta_keywords	Meta keywords for news article (4% null)
Meta_description	Meta description for news article (53% null)
tags	Tags of news article (77% null)
summary	Summary of news article, if any (100%null)
source	Source of the news article (78% null)

Table 2: News Types and Its Description.

News Type	Description
Fake	News consists of deliberate disinformation
Conspiracy	A secret plan by a group to do something unlawful or harmful
Political	Political news
Unreliable	Unreliable news
Junksci	Fake Science News
Bias	Unfairly prejudiced for or against someone or something.
Reliables	Trustworthy news
Hate	Strong dislike against someone or something
Clickbait	The purpose of the content is to attract attention and to enable users to click on the link to a particular web page (on the Internet)
Satire	Use satire, irony, exaggeration, or mockery to reveal and condemn the dumbness or voices of people, especially in the context of contemporary politics and other issues
Rumor	Currently circulating story & report of uncertain or doubtful truth
Unknown	Category not known

IV. METHODOLOGY

This research uses 4 layers model which is made of 2 CNN layers, 1 LSTM layer and 1 fully connected layer. CNN is a Deep learning Model which is very useful when working with a data that has close relation with other close by data, such as pixels in image or words in a sentence. So we think this type of model will be very useful when classifying Fake news from real one. We also used LSTM [16] which is also a Deep Learning model. This model is found to be very useful when working with sequence of data related to other data.

For this research, the database we contain has text, but Machine learning model cannot work directly on text. So we have to apply some data preprocessing on the dataset, which includes converting all the capital alphabets into small. The reason for doing so is that small and capital alphabets are different and we need all the text in one form [17, 18]. We then apply *Tokenization* on our data to convert it into numbers. We need this step for our machine learning model. Next step is padding in which we make length of data equal. This is done by adding zeros at the end of data having less numbers resulting in all the data sample with equal length. Finally, if there were some missing values in our dataset, we fill it.

We also converted 12 output class labels using one-hot vector encoding giving us 12 different columns each having either a 0 or a 1 as values where 1 represents the class from which news article belongs to.

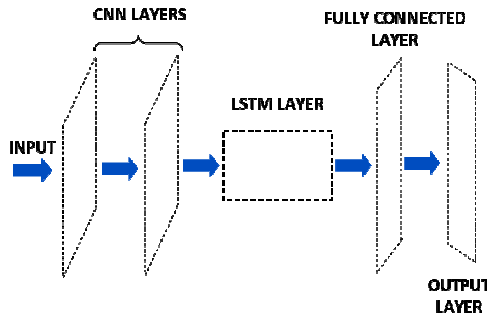


Fig. 1. CNN+LSTM Model.

For this article, we are first using glove embedding layer, which is a layer in our model. This layer will convert our input data into feature vectors. We apply limit of the maximum length of 500 and maximum features up to 50,000. We believe that it will be enough for our database to represent all the different features. Next we have two, one dimensional CNN layers each having 10 kernel size and 10 filters. Each has relu activation function. Next we have one LSTM layer of size 10 [19], and after that we have two fully connected layers. First layer has 100 neurons and second has 12 neurons, one for each output. Finally we used softmax function in the end because softmax is very useful when working with multi-class problems.

When training our model, we used Adam optimizer and loss function was categorical cross entropy. The output is shown in the form of accuracy. Next we generated class weights. Class weights are very useful for our model because we have a little bit unbalanced database as some classes of news have very few samples resulting in a biased model. To remove such bias, we need class weights. These class weights are calculated based on number of samples of each type. More samples mean less weight and less samples means more weights.

V. RESULTS

The purpose of this research was to understand the characteristics of fake news using CNN + LSTM. After training it for 2 iterations, we were able to get 99.7% and 97.5% accuracy of training and testing, respectively. Since we used 12 classes to predict from, it is better to show results in the form of confusion matrix (Fig. 2). The matrix shows real values along with what we have predicted through our model.

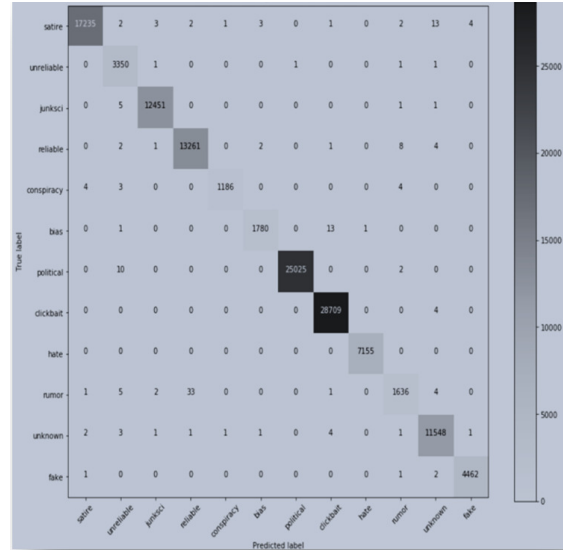


Fig. 2. Result in Confusion Matrix.

From this we can understand that most of the prediction were correct and only a few errors were noticed in this outcome. So we can say that it is a good idea to use CNN+LSTM model to classify text data based on sentiments. This proves that it is quite possible to detect fake news using machine learning model for sentiment analysis, just because those article have some similarity and based on that we can classify them as fake or real. The most important attribute will be the source of news, the author and the domain where it was published along with the title of the news. Using source to classify news will easily filter out the repeated fake news publisher.

VI. DISCUSSION

We used Kaggle GPU for the machine learning model, because our model involved a lot of computing, particularly in the Embedding and LSTM layers, so we used Kaggle and its GPU kernels. Most of the predictions were right and only a few errors were found in the result. So we can say that it is a good idea to use the CNN+LSTM model to classify sentiment dependent text data.

VII. CONCLUSION

By using a deep learning model, we got good results, which means we can apply some deep learning techniques to classify fake news based on previous data that we have about other fake news. When working with text data and we need to do sentiment analysis, it is best to use CNN and LSTM which are found to be one of the best models for text data along with the embedding layer. Because LSTM processes the whole sequence of data and finds the pattern, then in the end it gives the result.

Also some news author may figure out the pattern of real news, and they may change their way of writing

news in a way that fake news could also look like the real news. No matter what classifier is used, it is still not easy to be identified.

VIII. FUTURE WORK

Still we cannot just look at the text and say that it is authentic or not, specially news which can be "real" or "fake" based on some real incident that happen somewhere in the world the only way to classify such a news as real will be to witness such event in real life and to convey such an event to other people we needs evidence in the form of pictures or videos or audio. Moreover through preprocessing we can get better accuracy

Conflict of Interest. The authors have no conflict of interest.

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