A SURVEY ON FAKE NEWS DETECTION USING MACHINE LEARNING

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Abstract: In recent years widespread fake news has given rise to several social and political problems. Most of the knowledge today is acquired from digital sources. In Digital media it's difficult to assign accountability to the opinion thanks to which the info received can't be authenticated. Since the extent of ecological and societal issues, machine learning is especially relevant within the perspective of fake messages in Social Media. Anyone can make a message viral which may be a fake or real one. The goal is to understand a mechanism that's automatic, robust, reliable and efficient, despite various challenges which may help for the efforts to progress. In this i present the review on the state-of-the-art of faux news detection mechanisms on social media. After we discuss the background of the issues that are surrounding fake news and therefore the impacts it's on the users. We further discuss on different approaches presented in categories like the content-based, social context-based and hybrid-based methods. We conclude the paper with four keys of open research challenges which will guide the longer term research.

Keywords: Fake news detection, Sentence matching, Natural language processing, deep learning, and Word embedding, tf-idf, Sentiment, Machine Learning, Convolution Neural Networks, NLP, and Sentence Classification.

1. INTRODUCTION

One can generate more data and knowledge than one can obtain from the outset of the web. Therefore, some false news or rumours could also be disseminated across the online, allowing the users to acknowledge and spread them during a sequence of deliberate lies. Such misinformation can guide to intangible ideas and opinions, group madness or other severe implications. within the previous couple of years, scientists are researching the knowledge flow and age on social media, concentrating on topics like opinion mining, user connection, sentiment analysis, hate distribution, etc. to stop such stuff happening, especially shut to political occurrences like elections. Fake news isn't new, but social media platforms have enabled the phenomenon to grow exponentially in recent years.

The researchers analysed conflicting views concerned with fake news supported a scientific review of existing literature just within the last 10 years. The researchers interested to gauge methods for technical training to identify fake news, concentrating on the features of distinct techniques and methods, cognitive designs for identifying fake news. However, Social Networks lack in content control, and this allowed the emergence of several malicious phenomena just like the spreading of hate messages or fake-news messages. Because of their impact, in recent years, the analysis of online platforms as Online Social Networks (OSNs), blogs, and forums attracted an honest area of security researchers. Different tasks are often found, from bot detection in OSNs to hate speech detection.

Among the varied Social Network analysis, fake-news detection is increasingly attracting the researcher and industrial attention because of the impact of such a phenomenon. Few authors investigated on the fake-news spreading on Twitter during the 2016 U.S. presidential election showing dramatic results in term of fake-news exposition and sharing. To limit the spreading of faux news, it is also important to identify beforehand users more likely believe them. These results highlight the importance of developing accurate techniques to identify and stop fake-news spreading. During this context, Machine Learning plays an important role because it can help to classify fake-news in an automatic manner, that

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otherwise would be impossible for an individual's operator. Common approaches for the identification of fake-news believe traditional methods of features extraction such as: Bag of Words, TF-IDF; but also novel methods like fact-checkers automatic detectors.

2. FAKE NEWS

There is no universal definition for fake news. An accurate definition helps lay solid foundation for fake news analysis and evaluating related studies. Fake news could still arise in several ways, like unintended defects committed by news websites, intentionally false news, or stories developed to mislead and impact the views of readers. Whereas fake news has various forms, the impact it can wear individuals, governments, and organisations can usually be negative because it varies from the realities.

Online social network fake news recognition is very difficult for a spread of things. Fake news reports are challenging to obtain and it is often challenging to manually mark fake news. a huge number of users of social media provides a clear and excellent environment for fake news. It can always divert our attention to false news featuring deception and complexities. Such type of data people wish to share mostly with their friends. Most of the individuals certainly think all the false news as true by just scrolling the key titles without reading the elaborated news. Rubin et.al. Depict fake news as the anticipation of possibilities for a given message to be intentionally incorrect or mistaken. Fake News dissemination is extremely common in social networks. Some internet news datasets only contain a small amount of cases that aren't enough to train a generalized application model. Fake reviews collected on Amazon were relied on the assessment of emotions, syntactic, resemblance of material, similarity of favour and semantic inconsistency to recognize fake reviews. Deep learning is making great progress in solving problems that have been resisting the synthetic intelligence society's greatest efforts for a few years. It proven to be excellent at finding complex structures in high-dimensional information and has relevancy to several scientific, company and state domains. This text incorporates some of the important classifiers of Natural Language Processing and methods of Deep Neural Networks to detect fake news. Even though there are so many survey attempts made by various researchers, the authors intended to try to to this survey so as to depict the researchers and developers to seek out the best method among the best classifiers and to show the level of existing researches with deep learning techniques to detect fake news from complex and really large datasets.
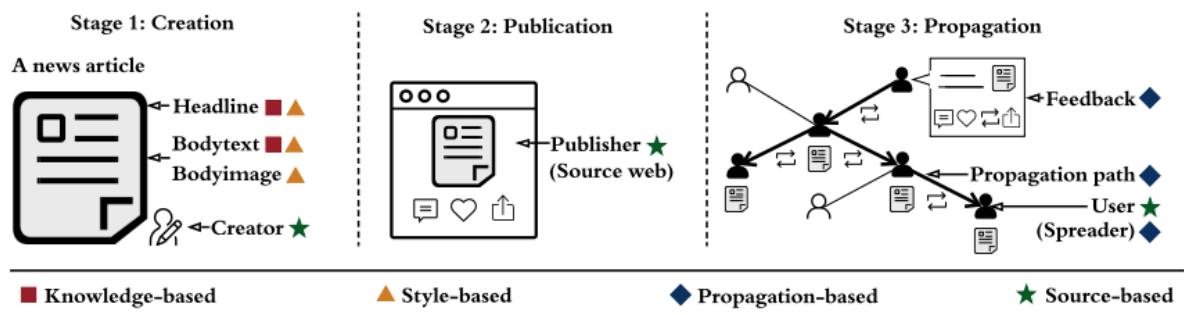
Picture 1: Fake News Life Cycle and Connections to the Four Fake News Detection Perspectives Presented in this Survey

Social networks are not only distinguished by an outsized audience, but also promote fast information exchange and dissemination. Sadly, the dissemination of rumours, like false news, was also encouraged. The topic of false news raises the issue of the existence of true news. There have been several ways of defining news that varied from an account of a current, interesting and important occurrence. The use of accurate pictures or video to create a false story is being used for fake news. In the previous sections where text-based articles are associated with, visual news is listed therein context. Photo processing has become progressively more common with the arrival of digital photography, effective tools for editing of photos and technical expertise.

3. AN OVERVIEW OF THE SURVEY

We have defined fake news and presented some fundamental theories in various disciplines. We detailed the detection of fake news from four perspectives : Knowledge based methods, which detect fake news by verifying if the knowledge within the news content is consistent with facts Style-based methods are concerned with how fake news if it is written

with extreme emotions, Propagation based methods, where they detect fake news based on how it spreads online and Source based methods detect fake news by investigating the credibility of the sources at various stages being created, published online, and spread on social media. We also discuss open issues in current fake news studies and in fake news detection. Later details about how fake news is related to terms such as deceptive news, false news, satire news, disinformation, misinformation, cherry-picking, click bait, and rumour. Compared to other related surveys that often provide a specific definition for fake news, this survey highlights the challenges of defining fake news and introduces both a narrow and a broad definition for it. Though the recent studies have highlighted the importance of multidisciplinary fake news research, we provide a path towards it by conducting an extensive literature survey across various disciplines, identifying a comprehensive list of well-known theories. I have demonstrated how these theories relate to fake news and its spreaders and illustrate technical methods utilizing these theories both in fake news detection and intervention. For fake news detection, current surveys have mostly limited their scope to reviewing research from a certain perspective or within a certain research area, e.g., NLP and data mining. These surveys generally classify fake news detection models by the types of deep machine learning methods used or by whether they utilize social context information. We have four perspectives: knowledge, style, propagation and source. Reviewing and organizing fake news detection studies in such a way it allows analysing both news content and the medium often, social media on which the news spreads, where fake news detection can be defined as a probabilistic regression problem linked to entity resolution and prediction of tasks is linked, or as classification problem that relies on feature engineering and text, graph embedding techniques. In our survey of fake news detection, patterns of fake news in terms of its content or how it propagates are revealed, algorithms and model architectures are presented, and comparison of performance of various fake news detection methods. We point out that the survey focuses more on how to construct a fake news dataset like ground truth data, and the possible sources to obtain such ground truth, other than detailing existing datasets, which have been already provided in past surveys.

4. FUNDAMENTAL THEORIES

Fundamental human cognition and behaviour theories developed across various disciplines, like social sciences and economics help in understanding for fake news analysis. These theories introduce new opportunities for qualitative and quantitative studies of massive fake news data and can also facilitate building few justified and explainable models for fake news detection and intervention, which to date is rarely available. We conducted a comprehensive literature survey across various disciplines and have identified well-known theories which can be potentially used to study fake news.

4.1 News-related theories:

News-related theories reveal the possible characteristics of faux news content compared to true news content. as an example , theories have implied that fake news potentially differs from the truth in terms of writing style and quality, quantity like word counts, and sentiments expressed by four-factor theory. We should remember that these theories developed by forensic psychology are target deceptive statements but not fake news. Therefore one research opportunity is to verify whether the attributes like information sentiment polarity are statistically distinguishable among disinformation, fake news, and thus the reality, especially, using big fake news data. Simultaneously these attributes that are identified are often used to automatically detect fake news using its writing style using supervised learning.

4.2 User-related theories:

User-related theories check the characteristics of users involved in fake news activities like posting, forwarding, liking, and commenting. Information like fake reviews, can attract both malicious and normal users. Malicious users like bots spread fake news often intentionally and are driven by the advantages. Some normal users whom we call as vulnerable normal users can frequently and unintentionally spread.

Fake news without recognizing the falsehood. Such vulnerability psychologically stems from social impacts and self-impact, where theories are accordingly categorized within the table below. Specifically, as indicated by the consequence , normative influence theory by Dbeutsch and Gerard, social identity theory , and availability cascade by Kuran and Sunstein to be liked and/or accepted by the community, normal users are encouraged to interact in fake news activities when many users have done so because of peer pressure. One's trust to fake news and his or her unintentional spreading are often promoted also when being exposed more to fake news like validity of faux news, which regularly takes place because of the echo chamber effect on social media. Such trust to fake news are often built when the fake news confirms one's pre-existing attitudes, beliefs or confirmation bias , selective exposure , and desirability biases, which are often

appeared to surpass that of others and have a bent to be insufficiently revised when new refuting evidence is presented. In such settings, strategies for intervening fake news from a user perspective should be cautiously designed for users with different levels of credibility or intentions, albeit they might all engage within an equivalent fake news activity. As an example, it's reasonable to intervene with the spread of faux news by removing malicious users how of penalizing them, but not for normal accounts. Instead, education and personal recommendations of true news articles and refuted fake ones are often helpful for normal users. Such recommendations shouldn't only cater to the topics that the users want to read but should also capture topics that users are most gullible to. There are some theories described during this survey which can provide an insight on quantifying social and self-impact, to strengthen fake news research by identifying user intent and evaluating user credibility

Table 1: Fundamental Theories in Social Sciences (Including Psychology and Philosophy) and Economics

	Theory		Phenomenon
News Related Theories	**Undeutsch hypothesis**		A statement based on a factual experience differs in content style and quality from that of fantasy.
	Reality monitoring		Actual events are characterized by higher levels of sensory- perceptual information.
	Four-factor theory		Lies are expressed differently in terms of arousal, behaviour control, emotion, and thinking from truth.
	Information manipulation theory		Extreme information quantity often exists in deception.
User-related Theories (User's Engagements and Roles in Fake News Activities)	**Social Impacts**	**Conservatism bias**	The tendency to revise one's belief insufficiently when presented with new evidence.
		Semmelweis reflex	Individuals tend to reject new evidence because it contradicts with established norms and beliefs.
		Echo chamber effect	Beliefs are amplified or reinforced by communication and repetition within a closed system.
		Attentional bias	An individual's perception is affected by his or her recurring thoughts at the time.
		Validity effect	Individuals tend to believe information is correct after repeated exposures.
		Bandwagon effect	Individuals do something primarily because others are doing it.
		Normative influence theory	The influence of others leading us to conform to be liked and accepted by them.
		Social identity theory	An individual's self-concept derives from perceived membership in a relevant social group.
		Availability cascade	Individuals tend to adopt insights expressed by others when such insights are gaining more popularity within their social circles.
	Self-Impact	**Confirmation bias**	Individuals tend to trust information that confirms their pre-existing beliefs or hypotheses.
		Selective exposure	Individuals prefer information that confirms their pre-existing attitudes.
		Desirability bias	Individuals are inclined to accept information that pleases them.
		Illusion of asymmetric insight	Individuals perceive their knowledge to surpass that of others.
		Naïve realism	The senses provide us with direct awareness of objects as they really are.
		Overconfidence effect	A person's subjective confidence in his judgments is reliably greater than the objective ones.
	Benefits	**Prospect theory**	People make decisions based on the value of losses and gains rather than the outcome.
		Contrast effect	The enhancement or diminishment of cognition due to successive or simultaneous exposure to a stimulus of lesser or greater value in the same dimension.
		Valence effect	People tend to overestimate the likelihood of good things happening rather than bad things.

5. PRE PROCESSING

Raw data sets obtained for the identification of faux news generally contain certain noise including missing values. to spice up the efficiency of faux news recognition dependent on machine learning, a contemporary approach to data pre-processing should be implemented [8]. The structure of knowledge must be right so as to get better results from the algorithm used in machine learning initiatives. For example, Random Forest algorithm does not accept null values; thus, null values must be handled in the first raw data collection if random forest algorithms are implemented. Some of the defined machine learning model would need data in a selected format of example. The whole pre-processing can be done using Natural Language Processing (NLP) techniques. Tokenizing and decoding, lemmatization / series, part-speech classification, language recognition and description of semantic associations are the most NLP activities. NLP tasks break the word into simpler, clearer parts to see if the components function in tandem to establish a meaning. Pre-processing typically requires tokenizing, stemming and generalization processes. The NLP strategies, such as Word2Vec, Bag of Words, TF-IDF Vectorizer and N-Gram Analysis, are often utilized in activities such as information categorisation, subject exploration and modelling, meaning retrieval, emotion analysis. The first aim of NLP is to access raw language and to use linguistic structures and algorithms to convert or attach aiming to the texts. Term Frequency-Inverse Document Frequency (TF-IDF) and Linguistic Inquiry and Word Count (LIWC) are frequently used for the conversion of tokenized texts into features. For word sequences, pre-learned word embedding vectors such as word2vec and Glove are usually used. If the input is a full article then additional pre-processing steps are needed to recognize the central idea from raw texts. Thorne et al., used TF-IDF and DrQA system to rank the sentences.

6. FEATURE EXTRACTION

Fake news detection on traditional journalism mainly relies on news content, while in social media, extra social context auxiliary information are often wont to as additional information to assist detect fake news. The core information about news are often described by the news content features which are the Source, Headlines, Body Text and Image. Cantered on the news information characteristics, a variety of feature representations could also be designed to get rid of the distinct properties of faux news. Existing researches has taken use of both generic language characteristics, used primarily to classify natural language and domain relevant linguistics records such as quoted terms and external connections. It's intelligent to seek out potential fake news through the reactions like sceptical opinions and sensational reactions by the people expressed in posts. Particularly there are three features which we will acquire from the people's response, they are, Stance feature, Topic feature and Credibility feature. The response of the people to news like support and denial is provided under Place. Topic models like Latent Dirichlet Allocation (LDA) are often wont to extract Topic features Credibility features for a post evaluate the degree of reliability. Most of the fake news detection models which are available now extract the features using the news content and social background. In particular, the models of the news material are focused on two approaches: knowledge based and style based. Probably the news content models are often adopted to seek out the fake news in traditions journalism. So as to detect fake news which is spread like swarm within the social media, social context models are often used. By analysing the recent researches we will classify the social context model into Stance-based and Propagation-based.

7. DATASETS

Online news are often collected from various sources, such as homepages from press agency, search engines, and social media websites. To determine the accuracy of stories manually is a challenging task, when we are making annotators necessary with domain expertise which perform careful analysis of the claims, extra evidence, context, and reports from authoritative sources. Generally, news data with annotations are often gathered within the following ways: Expert journalists, Fact checking websites, Industry detectors, and Crowd-sourced workers. There aren't any prescribed benchmark datasets for the fake news detection problem. Some publicly available datasets are •BuzzFeedNews15 : This dataset comprises an entire sample of stories published in Facebook from 9 news agencies over every week on the brink of the 2016 U.S. election from September 19 to 23 and September 26 and 27.Every post and therefore the linked article were fact-checked claim-by-claim by 5 Buzz Feed journalists. This dataset is further enriched by adding relevant metadata. It contains 1, 627 articles–826 mainstream.

•LIAR16: This dataset is collected from fact-checking website Fact through its API. It contains short statements which are sampled from different contexts, like news releases, TV/radio interviews, campaign speeches, etc. The labels for news truthfulness are false, barely-true, half-true, mostly true.

We will see that no existing public data set can provide all possible features of interest. In addition, these datasets even have specific limitation that makes them challenging to use for fake news detection. Buzz Feed News only contains headlines and text for every news piece and covers news articles from only a few news agencies. LIAR includes mostly short statements, instead of the whole news content. Further from various speakers these statements are collected instead of news publishers, and should include some claims that aren't fake news. In BS Detector data is collected and annotated by employing a developed news accuracy checking tool. Because the labels haven't been properly validated by human experts, any model trained on this data is really learning the parameters of BS Detector, rather than expert annotated ground truth fake news. All the mentioned news content with social context features with reliable ground truth fake news labels are available in Fake NewsNET20.

8. EVALUATION

Sections that are related with false news detection. We aim to see the differences between these areas and pretend news detection by briefly explaining the task goals and highlighting some popular methods.

8.1 Rumour Classification

A rumour can usually be defined as "a piece of circulating information whose veracity status is yet to be verified at the time of spreading". The function of a rumour is to make sense of a situation, and thus the veracity value could be true, false or unverified. Previous approaches for rumour analysis specialize in four subtasks:

• Rumour detection: aims to classify a touch of knowledge as rumour or non-rumour

• Rumour tracking: aims to collect and filter posts discussing specific rumours detection, rumour tracking

• Rumour Stance classification: determines how each relevant post is oriented with regard to the rumour's veracity

• Veracity classification: attempts to predict the particular truth value of the rumour. Its classification relies heavily on the other subtasks, requiring the stances or opinions are often extracted from relevant posts.

8.2 Truth discovery

Truth discovery is that the matter of detecting true facts from multiple conflicting sources. Truth discovery methods don't explore the actual fact claims directly, but believe a group of contradicting sources that record the properties of objects to figure out the truth value. Truth discovery aims to figure out the source credibility and object truthfulness at the same time. This problem can benefit from various aspects of truth discovery approaches under different scenarios. First, the credibility of different news outlets are often modelled to infer the truthfulness of reported news. Second, relevant social media posts can also be modelled as social response sources to raise determine the truthfulness of claims. However, there are another issues that possesses to be considered to use truth discovery to fake news detection in social media scenarios. First, most existing truth discovery methods specialize in handling them, while social media data is extremely unstructured and noisy. Second, truth discovery methods cannot be applied when a fake news article is newly launched and published by only a few of stories outlets because at that point there's not enough social media posts relevant thereto to function additional sources.

8.3 Click bait detection

Click bait could also be a term commonly used to describe eye-catching and teaser headlines in online media. Click bait headlines create a curiosity gap, increasing the fact that reader will click the target link to satisfy their curiosity. For already existing click baits they are approached by utilising various linguistic features extracted from teaser messages, webpages which are linked, and tweet Meta information. Different kinds of click bait are categorized, and a couple of them are highly correlated with non-factual claims. The motivation of click bait is usually for clicking through rate and thus the resultant advertising revenue. Therefore the body text of click bait articles are often informally organized and reasoned poorly which has been devised by researchers to spot the inconsistency between headlines and news contents in an effort detect fake news articles. Albeit not all fake news may include click bait headlines, specific click bait headlines could function an important indicator, and various features are often utilized to help detect fake news.

8.4 Spammer detection

Spammer detection on social media, which aims to capture malicious users that coordinate among themselves to launch various attacks, like spreading ads, disseminating pornography, delivering viruses, and phishing, has recently attracted wide attention. Existing approaches for social spammer detection mainly believe extracting features from user activities

and social network information. Additionally, the rise of social bots has also increased the circulation of false information as they automatically retweet posts without verifying the facts. The most challenge brought by social bots is that they're going to provide a misunderstanding that information is extremely popular and endorsed by many folks, which enables the echo chamber effect for the propagation of faux news. Previous approaches for bot detection are supported by social network information, crowd sourcing. Therefore both spammer and social bots could provide us the capacity to understand deeply about target specific malicious social media accounts which can be used for detection.
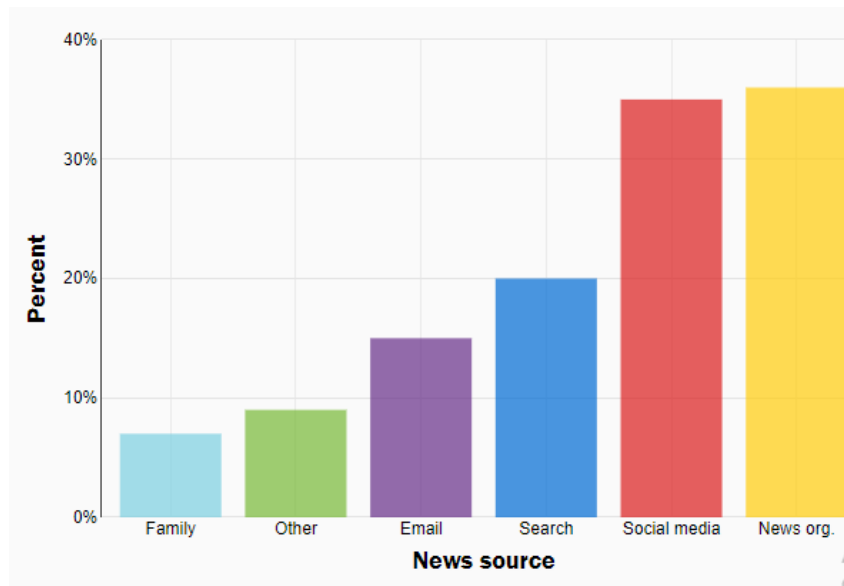
Picture 2: Where people Get Online News in US (2017)
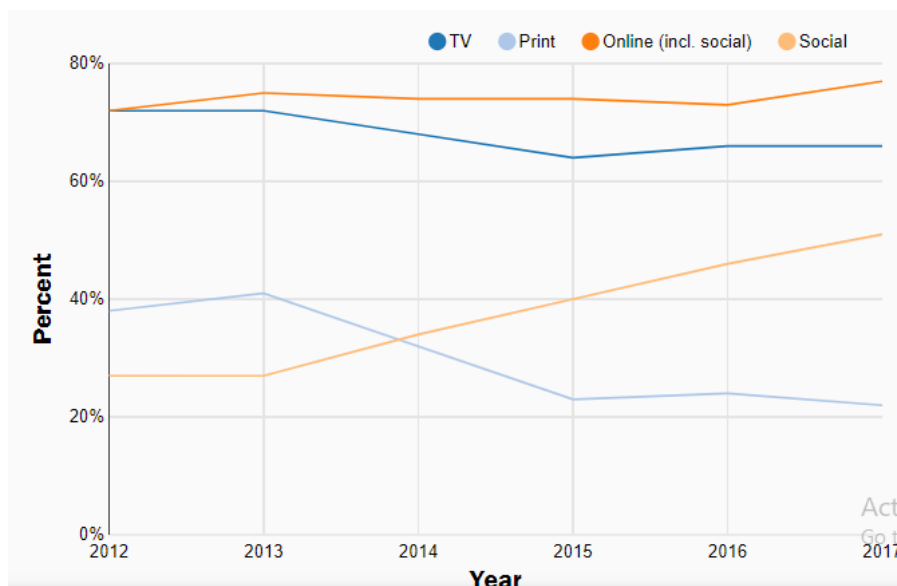
Picture 3: Change in News Source Over years

9. CONCLUSION

With the increasing popularity of social media, more and more people consume news from social media rather than traditional journalism. This makes social media to have strong negative impacts on individual users and broader society. In this article, we also explored the fake news problems by reviewing existing literature in two phases: characterization and detection. In the characterization phase, we introduced the essential concepts and principles of faux news in both traditional media and social media. In the detection phase, we reviewed existing fake news detection approaches from a knowledge mining perspective, including feature extraction and model construction. We further evaluation metrics, and promising future directions in fake news detection research and expand the field to other applications.

This survey extensively reviews and evaluates current fake news research by defining fake news, differentiating it from deceptive news, false news, satire news, misinformation, disinformation, click baits, cheery-picking, and rumours based on three characteristics: authenticity, intention, and being news ,detailing interdisciplinary fake news research by firstly and comprehensively identifying related fundamental theories , reviewing the methods that detect fake news from four perspectives: the false knowledge fake news communicates, its writing style, its propagation patterns, and the credibility of its source; and highlighting challenges in current research and some research opportunities that go with these challenges.

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