HASIL CEK_A new link prediction

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A new link prediction method to alleviate the cold-start problem based on extending common neighbor and degree centrality

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ABSTRACT

The cold-start problem occurs when a new user with limited information joins the network, and it becomes challenging to predict new links in future networks. Several studies have proposed link prediction methods based on common neighbors by exploring topology information using the Triadic Closure concept. However, the common neighbor failed to predict future relations because the new user with cold-start problems was isolated and had no common neighbors. This study proposes a common neighbor enhanced by the proposed gravity of node pairs inspired by Newton's law of gravity called Degree of Gravity for Link Prediction (DGLP). The DGLP considers degree centrality, common neighbors, and distance between candidate node pairs generated by topological information in a single-layer network. The proposed DGLP was evaluated using sixteen datasets and nine benchmark methods. The evaluation results showed that DGLP could increase Area Under the Curve (AUC) values by 7.15%, and the average AUC value reached 0.819 for experiments with 10-fold cross-validation. In addition, the calculated ratio of successfully predicted and node pairs with the cold-start problem achieved 99.94%. The prediction ratio is calculated to ensure that DGLP alleviates the cold-start problem and outperforms benchmark methods.

1. Introduction

The recommender system (RS) provides possible options based on appropriate preferences [1]. There are four main approaches for RS [2]: collaborative filtering [3], content-based [4], context-aware [5], and graph-based [6]. The cold-start problem is a drawback of new user recommendations, in which new users are added without previous information [7], data sparsity, and poor performance. The RS is also extended to recommend new user connections from other users on the social network, known as link prediction [8]. Leroy et al. [9] introduced the cold-start problem for link prediction as a missing social network structure problem while other information about nodes is available. New nodes appear in future networks which do not have either node attributes or network structure information, providing a challenge for link prediction [10]. There are two types of cold-start problems: pure cold-start with isolated nodes and partial cold-start with low-degree nodes [11].

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