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REVIEW ON FAKE NEWS DETECTION TECHNIQUES

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ABSTRACT
Fake news detection has recently attracted a growing interest from the general public and researchers as the circulation of misinformation online increases, particularly in media outlets such as social media feeds, news blogs, and online newspapers. In this paper, we present the review on the state-of-the-art of fake news detection mechanisms on social media. We first discuss the background of the problems that are surrounding fake news and the impacts it has on the users. We further describe the definition of fake news and discuss on different deception detection approaches. This survey reviews and evaluates methods that can detect fake news from different perspectives: (1) type of detection (2) approaches based on phases of fake news life, and(3) the methods for detection used. The survey also highlights some potential research tasks based on the review. In particular, we identify and detail related fundamental theories across various disciplines to encourage interdisciplinary research on fake news.

I. INTRODUCTION

Fake news is now playing a dominant role in spreading misinformation by influencing people's perceptions or knowledge to distort their awareness and decision-making. The authenticity of information has become an issue affecting people, politics, businesses and society, both for printed and digital media. The rapid growth and wide use of the Internet and the social media causing a significant effect on the growth of news access across the social media platforms.

The growth of social media and online platforms sucha as blogs, microblogs, Facebook and twitter has stimulated the reach and effects of information spread to millions of users within minutes. Fake news is a powerful and misleading means that can be adopted to influence public sentiment purposely in gaining political, social or financial benefits. The effects of fake news can be very harmful. The viral spread of misinformation can result in serious damages such as affecting the reliability of the news ecosystem, tarnishing the reputation of any personal or organization, or causing panic among the public that can weaken the social stability [1].

The reach of fake news was best highlighted during the critical months of the 2016 U.S. presidential election campaign. During that period, the top twenty frequently-discussed fake election stories generated 8,711,000 shares, reactions, and comments on Facebook, ironically, more than the 7,367,000 for the top twenty most-discussed election stories posted by 19 major news websites [2]. Research has shown that compared to the truth, fake news on Twitter is typically retweeted by many more users and spreads far more rapidly, especially for political news [3]. Other important fakenews viral stories can be illustrated during the current COVID-19 pandemic. While fake news is not a new phenomenon, the rise of social media and its popularity, and the creation and publishing the data in online media is cheaper and faster when compared with the traditional news media such as newspapers and television is the leading cause for the exploratory growth in fake news. Social

and psychological factors play an important role in fake news gaining public trust and further facilitate the spread of fake news. Reducing the negative effects caused by fake news to benefit the both public and the news ecosystem is required.

The speed of fake news propagation requires automated processes of detecting misleading sources and content, prompted more studies particularly on developing fake news detection mechanisms to counter the problem. Detecting fake news on social media poses several new and challenging research problems. A fake news detection mechanism is a technique or system that assists users with the tools and functions in predicting deceptive news content. The mechanism works with algorithms and measures that can classify and verify information or news. However, developing a fake news detection mechanism is ever challenging effort that requires deep comprehension on different aspects related to news consumption on social media.

II. FAKE NEWS CHARACTERIZATION

There has been no universal definition for fake news, even in journalism. The definition of the term is usually presented according to how it is operated in the research articles and guided from which perspective or research discipline the studies stand on. One definition is Fake news can be defined as the online publication of intentionally or knowingly false statements of fact [4]. Fake news refers to information content that is false, misleading or whose source cannot be verified. This content may be generated to intentionally damage reputations, deceive, or to gain attention. Definitions of fake news focus on the either authenticity, intent of the news content or the source. Various types of fake news include: (1) Clickbait - Often eye-catching content to capture readers at the expense of being factual. (2) Satire/parody - This type of content is considered to be fun and humorous thus considered being entertaining, yet some readers may interpret the content as fact. (3) Propaganda - This is content meant to mislead and influence the reader. (4) Biased/partisan/hyper-partisan - Often this is biased political content claiming to be impartial. (5) Unreliable news - Journalists may publish news whose sources are unverified, or without carrying out any form of fact checking themselves.

As the goal is to provide a survey on existing literature based on scientific definition for fake news, we have conducted a comprehensive literature survey across various disciplines and have identified well-known theories that can be potentially used to study fake news. This paper aims in providing a review on the state-of the-art of the fake news detection mechanisms on social media. In the rest of this paper, we cover various aspects related to fake news and its detection mechanisms.

III. FAKE NEWS DETECTION MECHANISMS

Fortunately, many techniques and tools have been developed for detecting fake news. For example, a tool has been developed to identify fake news that spreads through social media through examining lexical choices that appear in headlines and other intense language structures [5]. Another tool, developed to identify fake news on Twitter, has a component called the Twitter Crawler which collects and stores tweets in a database[6]. There are many available approaches to identify fake news and this paper aims to enhance understanding of these by categorizing these approaches as found in existing literature. Organization of literature study can be done in several ways, for example, based on the fake news life stages. The first stage is creation of news article that is content of article, then the style used for publication, propagation - based on the spreading of

fake news, and from the credibility and authenticity of the source. We detail the detection of fake news from different perspectives. (a) Based on type of detection (b) based on the mechanism (c) based on the techniques.

(I)TYPE OF DETECTION

We will look at it from the perspective of being either manual or automatic.

A. Manual Fake News Detection

Manual fake news detection often involves all the techniques and procedures a person can use to verify the news. It could involve visiting fact checking sites. It could be crowd sourcing real news to compare with unverified news. Manual fake news detection relies on domain-experts as fact-checkers to verify the given news contents. Expert-based fact-checking is often conducted by a small group of highly credible fact-checkers, is easy to manage, and leads to highly accurate results. But, the amount of data generated online daily is overwhelming. Also noting how fast information spreads online, manual fact checking quickly becomes ineffective. Manual fact checking struggles to scale with the volume of data generated.

B. Automated Fake News Detection

Automated detection systems provide value in terms of automation and scalability. There are various techniques and approaches implemented in fake news detection research. And it is worth noting that these approaches often overlap depending on perspective. Automated detection systems rely on Information Retrieval (IR), Natural Language Processing (NLP), and Machine Learning (ML) techniques, as well as on network/graph theory [7]. To review these techniques, a unified standard representation of knowledge is first presented that can be automatically processed by machines and has been widely adopted in related studies [8]. B.S. Detector – alerts users of unreliable news sources [9] by searching all links of a given webpage for sources that have been collected in a unreliable-news database, which includes samples of fake news, satire, extreme bias, conspiracy theory, rumor mill, state news, junk science, and the like. Fake News Detector AI – identifies fake-news websites by measuring similarity to existing fake-news websites using artificial intelligence techniques as a blackbox [10]. This system uses a neural network–based feature analysis (e.g., headline, code structures, site popularity) approach on known websites, thereby yielding the credibility of the tested websites.

These two approaches focus on the methods used, as opposed to the content being analyzed. They may also both involve Natural Language Processing (NLP) in their methodology.

(II) DETECTION MECHANISMS

A. Content-based Approaches

Fake news detection mechanisms that are strictly content based predict the deception cues based on the features or elements extracted from the news content. The content based detection mechanism centred on the linguistic cue approaches and visual-based approaches. The following further discuss the different types of content-based approaches in fake news detection mechanisms.

linguistic cue approaches

This approach focuses on the use of linguistics by a human or software program to detect fake news. Most of the people responsible for the spread of fake news have control over what their story is about, but they can often be exposed through the

style of their language [11]. The approach considers all the words in a sentence and letters in a word, how they are structured and how it fits together in a paragraph[12]. The focus is therefore on grammar and syntax. There are currently three main methods that contribute to the language approach:

Bag of Words (BOW): In this approach, each word in a paragraph is considered of equal importance and as independent entities[12]. Individual words frequencies are analysed to find signs of misinformation. These representations are also called n-grams[13]. This will ultimately help to identify patterns of word use and by investigating these patterns, misleading information can be identified. The bag of words model is not as practical because context is not considered when text is converted into numerical representations and the position of a word is not always taken into consideration [14].

Semantic Analysis: [15] explain that truthfulness can be determined by comparing personal experience (e.g. restaurant review) with a profile on the topic derived from similar articles. An honest writer will be more likely to make similar remarks about a topic than other truthful writers. Different compatibly scores are used in this approach.

Deep Syntax: The deep syntax method is carried out through Probability Context Free Grammars[16]. The Probability Context Free Grammars executes deep syntax tasks through parse trees that make Context Free Grammar analysis possible. Probabilistic Context Free Grammar is an extension of Context Free Grammars[17]. Sentences are converted into a set of rewritten rules and these rules are used to analyse various syntax structures. The syntax can be compared to known structures or patterns of lies and can ultimately lead to telling the difference between fake news and real news[12].

Topic-Agnostic Approach

This category of approaches detect fake news by not considering the content of articles bur rather topic-agnostic features. The approach uses linguistic features and web markup capabilities to identify fake news [18]. Some examples of topic agnostic features are 1) a large number of advertisements, 2) longer headlines with eye catching phrases 3) different text patterns from mainstream news to induce emotive responses 4) presence of an author name[18,19]

B. Knowledge Based Approach

Recent studies argue for the integration of machine learning and knowledge engineering to detect fake news. The challenging problem with some of these fact checking methods is the speed at which fake news spreads on social media. Microblogging platforms such as Twitter causes small pieces of false information to spread very quickly to a large number of people[20]. The knowledge-based approach aims at using sources that are external to verify if the news is fake or real and to identify the news before the spread thereof becomes quicker. There are three main categories; (1) Expert Oriented Fact Checking, (2) Computational Oriented Fact Checking, (3) Crowd Sourcing Oriented Fact Checking [21].

Expert Oriented Fact Checking: With expert oriented fact checking it is necessary to analyze and examine data and documents carefully [21]. Expert oriented fact-checking requires professionals to evaluate the accuracy of the news manually through research and other studies on the specific claim. Fact checking is the process of assigning certainty to a specific element by comparing the accuracy of the text to another which has previously been fact checked [22].

Computational Oriented Fact Checking: The purpose of computational oriented fact checking is to administer users with an automated fact-checking process that is able to identify if a specific piece of news is true or false[21]. An example of

computational oriented fact checking is knowledge graphs and open web sources that are based on practical referencing to help distinguish between real and fake news[21]. A recent tool called the ClaimBuster has been developed and is an example of how fact checking can automatically identify fake news[23]. This tool makes use of machine learning techniques combined with natural language processing and a variety of database queries. It analyses context on social media, interviews and speeches in real time to determine 'facts' and compares it with a repository that contains verified facts and delivers it to the reader [23].

Crowd Sourcing Oriented: Crowdsourcing gives the opportunity for a group of people to make a collective decision through examining the accuracy of news[24]. The accuracy of the news is completely based on the wisdom of the crowd[21]. Kiskkit is an example of a platform that can be used for Crowd sourcing where the platform allows a group of people to evaluate pieces of a news article [23]. After one piece has been evaluated the crowd moves to the next piece for evaluation until the entire news article has been evaluated and the accuracy thereof has been determined by the wisdom of the crowd [23].

C. Social Context-based

The social context-based detection techniques highlight on users' social engagement analysis, involving the utilization of relevant social context features representing users, posts and networks aspects of the news consumption on social media. Based on the users social engagement, the social context-based approaches can be categorized to stance-based and propagation-based [1].

Stance-based methods use users' viewpoints from relevant post to infer the validity of original news articles while propagation-based approaches is concerning on interrelations of relevant social media posts for news credibility prediction. Recent work by [25] propose an approach to predict fake news that utilize the correlation of three entities of the news ecosystem involving publisher bias, news stance, and relevant user engagements simultaneously. The experimental result demonstrates the effectiveness of the proposed framework and importance of tri-relationship for fake news prediction.

Propagation based approach captures high-order patterns differentiating different types of rumours by evaluating the similarities between their propagation tree structures. Work in[26] propose a kernel-based method called Propagation Tree Kernel. The result demonstrates that the proposed kernel-based approach can detect rumours more quickly and accurately than state-of the- art rumour detection models.

(III) FAKE NEWS DETECTION TECHNIQUES

A. MACHINE LEARNING APPROACH

Machine learning algorithms can be used to identify fake news. This is achieved through using different types of training datasets to refine the algorithms. Different types of algorithms used in machine learning for fake news detection are:

Naive Bayes Classifier (Generative Learning Model)

Naïve Bayes is a probabilistic machine learning model and this is a probabilistic classifier that makes classifications using max posteriori decision rule. This classifier is scalable and traditional algorithm of choice and relates with real-world applications. These real-world applications give a quick response to the users. This algorithm is used in spam filtering for emails and sentiment analysis, etc. This is an oldest classification problem and deals with large datasets.

K-Nearest Neighbour

The k-nearest neighbour algorithm is an easy and simple supervised machine learning algorithm that solves classification and regression problem. Let us consider some labelled points and then calculate the distance between each point and sort the distances in decreasing order and label the first point as "k". The K labels return the mean and mode of the regression and classification models. This is a sensitive model. And classification problems have discrete values as outputs. K nearest is a pattern recognition and intrusion detection model.

Support Vector Machine

SVM is a supervised learning algorithm. Comparing with other algorithms this is one of the best fit algorithms. SVM is utilizing computational linguistics to find the fake news. This algorithm is used to convert the learning models, which are only for specific use. Normalization is done to the training sets and data sets. It has achieved good scope in trained set. Support vector machine is a widely used classification algorithm. Mostly used for extracting large amount of data and small amount of image dimension.

Decision Trees

Decision tree is a supervised learning model and is represented as flowcharts. It is an efficient non-parametric method that can be used for classification and regression. In decision tree we divide the source set into subsets based on attribute value test. The division process is recursively repeated on each set.

Datasets enables new machine learning approaches and techniques. Datasets are used to train the algorithms to identify fake news. How are these datasets created? One way is through crowd sourcing. [27]created a fake news data set by first collecting legitimate information on six different categories such as sports, business, entertainment, politics, technology and education [27]. Crowd sourcing was then used and a task was set up which asked the workers to generate a false version of the news stories [27]. Over 240 stories were collected and added to the fake news dataset.

A machine learning approach called the rumour identification framework has been developed that legitimizes signals of ambiguous posts so that a person can easily identify fake news[28]. The framework will alert people of posts that might be fake. The framework is built to combat fake tweets on Twitter and focuses on four main areas; the metadata of tweets, the source of the tweet; the date and area of the tweet, where and when the tweet was developed. By studying these four parts of the tweet the framework can be implemented to check the accuracy of the information and to separate the real from the fake. Supporting this framework, the spread of gossip is collected to create datasets with the use of a Twitter Streaming API. 18 D. de Beer and M. Matthee Twitter has developed a possible solution to identify and prevent the spread of misleading information through fake accounts, likes and comments [6] - the Twitter crawler, a machine learning approach works by collecting tweets and adding them to a database, making comparison between different tweets possible.

B. NLP TECHNIQUES USED IN FAKE NEWS DETECTION

Natural language processing has come from the extension to computer science and artificial intelligence which is the interaction between the humans and computers. NLP has introduced to process the large amount of data in a meaningful manner.

Collobert [29] introduced Natural Language Processing from the unified neural networks architecture and algorithms. This says that how to differentiate words and sentences which are human made. The word vector representations such as:

BOW: Bag of Words model, sentences are arranged in multisets. It doesn't work on the order and context of the word occurrence.

TF-IDF: The Term Frequency –Inverse document Frequency weights the word to showcase the importance of that word in a sentence.

GlOVE: First construct the Co-occurrence matrix and then reduce the dimensions with the matrix by factorization method.

Word2VEC: Predicts whether the given word is present or not

C. DEEP LEARNING ALGORITHMS USED IN FAKE NEWS DETECTION

Deep Neural Networks were proposed to mimic the human brains for recognizing patterns. DNN is a neural network with networks, which contain the input layer, output layer and a single hidden layer. Finds mathematical manipulations to turn on the input and output non-linear or linear relations. This is a feed forward network in which the data flows from input to output without looping back. These are trained with back propagation.

Convolutional Neural Networks

Convolutional neural networks are a network of neurons connected in layers which are used to take the inputs and outsources the output. CNN is a feed forward network model suitable for object recognition and image analysis. The neural network is represented as stages to perform the functions, there are three stages such as convolution layer, detector layer, pooling layer. The work of convolutional layer is to build convoluted feature map. Detector layer is prominent the nonlinear components of feature maps. Pooling layer reduces the predecessor information and gives the output. CNN finds the dormant characters in the news content. Main use of this model is the data size and trained data. CNN model is taken in to consideration based on performance and speed.

Recurrent Neural Networks

RNN model is trained using back propagation. And this is a type of ANN model. This is also a feed forward network which takes the input from recurrent loops. RNN performs the data analysis in sequential manner such as sentiment analysis, speech recognition and in some other task. RNN is a model with memory. That it takes the previous model inputs. This model understands the human language and responds accordingly. Example of RNN is Apple's Siri and Amazon's Alexa. This cannot predict the future work based on past data. It remembers the past information and uses same parameters for further inputs or hidden layers to outsource the output.

Artificial Neural Networks

ANN is a computational algorithm. The topological structures were imitated with non-linear and complex patterns. In Satellite image classifications ANN's are used. ANN is similar to human neuron. That sends electrical signals. Include large amount of connected processor units which works together. This is a feed forward model with input layer, output layer and hidden layers. The purpose of input layer is to receive inputs and to communicate with the hidden layer. Accordingly, hidden

layer combines with input layer and sends response to output layer. We feed the neural network with some inputs and outputs to compare the actual output with the gained ANN output.

Within a deep learning framework, news content (text and/or images) is often first embedded at the word-level [30] (for text), or as a pixel matrix or tensor (for images). Then, such an embedding is processed by a well-trained neural network (e.g., CNNs [31] such as VGG-16/19 [32] and Text-CNN [33]; RNNs such as LSTMs, GRUs, and BRNNs; and the Transformer [34, 35] to extract latent textual and/or visual features of news content. Ultimately, the given news content is classified as true news or fake news often by concatenating and feeding all these features to a well-trained classifier such as a softmax.

IV. CONCLUSION

Fake news detection on social media requires a method that is able to find and capture distinctive characteristics, patterns and regularities of the news consumption on the online ecosystem. In this article, we explored the fake news problem by reviewing existing literature. In this paper, we tried to perform a comprehensive and extensive study of different fake news detection methodologies, techniques and approaches. This review may be useful to help other researchers to discover which combination of methods should be used in order to accurately detect fake news in social media. Motivated by reviewing the methods that detect fake news from different perspectives such as the false knowledge fake news publication, its writing style, its propagation patterns, and the credibility of its source.

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