Yuqi Jin

Project 4

EC601

Dec 11. 2023

Detect Fake News

During the 2016 U.S. presidential election, the term "fake news" became well-known. The social media platforms saw a noticeable uptick in the propagation of false or misleading information throughout this period. Misinformation, conspiracy theories, and false stories increased and could sway public opinion. Although the phrase "fake news" became well-known in the political sphere after the 2016 election, disseminating misleading information or propaganda has long been a practice. There have been cases of false or misleading information used for social or political manipulation in the U.S. and other countries throughout history. Nowadays, it is easier to share information online, and the digital age has expedited the spread of fake news, making it more difficult to discern between trustworthy information and fake news. This paper will summarize and analyze two research articles about detecting fake news using data mining and deep learning. Then, provide the feedback and conclusions on these research articles.

According to Shu, Sliva, Wang, Tang, and Liu (n.p.), the approach to detecting fake news on social media is from a data mining perspective, emphasizing feature extraction and subsequent model construction. These extracted features are utilized within machine learning frameworks to discern fake news from real news. Figure 1 provides an overview of fake news background, employing theories and properties from social studies. To characterize fake news,

the analysis primarily revolves around linguistic-based and visual-based features. Linguistic-based features aim to discern various writing styles, catchy headlines, and subtle nuances found within the text. These encompass syntactic characteristics, vocabulary traits, and domain-specific linguistic features pertinent to the news domain. Examples include character count, unique word count, and incorporated quotes. Visual-based features are bifurcated into individual-level and group-level features, based on registration age and community traits. It also encompasses post-based content reflecting users' sentiments and expressions in social media posts. Furthermore, it delves into network patterns among users engaging in discussions related to news articles on social media. For instance, connections might be established between users sharing similar opinions regarding news.

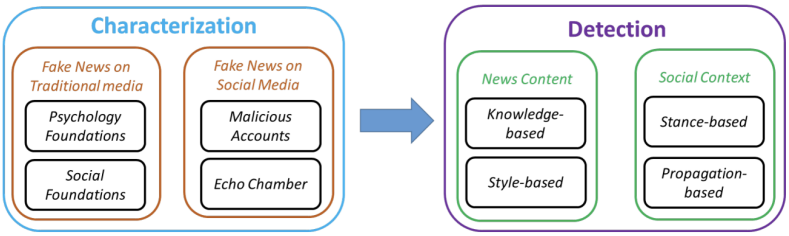

Figure 1: From Characterization to Detection

Shu, Sliva, Wang, Tang, and Liu (n.p.) analyze various methods for constructing detection models. They initially delve into the news content model, which categorizes fake information by utilizing elements from news content and credible sources. This model encompasses two primary categories: knowledge-based and style-based. The knowledge-based category primarily involves domain experts who scrutinize and validate statements within news articles. Additionally, this approach relies on user annotations or discussions to collectively assess the accuracy of news content. It effectively identifies and validates assertions deserving of further investigation by extracting factual statements and utilizing external resources to verify their validity. On the other hand, the style-based approach employs linguistic and syntactic

analysis to uncover false assertions or claims within news content. Diverse models like CNNs, PCFG, and Rhetorical Structure Theory are used to identify misleading information. Furthermore, this approach can detect indicators of declining objectivity in styles, such as hyperpartisan approaches or attention-grabbing headlines

In the paper 'Fake News Detection: A Deep Learning Approach' authored by Thota, Tilak, Ahluwalia, and Lohia (2018), the authors detail the steps involved in data preprocessing applied to both headlines and news articles. They focus on tasks such as stop word removal, pronunciation correction, and word vector representation. Furthermore, they employ stemming techniques to eliminate prefixes and suffixes from the document. Additionally, a crucial aspect of their approach is the utilization of 'Term Frequency and Inverse Document Frequency' (TF-IDF). This technique aids in identifying word occurrences within a document and highlights significant words that occur infrequently. Furthermore, during their experiment, they specifically use 'unrelated,' 'agree,' 'discuss,' and 'disagree' to elucidate the similarity between news contents and articles.

Thota, Tilak, Ahluwalia, and Lohia (2018) provides concise deep learning concepts and models based on how to detect the fake news. They have trained three different models on neural networks, which are Tf-Idf Vectors with Dense Neural Network, Bag of Words Vector with Dense Neural Network, and Pre-trained word embedding’s with neural networks. The Tf-Idf Vectors with Dense Neural Network is shown in Figure 2, it utilizes Tf-Idf vectors, along with their cosine similarity, which serves as a standard measure for evaluating the likeness between two non-zero vectors, as the model's input to predict the output stance based on headline-article pairs. This neural network operates by representing words in a hidden dimension, enabling subsequent layers to utilize this representation seamlessly. Eventually, the final dense layer

produces output probabilities for the stances. And similarly, the rest two models are generally the same structure as Tf-Idf, the only difference is to apply different vectors such as Bow vector of article and Tokenized word vectors.

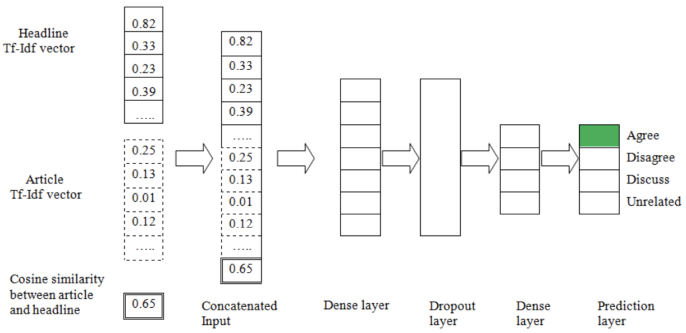

Figure 2: Tf-Idf Vectors with Dense Neural Network

Thota, Tilak, Ahluwalia, and Lohia (2018) based on the Tf-Idf model to evaluate the local and global significance of words in article-headline pairs, capturing their relative importance within pairs and across the entire corpus. To measure the similarity between headline-article pairs, they also use Cosine similarity on their TF-Idf representations. In the result of the article, they show that using the TF-Idf model can achieve 94.21% accuracy on test data, especially in predicting 'unrelated,' 'agree,' and 'discuss' stances. However, it has a low accuracy of about 44% in predicting a 'disagree' stance. The confusion matrix depicted in Figure 3 highlights notable misclassification rates across different Stance types. Particularly, the misclassification rate of the 'disagree' class as 'agree' stands out significantly, raising concerns.

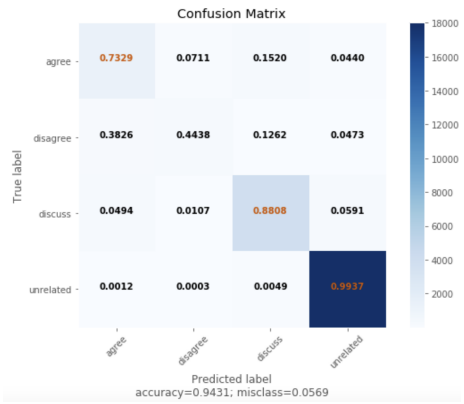

Figure 3: Conclusion Matrix for Final Model

As a final point, these two articles on detecting fake news offer comprehensive and professional insights into a widely discussed topic on the internet. The first article, focusing on a data mining approach to detecting fake news, first provides a detailed background on fake news, particularly its characterization. Then there is an extensive discussion by using multiple pages, exploring various strategies for detecting fake news. The second article, centered on employing a deep-learning approach, serves as an informative source for fundamental concepts in deep learning models, including Dense Neural Network (DNN), Convolutional Neural Network (CNN), and Recurrent Neural Network (RNN). While the primary focus remains on DNN, its comprehensive explanation details its operation as a fully connected dense neural network, processing input as a sequence of words. The layered architecture within this network allows for flexible exploration of optimal depth tailored to specific tasks, encompassing an input layer, an output layer, and the potential inclusion of multiple hidden layers. In the experiment, they emphasize on data preprocessing to craft nearly perfect datasets. The article elaborates step-by-step on the data preparation process, outlining various stages involved. It highlights the usage of these refined datasets within the deep learning model, demonstrating the effectiveness of this approach in achieving accurate results.

Reference

Shu, K., Sliva, A., Wang, S., Tang, J., & Liu, H. (n.d.). Fake News Detection on Social Media: A Data Mining Perspective. Journal Name, Volume(Issue), 1-28. Retrieved from https://dl.acm.org/doi/abs/10.1145/3137597.3137600?casa_token=geekykaCbqsAAAAA:dkwvVynFHRVjfCmmDtwxdn-TCkpXt0DzscDCJdRdoIbyRh5f-omJ7DUfRC5L07shgJhVOkAvrC60NNw

Thota, A., Tilak, P., Ahluwalia, S., & Lohia, N. (2018). Fake News Detection: A Deep Learning Approach. *Journal Name*, 1(3). Retrieved from https://scholar.smu.edu/cgi/viewcontent.cgi?article=1036&context=datasciencereview