# Detection of Fake News using Artificial Intelligence

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# 1 Introduction

The advent of digital age means that people are more dependent on online sources of information than ever. But these online sources are not online news websites, instead social media platforms where there is an unregulated exponential rate of propagation of information. It is rightly said that the news that people want to hear is more popular than the correct news. Thus, clickbait titles grab the attention of people and spread like forest-fire all over the internet. There have been many examples in the past of fake news causing massive public panic. For example, a false rumor on Twitter about an explosion in Whitehouse which caused injuries to Barack Obama, the US President in 2013 wiped out $130 billion in stock market. Another worrying statistic is that in 2016, the top twenty frequently discussed fake election stories got 8.7 million interactions with users on Facebook, whereas the top twenty most discussed election stories posted by 19 major news websites got only 7.3 million. The problem is that identifying which news is fake and which is not is not an easy task, even for the very powerful super-computers because Natural Language Processing can confuse the fake with the original one due to the similarity in keywords, and the fake news can even be coated with facts and tagging verified sources and people to make them look more true than the correct news. This calls for using AI to predict the fake news in social media with some decent accuracy.A lot of research has been going on in this field and people have come up with four major techniques, namely - Knowledge-based Fake News Detection, Style-based Fake News Detection, Propagation-based Fake News Detection and Credibility-based Fake News Detection.

# 2 Knowledge Based Fake News Detection

Knowledge-based Method to detect fake news is one of the Earliest found method used in this domain. Knowledge-based detection determines news authenticity by comparing the knowledge extracted from its content with the known facts. Traditional process of fact-checking involved group of domain-experts to verify given news which doesn't scale with the growing volume of news contents. Natural Language Processing (NLP) and Machine Learning(ML) related automatic fact-checking techniques have been developed, that address the issue of scalability. Fact extraction and Fact-checking are the two main components of automatic fact-checking process.

## 2.1 Fact Extraction

Knowledge is first aggregated from the textual sources available on open-Web as raw facts.To have more complete and reliable knowledge, distinct sources and high-credibility websites should be considered. Knowledge representation

is a crucial part in AI, which plays the role in setting up the environment for systems.Here Knowledge is represented as a set of SPO(Subject, Predicate, Object) triples that well represent the information. Example of SPO triples:
"Virat Kohli is an Indian cricketer and captain of India's national men's cricket team." (Virat Kohli,profession,Cricketer)
(Virat Kohli,country,India) etc. Fact is defined as a knowledge (SPO triple) verified as truth.Using the set of facts we then create a graph structure termed as Knowledge Graph(KG) having entities(subjects or predicates) as nodes and relationships or predicates as edges between the nodes. Before forming KG it should be ensured that SPO triples are not conflicting. For example same person can't have two birthplaces so (Virat, birth-place, India) and (Virat, birth-place, Japan) are conflicting triples. Multi-Criteria Decision-Making methods [1] are options to resolve such conflicts.The triples can also be incorporated with a timeline as some of the facts depend on specific time intervals.

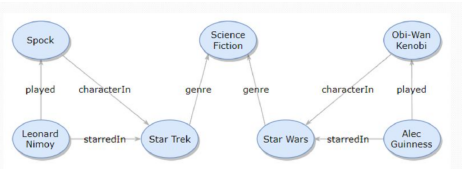


Figure 1: A typical Example of Knowledge Graph

## 2.2 Fact Checking

Fact checking signifies the process of knowledge comparison. We compare the knowledge extracted from to-be-verified news content, in the form of SPO triples, with true knowledge (facts).Triples present in Knowledge Graph(KG) are used as facts. Hence a news fact checking relies heavily on the correctness of KG. In fact-checking we evaluate the possibility of triples to exist in a KG. At first entity resolution techniques are used to locate node(Subject and Object) in a KG and if the edge labeled Predicate between nodes representing Subject and Object exists in KG, the triple is considered valid . If the SPO triple is not in KG, it's probability is computed using link prediction methods such as semantic proximity, discriminative predicate path,or LinkNBed. Fake news spreads faster than true news. Building KGs fast with as many facts as feasible is the emphasis of current research in this area.Fast news fact-checking, on the other hand, necessitates not only identifying check-worthy portions of the to-be-verified news, but also a KG that only retains as many useful facts as feasible. Within such a framework, however, one must face a variety of obstacles. To begin with, KGs are frequently incomplete, necessitating additional post-processing procedures for knowledge inference. Lastly news, as newly received or noteworthy information especially about recent events, demands knowledge to be timely within KGs.

# 3 Style-Based Fake News Detection

Style-based false news identification, like knowledge-based fake news detection relies on assessing the news content. Knowledge-based approaches, primarily analyse the news's authenticity, whereas style-based methods can assess news intention, i.e., whether the news is intended to mislead the public or not. Style-based approaches are founded on the notion that hostile entities prefer to produce fake news in a unique style to entice others to read it and persuade them to trust it.

## 3.1 Style Representation

The features can be grouped into textual features (text) and visual features (images).Textual features can be grouped into general features and latent features.

**General features:** These characteristics describe content style at four levels of language: discourse,lexicon, syntax, and semantics. The objective is to evaluate lexicon frequency statistics. These attributes and their corresponding computational features can be grouped in ten dimensions: subjectivity,diversity, informality, specificity,non-immediacy, sentiment, quantity, complexity, uncertainty, and readability.

**Latent Features:** Latent features are often used for news text embedding which are done at the word, sentence, or document level. The results are vectors that represent a news article and can be used directly as the input to classifiers when predicting fake news.

**News Images:** News images can be represented by non latent features, e.g, the visual features such as Coherence Score, Clarity Score, Diversity Score, Clustering Score. Each image is embedded as a pixel matrix or tensor so that they can be processed by a neural network.

## 3.2 Style Classification

Style-based fake news detection models depend on ML and DL.

**Machine Learning Models:** A traditional ML framework, news content is represented by using manually selected features, which can be extracted from news images, or text. Machine learning models can be supervised, semi-supervised, or unsupervised, where supervised methods are mainly used for fake news detection, e.g. SVM, Random Forest, and XGBoost.

**Deep Learning Models:** News content (text and/or images) are often first embedded at the word-level for text, or pixel matrix or tensor for images. A well-trained neural network processes the embedding to extract latent textual and visual aspects of news information. Finally, news information is classified as real or fake news by concatenating and feeding all of these characteristics to a well-trained classifier. This technique believes that there is a gap between the textual and visual information of fake news since certain fake news writers choose to utilise attractive but irrelevant photos to gain public attention.

# 4 Propagation based Fake News Detection Methods

In this section we discuss another method of fake news detection popularly termed as propagation based in literature. Propagation-based method detects fake news by analyzing how the particular piece of news article propagates through social media networks.The approach involves identification of the diffusion pattern of news articles on social media. The data structure used to model the spread of a particular post is a tree, where nodes usually represent the user or the post itself and the social connection (follower or following) or influence path (like repost) define the directed edges.The data structure is termed as a propagation or news graph.

## 4.1 Propagation Graph

Let us define the news graph $G\bar{(}V,E)$ as follows:
The nodes V are classified as:- 1.**Post/Tweet node:**the node stores the post/tweet id and its associated user id from whose account the respective article has been posted first. 2.**Repost/Retweet node:** likewise these types of nodes store the repost/retweet id and its user id. All posts and reposts are nodes in the given graph G. E is the set of edges in the graph. Edges exist between post and repost nodes with the weight being the time difference between the two posts.For instance in Twitter retweets of the original tweet points back to the original tweet itself.Thus it can be said that the depth of the graph is never more than 1. Thus we have a graph of non-connected components where each subgraph consists of tweet and its retweet nodes.

## 4.2 Features of the propagation Graph

There are a number of features both context or social and network features that were used in the classifier.Like number of followers and number of following are social features.These numbers are averaged over the whole graph.The network features consist of retweet percentage, average time difference-average of all edge weights in the graph, number of tweets and retweets, news lifetime, average favourite count - average number of favourites, AvgRetcount- average retweets for each tweet, users touched 10h - number of posts recorded from the first post in the first 10 hours, percentage posts per hour.

## 4.3 Classification

Different ML algorithms like Random Forest, Decision Tree, Bayes Neural Network, Logistic Regression, K-Nearest Neighbors and Support Vector Machine were used to classify the dataset across all features. This helped to determine which features are important for the classification task at hand. Another approach taken is Geometric Deep Learning where the graph convolutional layer is applied to social networks and molecule graphs classification. Along with this topk pooling

layer is paired to decrease the size of the graph at each iteration. The results when analysed have some interesting takeaways.One of them is that real news stays in the social media domain for much more time in comparison to fake news. This can be attributed to the fact that real news is authenticated by more users as time passes by whereas in case of fake news users eventually come to know that the post/tweet is false.It has been observed that users who contribute in spread of fake news tend to follow a lot of others while they themselves don't have many followers.It has been seen that real news have a slower increase over time and hence reach their 100% posts at a later time while fake news reach the end of their spread a lot quicker.

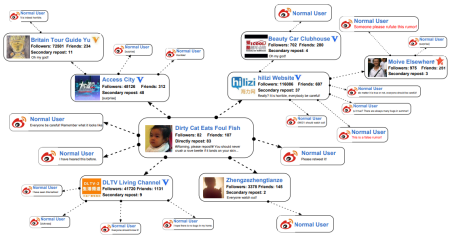

Figure 2: Propagation Graph

# 5 Credibility Based Fake News Detection

In Credibility Based Fake News Detection quality and believability of news material are frequently used to assess its legitimacy. Datasets for credibility-based false news identification are often acquired from Twitter or any other platform with a follower graph. After collecting datasets various hypothesis are tested and then used as a feature to classify the news/ post as a fake or authentic. Credibility of a news can be broadly classified into two sections, one is Credibility of the Source and the other is the Credibility of the Content.

## 5.1 Credibility of Source

In this section, we examine the news source's credibility in terms of the number of writers, credibility of the author(s) and the co-relationship network. If a news article does not provide any information on its authors, its credibility can be questioned since research shows the rumours are mostly spread by unknown sources/users.Also since fake IDs can be created that is why deeper introspection is done. Various studies prove that If an article has more than one author, it is more likely to be true news. Earlier studies on Co authorship networks found that a small number of influential individuals exist in such networks as nodes and after disconnecting the users by removing the edge of the graph it results in a set of small disjoint networks. In these networks, homophily exists, because authors who solely write accurate news are less likely to collaborate with authors who create fake news. These findings also suggest that if there are groups of authors involved with a piece of news, we may be able to deduce the credibility of the news and its other authors by knowing the credibility of any one of them.

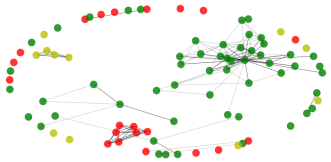

Figure 3: Authors Collaboration Network, showing authors that publish only fake news

### 5.2 Credibility of Content

Here the goal is to explore how various characteristics of a news article content can help assess its credibility. First the articles can be classified as fake or true using sentiment analysis. The sentiment intensity for each sentence in the news articles is calculated using VADER Model available in natural language toolkit. It was found that the proportion of neutral sentiment is significantly higher in true news compared to fake news, and the proportion of negative sentiments is higher in fake news compared to true news. Positive sentences immediately followed by neutral sentences are also more common in authentic and true news than in fake news. Fake news can also be classified based on the reliability of the arguments presented in the news. Data and references can also be used to support powerful arguments in a news piece. A higher frequency of numbers, digits, and hyperlinks in a news article indicates that it has been well-researched. and is supported by external sources. Research has also found that classification using the number of characters and number of words were among the important features to evaluate credibility of a news. Similar research has indicated that the existence of special characters, such as a colon, exclamation mark, or question mark, can aid in determining authenticity, because special characters are more frequently seen in true news. After taking these features fake news detection models are trained using various classifiers, which include SVM (RBF Kernel), Linear SVM, Logistic Regression Random Forest, AdaBoost , Naive Bayes and Gradient Boosting Decision Tree. Hence, the simple approach provides a straightforward fake news detection framework with a few features that can quickly detect fake news by assessing its credibility.

## 6 Conclusion and Future Works

Fighting fake news is like a double-edged sword, on the one hand warning news consumers and promoting tools to help them be aware of and challenge information sources is a good thing, but on the other hand, we risk creating news consumers who don't believe in the power of well-sourced news and distrust everything. Also with the advent of Technology the people who generate fake news would be able to pass on features which will make the existing model which are described in this paper to lose it's accuracy. As a result in future we can create a system which provides general solutions for data collection, interactive visualization, and analytical modeling towards fake news detection.

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