

Knowledge Graph and GNN-Based News Recommendation Algorithm With Edge Computing Support

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ABSTRACT

The current news information from different media websites has posed a serious problem (i.e., it is very difficult to obtain the satisfactory news content from the measured data information). There have been some researches on news recommendation to improve the experience of users. In spite of this, they always need further improvement. Therefore, this paper studies knowledge graph and graph neural network (GNN)-based news recommendation algorithm with edge computing consideration. At first, the knowledge graph is used for the knowledge extraction. Then, GNN is used to train the extracted features to complete the news recommendation algorithm. Finally, the edge computing is used to offload high volumes of traffic to the edge server for the news recommendation computation. Compared with two baselines, the proposed algorithm is more efficient, increasing accuracy by 2.73% and 9.94%, respectively, and decreasing response time by 84.27% and 87.58%, respectively.

KEYWORDS

Accuracy Rate, Bat Algorithm, Edge Computing, Experience Quality, GNN, Knowledge Graph, News Recommendation, Response Time, Scheduling Strategy

1. INTRODUCTION

With the rapid development of mobile Internet (Nguyen et al., 2020) and Internet of things (Kamilaris & Pitsillides, 2016), more and more people are inclined to enjoy the services of news recommendation. According to the world economic report, the number of news users is expected to reach 5.63 billion by 2022, and accounts for 77 percent of the world's population. In other words, the news data size could be counted in PB unit. Under such situation, it is considerably difficult for users to obtain the satisfactory news contents, and thus the experience quality of users is very bad. In order to eliminate such negative effects generated from the unmatched and redundant news, there are a lots of scholars especially including some big companies with news business (such as ByteDance, YouTube) taking parting in the study of news recommendation algorithm (Feng et al., 2020). It is obvious that, the purpose of them is to help users obtain the interested news contents as quickly as possible and further improve the experience quality of users by using the related recommendation techniques.

To the best of our knowledge, the current recommendation techniques are usually divided into three categories, i.e., traditional recommendation algorithm (e.g., collaborative filtering (Dong et al., 2016) (Aljunid & Huchaiah, 2020)), knowledge graph-based recommendation algorithm and deep learning-based recommendation algorithm. The traditional recommendation algorithm has two conspicuous limitations (Li & Wang, 2020). On one hand, when new users are added, the cold

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start problem easily happens. On the other hand, the users data is perhaps sparse and the over-fitting problem is easily emerged. The knowledge graph-based recommendation algorithm can overcome the above mentioned problems and brings about accuracy, diversity and interpretability for news recommendation by using the strong relation ability and rich semantic features (Kulkarni & Rodd, 2020). In spite this, the knowledge graph lacks of the training ability and fails to obtain the efficient recommendation results. On the contrary, the deep learning has the inherent learning ability based on the extracted features to further exploit users behaviors and complete the efficient training (Shambour, 2021). By considering their advantages, this paper will propose a news recommendation algorithm based on knowledge graph and deep learning. For the deep learning for recommendation algorithm, it usually adopts some neural network to do the data training, such as convolutional neural network (CNN) (Hu et al., 2019) and graph neural network (GNN) (Wang et al., 2019). Compared with CNN, GNN has more obvious advantages in terms of news recommendation. To be specific, GNN-based news recommendation algorithm can integrate browse history and browse order of users to provide more accurate recommendation. Therefore, in this paper, we consider GNN as the core part of deep learning-based news recommendation algorithm.

However, the computation overhead of news recommendation algorithm is very high. In addition, the whole requests mode is usually distributed rather than centralized; under such mode, if all requests are submitted to a center server for the recommendation computation, it will consume a great mass of time, which affects the recommendation efficiency. To this end, this paper plans to use the edge computing (Xia et al., 2021) (Mansouri & Babar, 2021) architecture to help offload the complex recommendation tasks to the edge servers for the news recommendation computation.

With the above considerations, this paper studies knowledge graph and GNN based news recommendation algorithm with edge computing support, called KGE, and the involved major contributions are summarized as follows.

- (1) A system framework of KGE is presented, to the best of our knowledge, it is the first proposal.
- (2) A recommendation algorithm based on knowledge graph and GNN is proposed, where knowledge graph is used for the knowledge feature extraction and GNN is used for the feature training.
- (3) A edge computing scheduling strategy with two metrics is devised to offload the complex recommendation tasks.
- (4) Some experiments including accuracy rate, response time and experience quality are tested to prove the efficiency of KGE.

The rest paper is organized as follows. Section 2 reviews the related work. Section 3 presents the system framework. The recommendation algorithm is proposed in Section 4. In Section 5, an edge computing scheduling strategy is devised to optimize the news recommendation algorithm. Section 6 reports the experimental results. Finally, Section 7 concludes this paper.

2. RELATED WORK

There are a number of proposals on news recommendation. For example, in (Han et al., 2015), a personalized news recommendation algorithm was proposed through the analysis of users interests, where the collaborative filtering algorithm was used to improve the association rules. In (Kumar et al., 2017), a recommendation model which used semantic similarity between words as input to a 3DCNN was proposed to extract the temporal news reading pattern of users. It improved the quality of recommendation in turn. In (Wang et al., 2018), a deep knowledge-aware network that incorporated knowledge graph representation was devised for news recommendation. It was a content-based deep recommendation framework for click-through rate prediction. In particular, its key component was a multi-channel and word-entity-aligned knowledge-aware CNN by fusing semantic-level and

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