INTEGRATING TENSOR DECOMPOSITION WITH GRAPH CONVOLUTIONAL NETWORKS FOR FAKE NEWS CLASSIFICATION

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Abstract

With the widespread of fake news on social media, its impact has become a major concern of the public, so accurate detection methods are urgently needed. However, these methods rarely investigate the sentence interaction patterns of different news articles, and most of them do not consider fine-grained fake news classification. To overcome these issues, We proposes a method that constructs a graph representation for news articles and employs a graph neural network (GNN) to classify fake news. The method uses the local word co-occurrence information of sentences to obtain the interaction relationship between sentences, which is abstracted by the weight matrix of the graph representation. A third-order co occurrence tensor is built, and the weight matrix is calculated based on the canonical polyadic (CP) decomposition of this tensor. The computed representations can capture more accurate contextual information of news articles. The results on two real-world datasets demonstrate that the proposed method outperforms the competing methods in both binary and multiclass classification tasks.In particular, for multiclass classification on the selected dataset with 70% of the training set for training, the improvements got good accuracy and F1-score.

I INTRODUCTION

In the era of social media, it is convenient to create, access, and share information. However, it also facilitates the spread of misinformation, including fake news for various purposes, such as political and financial gain. Recent studies have shown that the impact of fake news has become a major concern of the public. In fact, fake news is not a new issue; before the advent of the Internet, news verification was done by journalists. Nowadays, the speed and volume of fake news produced make it impossible to verify every piece of news in a rigorous way. This results in automatic detection and classification of fake news to reduce the expert fact-checking process. It is a challenging task, due to the characteristics of fake news, such as timeliness, as well as various forms and styles, making it difficult to effectively detect.

II LITERATURE SURVEY

Fake news on Twitter during the 2016 US presidential election

The spread of fake news on social media became a public concern in the United States after the 2016 presidential election. We examined exposure to and sharing of fake news by registered voters on Twitter and found that engagement with fake news sources was extremely concentrated. Only 1% of individuals accounted for 80% of fake news source exposures, and 0.1% accounted for nearly 80% of fake news sources shared. Individuals most likely to engage with fake news sources were conservative leaning, older, and highly engaged with political news. A cluster of fake news sources shared overlapping audiences on the extreme right, but for people across the political spectrum, most political news exposure still came from mainstream media outlets.

A survey on fake news and rumour detection techniques

False or unverified information spreads just like accurate information on the web, thus possibly going viral and influencing the public opinion and its decisions. Fake news and rumours represent the most popular forms of false and unverified information, respectively, and should be detected as soon as possible for avoiding their dramatic effects. The interest in effective detection techniques has been therefore growing very fast in the last years. In this paper we survey the different approaches to automatic detection of fake news and rumours proposed in the recent literature. In particular, we focus on five main aspects. First, we report and discuss the various definitions of fake news and rumours that have been considered in the literature. Second, we highlight how the collection of relevant data for performing fake news and rumours detection is problematic and we present the various approaches, which have been adopted to gather these data, as well as the publicly available datasets. Third, we describe the features that have been considered in fake news and rumour detection approaches. Fourth, we provide a comprehensive analysis on the various techniques used to perform rumour and fake news detection. Finally, we identify and discuss future directions.

A survey of fake news: Fundamental theories, detection methods, and opportunities:

The explosive growth in fake news and its erosion to democracy, justice, and public trust has increased the demand for fake news detection and intervention. This survey reviews and evaluates methods that can detect fake news from four perspectives: (1) the false knowledge it carries, (2) its writing style, (3) its propagation patterns, and (4) the credibility of its source. 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. We hope this survey can facilitate collaborative efforts among experts in computer and information sciences, social sciences, political science, and journalism to research fake news, where such efforts can lead to fake news detection that is not only efficient but more importantly, explainable.

Detecting and mitigating the dissemination of fake news: Challenges and future research opportunities:

Fake news is a major threat to democracy (e.g., influencing public opinion), and its impact cannot be understated particularly in our current socially and digitally connected society. Researchers from different disciplines (e.g., computer science, political science, information science, and linguistics) have also studied the dissemination, detection, and mitigation of fake news; however, it remains challenging to detect and prevent the dissemination of fake news in practice. In addition, we emphasize the importance of designing artificial intelligence (AI)-powered systems that are capable of providing detailed, yet user-friendly, explanations of the classification / detection of fake news. Hence, in this article, we systematically survey existing state-of-the-art approaches designed to detect and mitigate the dissemination of fake news, and based on the analysis, we discuss several key challenges and present a potential future research agenda, especially incorporating AI explainable fake news credibility system.

An overview of online fake news: Characterization, detection, and discussion:

Over the recent years, the growth of online social media has greatly facilitated the way people communicate with each other. Users of online social media share information, connect with other people and stay informed about trending events. However, much recent information appearing on social media is dubious and, in some cases, intended to mislead. Such content is often called fake news. Large amounts of online fake news has the potential to cause serious problems in society. Many point to the 2016 U.S. presidential election campaign as having been influenced by fake news. Subsequent to this election, the term has entered the mainstream vernacular. Moreover it has drawn the attention of industry and academia, seeking to understand its origins, distribution and effects. Of critical interest is the ability to detect when online content is untrue and intended to mislead. This is technically challenging for several reasons. Using social media tools, content is easily generated and quickly spread, leading to a large volume of content to analyse. Online information is very diverse, covering a large number of subjects, which contributes complexity to this task. The truth and intent of any statement often cannot be assessed by computers alone, so efforts must depend on collaboration between humans and technology. For instance, some content that is deemed by experts of being false and intended to mislead are available. While these sources are in limited supply, they can form a basis for such a shared effort. In this survey, we present a comprehensive overview of the finding to date relating to fake news. We characterize the negative impact of online fake news, and the state-of-the-art in detection methods. Many of these rely on identifying features of the users, content, and context that indicate misinformation. We also study existing datasets that have been used for classifying fake news. Finally, we propose promising research directions for online fake news analysis.

III EXISTING SYSTEM

In previous research they focus on unsupervised fake news detection. They use tensor decompositions to capture the latent relations between articles and terms. Furthermore, an ensemble method is introduced to leverage multiple tensor decompositions into a single, highquality, and high-coherence set of article clusters. In another research they focuses on detecting fake news solely based on the structural information of social networks. They suggest that the underlying network connections of users that share fake news are discriminative enough to support the detection of fake news. They model each post as a network of friendship interactions and represent a collection of posts as a multidimensional tensor. Taking into account the available labeled data, they developed a tensor factorization method which associates the class labels of data samples with their latent representations. Specifically, they combine a classification error term with the standard factorization in a unified optimization process.

Disadvantages

1.The existing work focuses on unsupervised fake news detection using tensor decompositions. This approach might require a large amount of unlabeled data, making it potentially less effective in cases where labeled data is limited.

2.The existing work relies on tensor decompositions to capture latent relations between articles and terms, which may have limitations in effectively representing complex relationships within the data.

3.Tensor decompositions used in the existing work might become computationally expensive as the dataset grows larger.

4.The ensemble method used in the existing work might provide good clustering performance, but it might be challenging to interpret and understand the decisions made by the model.

IV PROBLEM STATEMENT

The proliferation of fake news on social media poses a significant societal concern, necessitating urgent and accurate detection methods. Existing approaches often neglect sentence interaction patterns and lack fine-grained classification. To address this gap, this study aims to develop a method utilizing Tensor Decomposition and Graph Convolutional Network to enhance fake news classification, particularly focusing on capturing nuanced contextual information and achieving superior performance in both binary and multiclass scenarios on real-world datasets.

V PROPOSED SYSTEM

We propose a method that constructs a graph representation for news articles and employs a graph neural network (GNN) to classify fake news. The method uses the local word co-occurrence information of sentences to obtain the interaction relationship between sentences, which is abstracted by the weight matrix of the graph representation. Our framework consists of three main modules. The first one is a module for article graph representation, where an LSTM model is employed to obtain the feature vector of each vertex, and a CP decomposition based method is used to obtain the weight matrix. The second module is designed to obtain the feature vector of the article by using the graph convolutional layer and the max pooling operation. The last one is the classification module, where a fully connected layer is adopted.

Advantages

1. The present work, on the other hand, adopts a supervised approach using a GNN for classification, which can leverage labeled data and potentially achieve higher accuracy.

2. This graph-based representation can potentially capture more nuanced and meaningful features for fake news detection.

3. the GNN-based approach in the present work operates on the graph representation, which allows for better interpretability, as the relationships between sentences and their weights in the graph can be analyzed to understand how fake news is classified.

4.By employing an LSTM model for obtaining the feature vector of each vertex (sentence) and using CP decomposition-based method to obtain the weight matrix, the model can extract highlevel abstractions from the articles, enabling better discrimination between fake and legitimate news

VI IMPLEMENTATION

Data loading: using this module we are going to import the dataset.

DatasetLink:
https://www.kaggle.com/datasets/csmalarkodi/isot-fake-news-dataset/code

Data Preprocessing: using this module we will explore the data.

Splitting data into train & test: using this module data will be divided into train & test

Model generation: Model building - SVM - LSTM -CNN -GNN -BERT GCN -GCN with CP (Pytorch Graph CNN) -BERT GCN + LSTM -LSTM + GRU. Algorithms accuracy calculated

User signup & login: Using this module will get registration and login

User input: Using this module will give input for prediction

Prediction: final predicted displayed

Note:

As an extension we applied an ensemble method combining the predictions of multiple individual models to produce a more robust and accurate final prediction.

VII ALGORITHMS USED

SVM - SVM is a powerful supervised algorithm that works best on smaller datasets but on complex ones. Support Vector Machine, abbreviated as SVM can be used for both regression and classification tasks, but generally, they work best in classification problems.

LSTM – It is a special type of Recurrent Neural Network which is capable of handling the vanishing gradient problem faced by RNN. LSTM was designed by Hochreiter and Schmidhuber that resolves the problem caused by traditional rnns and machine learning algorithms. LSTM can be implemented in Python using the Keras library.

CNN – A CNN is a kind of network architecture for deep learning algorithms and is specifically used for image recognition and tasks that involve the processing of pixel data. There are other types of neural networks in deep learning, but for identifying and recognizing objects, CNNs are the network architecture of choice.

GNN – Graph Neural Networks (GNNs) are a class of deep learning methods designed to perform inference on data described by graphs. GNNs are neural networks that can be directly applied to graphs, and provide an easy way to do node-level, edge-level, and graph-level prediction tasks.

BERT GCN – BERT uses a multi-layer bidirectional transformer encoder to represent the input text in a high-dimensional space. That means it can take into account the entire context of each word in the sentence, which helps it to better understand the meaning of the text. The GCN is used to capture the spatial correlation between the node

GCN with CP (Pytorch Graph CNN) – The graph convolutional network (GCN) was first introduced by Thomas Kipf and Max Welling in 2017. A GCN layer defines a first-order approximation of a localized spectral filter on graphs. GCNs can be understood as a generalization of convolutional neural networks to graph-structured data.

BERT GCN + LSTM – A Graph Convolutional Network, or GCN, is an approach for semi-supervised learning on graph-structured data. It is based on an efficient variant of convolutional neural networks which operate directly on graphs.

LSTM + GRU- Gated recurrent units (GRUs) are a gating mechanism in recurrent neural networks, introduced in 2014 by Kyunghyun Cho et al. The GRU is like a long short-term memory (LSTM) with a gating mechanism to input or forget certain features, but lacks a context vector or output gate, resulting in fewer parameters than LSTM.

VIII CONCLUSION

This work focuses on fake news classification using only the body text of news. The key idea is to investigate the intra-article interaction of sentences for improvement. An effective approach using tensor decomposition and GCN is proposed, in which local lexical sentence-wise structures and sequential patterns are considered simultaneously. Specifically, we represent each article as a weighted graph whose vertices are the sentences of the article. To capture the semantic information in the graph representation, an LSTM is employed to compute the feature vectors of vertices. On the other hand, to capture local structural information between words for quantifying sentence interactions, a CP decompositionbased method is presented to compute the weight matrix. Furthermore, the graph is input into a GCN for classification, where the interaction between sentences can be captured. Since the local lexical structures and sequential patterns are jointly investigated, we can produce discriminative representations for news articles, thereby achieving better classification performance. Experimental results obtained on two real-world benchmark datasets for fake news classification show that the proposed method outperforms the competing methods, and the generalizability of our method is illustrated.

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