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Fake News Detection Using Convolutional Neural Networks

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Abstract

There exist catchy headlines in the digital media so as to lure readers to click on them. These exaggerate the facts and baits the users since the actual contents deviate farther from the clickbait headlines. A Machine learning model has been implemented using Convolutional Neural Network (CNN) to train and test on English dataset and then to perform classification. The CNN model was trained using Keras classifier with Tensor flow as backend. The model was trained and validated with the training dataset and validation dataset. Finally, the model is evaluated with the testing dataset. The CNN model obtained an F1 score of 92 % on test data. Cross validation technique was used for data validation.

Keywords: *Convolutional Neural Networks, Global Vector, Maxpooling*

1. Introduction

In an era dominated by information dissemination through digital platforms, the rapid spread of fake news has emerged a critical challenge. The development of the internet and technology has a positive impact on the society since it provides broad access to information (Liang et.al, 2017). The online and multimedia social networks provides advantages in communication and technology and they severely impact the social aspect. Misinformation not only distorts public perception but also poses significant threats to societal trust and decision-making processes (S. Dam et.al, 2024). This research explores into the realm of combating this phenomenon, focusing specifically on the context of English news. Leveraging the power of advanced technologies, we explore the efficiency of convolutional Neural Networks in defining the authority of news articles. This study aims to contribute valuable insights and methodologies to the ongoing effort in mitigating the impact of fake news, fostering a more reliable and trustworthy news environment. (Thota et. al, 2018) also proposed an automatically fake news detection methods using deep learning. Recently, the spread of fake news has become more prevalent due to the ease of creating and distributing information on the internet (Adelson et.al, 2018). As information manipulation techniques evolve, the role of machine learning models become crucial in finding deceptive content (Chakraborty et. al, 2016). Research for detecting Real and fake news is increasing. In this paper, we explore the application of CNN for detecting fake and real news. By leveraging large scale datasets, we train and evaluate CNN model to classify articles as either authentic or fake.

This research work follows to achieve below specific objectives:

- Utilize CNN to extract meaningful features from textual news content
- Train CNN to recognize linguistic pattern, syntactic structures and semantic cues.
- Design CNN model that generalizes well across different news sources.

2. Materials and Methods

This study uses Kaggle dataset to demonstrate a Convolutional Neural Network (CNN) model for fake news detection. To build automated machine learning model on text data, textual data need to be cleaned and converted into machine readable format. For the very purpose, Natural Language Processing (NLP) was applied to clean textual data by removing punctuation, English characters and digits, English digits, stop words and stemming them. In order to perform analysis on text, raw texts were converted into numeric features. GLOBAL VECTORS was used for word to vector representation. These GLOBAL VECTORS of the headline-body pair were input to CNN which predicts the output.

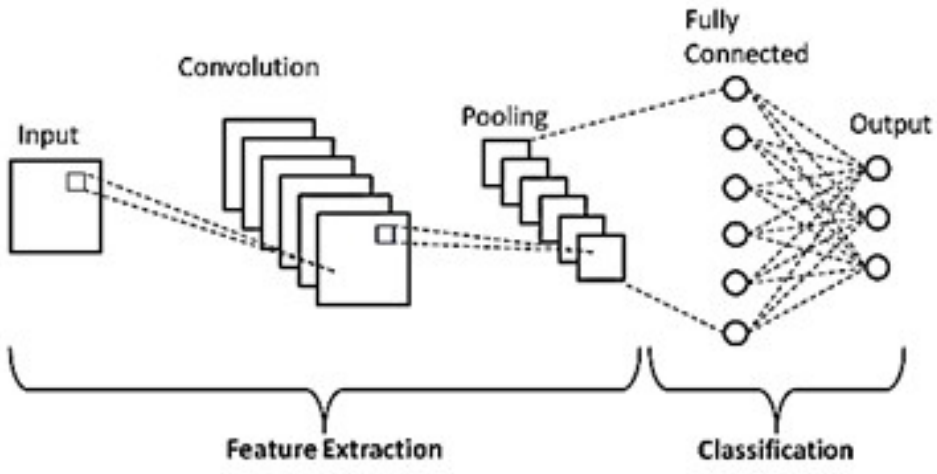

Figure 1: Convolutional neural networks model

Figure 1 shows the CNN model. Here the classification is accomplished after the features extraction from the provided input data sets.

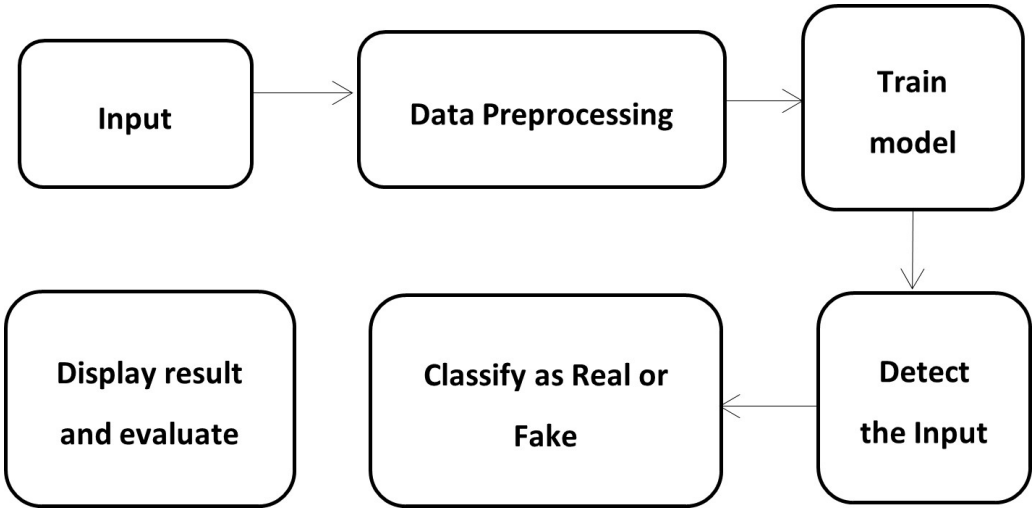

Figure 2: Work flow for fake news detection

Dataset

The dataset was taken from Kaggle. The dataset contained 44919 pairs of news article, out of which 23502 were real and 21417 were fake. The dataset consisted of 6 attributes: id, title, text, subject and label. Punctuations are just meant for grammatical context to the sentences. They have no significant role in NLP. So, various punctuations like comma, full stops, apostrophes, hyphen, single quotes, double quotes, question mark, exclamation sign, asterisk, parenthesis, braces and many other special characters were removed and re-placed with a blank space. The words present in the dataset after removal of punctuation, English characters and Nepali digits, were then split. The words are split if any white space is found in the string.

Stemming is technique of getting base form by removing suffixes and prefixes from the words in the dataset. A Single English word can have many forms because of the suffixes that are attached to them. So, in order to get the main word, suffixes had been removed. Stop words are the common words that hold less information and needs to be filtered out from the text. Stop words from Natural Language Tool Kit (NLTK) were taken, A set difference method was used to filter out the stop words from each title and body of the dataset.

3. Results and Discussions

A CNN is a network of fully connected (dense) neurons in a network layer. Figure 1 illustrates the architecture of the CNN model. Word2vec is a group of related models that are used to produce word embeddings. These models are shallow, two-layer neural networks that are trained to reconstruct linguistic contexts of words. Word2vec takes as its input a large corpus of text and produces a vector space, typically of several hundred dimensions, with each unique word in the corpus being assigned a corresponding vector in the space. Full dataset that consisted of 44919 pairs of news title and news body (23502 fake and 21417 real) were taken for experiment. The dataset consisted of six attributes: ID, title, text, subject, date and class. There are two target labels: 0 and 1. '0' represents fake news and '1' represents real news. The entire dataset is split into three subsets: training dataset, validation dataset and testing dataset, as shown in figure 5, in the ratio of 50:25:25. The entire dataset was shuffled beforehand.

The experiment was conducted to find the real and fake news from testing dataset as explained above. The CNN model was trained using Keras classifier with Tensorflow as backend. The model was trained and validated with the training dataset and validation dataset. Finally, the model is evaluated with the testing dataset.The CNN model achieved F1-score of 92% and accuracy of 92% on testing dataset. The Classification report, illustrated in figure 4, shows the performance of the classifier with testing dataset. From the graphs of accuracy and loss, it can be seen that the model has significant performance on both train as well as validation datasets (with labeled data). The model has a high learning rate and reaches the global minimum within three epochs and reaches saturation. The model propagates forward and backward, thus minimizing the error rates. The plot shows that the model is neither overfitting nor underfitting. The model shows good fit. The accuracy curve of validation dataset is just below with the curve of training dataset.

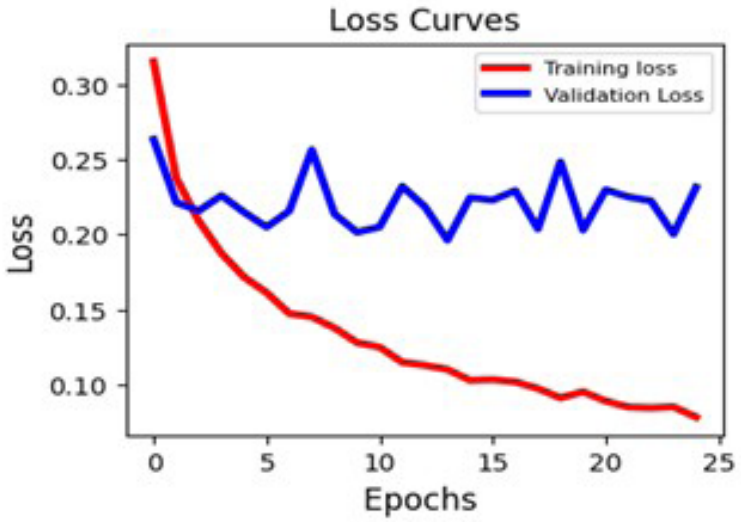

Figure 3: Loss curve

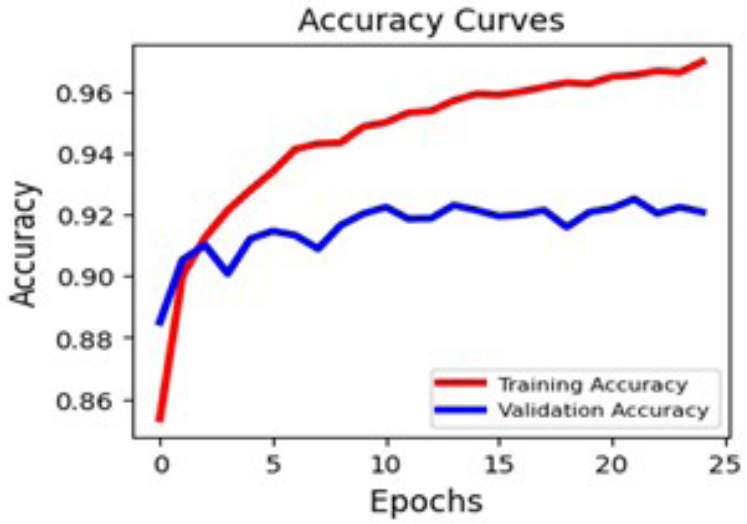

Figure 4: Accuracy curve

Classification report with Test Dataset

	precision	recall	f1-score	support
0	0.91	0.94	0.92	5869
1	0.93	0.90	0.91	5360
accuracy			0.92	11229
macro avg	0.92	0.92	0.92	11229
weighted avg	0.92	0.92	0.92	11229

Figure 5: Classification result

Confusion Matrix

Confusion matrix illustrated in ufigure 6 shows the performance of the classifier with testing dataset. Out of 5183 real news, 4819 were predicted correctly. Similarly, out of 6046 fake news, 505 were predicted correctly. The CNN model achieved F1-score of 92% and accuracy of 92% on testing dataset.

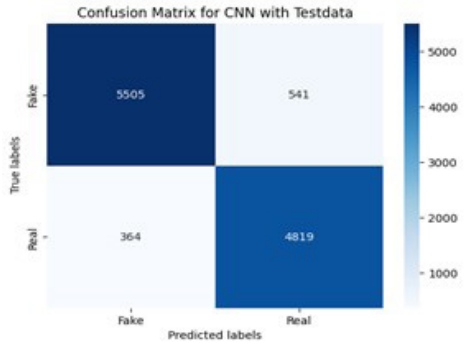

Figure 6: Confusion matrix

4. Conclusions

This research shows that the trend to fake news is increasing in online English media. To address this problem, a 45 thousand scale dataset has taken which contains pairs of news-title and new-body of real and fake news. The results show that CNN model trained on the dataset show decent performance. The proposed model detects fake news with 92% accuracy in English news.

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