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A formal model for intellectual relationships among knowledge workers and knowledge organizations ☆

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ABSTRACT

An academic learning network consists of multiple knowledge organizations and knowledge workers. The intellectual relationships can be derived from the interactions among them. In this paper, we propose a formal model to describe the interactions in an academic learning network and further provide an evaluation process to quantify intellectual relationships. Our approach is also integrated with a realistic social network platform SMNET.

1. Introduction

The analysis of social network relationships becomes a critical issue in recent years. People build their own network and connect to others by sharing their interests (e.g. photos, videos, articles, etc.) on specific platforms (e.g. Google+, Facebook, etc.). These platforms support approaches to analyse the information provided by users and further discover potential relationships among users. Numerous approaches including graph theory, information retrieval and machine learning techniques are used to evaluate the relationships among users and groups in conventional social networks. Such relationships will also be significant in defining metrics for commercial purpose (e.g. in advertisement and in recommendation systems).

An academic learning network can be considered as another type of social network. An academic learning network consists of knowledge workers and knowledge organizations. Knowledge workers/organizations publish/upload their papers and view/download other publications. Knowledge workers can cooperate with others in an knowledge organization for the same research goal or compete with knowledge workers in other knowledge organizations. However, there are few discussions about how to model and analyze these intellectual relationships among different academic organizations.

In this paper, we propose a formal model to describe the intellectual relationships of an academic network. Combined with existing social network platform, the relationships among different people/groups in academic learning network can be visualized and further provide more information about an academic learning network.

Our main contributions are as follows:

1. We propose a formal ownership model to describe academic learning networks.
2. This model can be combined with social graph to visualize intellectual relationships.
3. This model also provides significant and flexible characteristic metrics to evaluate relationships without using sophisticated algorithms.

The intellectual relationships would allow us to recognize who are the collaborators and who are the competitors in an academic learning network. Slow Intelligence

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principles [5] can then be applied so that the academic learning network can achieve its learning goals.

The paper is organized as follows: In Section 2 we present the background and previous works regarding academic learning network. The formal model will be presented in Section 3. In Section 4, we introduce extended social graph, and then we propose an evaluation approach in Section 5. Finally, we describe a case study on academic learning network implemented in SMNET platform.

2. Related work and background

Social network analysis uses different metrics (measures) for evaluating the relationships among various individuals in social network, e.g. centrality, degree and closeness and so on [2]. Most of these metrics are based on the relationships of nodes and links in social network and then using graph theory to analyze the relationships. In the proposed model, in addition to the above static metrics, we further consi der various dynamic situations in the academic learning network.

Some analysis utilizes software such as UCInet [4] to help explore various type of social networks with visualization and further investigation. Our ownership model is applicable in a realistic academic learning network SMNET [1], which is integrated with Intellectual Property Rights (IPR) model to formalize an institutional aggregator for metadata and content. In addition to traditional social graph, SMNET can represent hierarchical levels in an academic learning network, from individual worker to academic organization. Users can describe their network with our formal descriptions, and upload their contents to the academic learning network. The content could be academic publications, technical reports and the social graph can be generated automatically.

For the evaluation of relationships in academic learning network, many researchers [6,7] use bibliometric approaches such as citation and co-citation analysis to estimate the relationships in the network. The results can be used for finding strategic alliance or identifying the structure of invisible colleges. Our formal model also can include citation and co-citation metrics, because the source of these two metrics can be obtained from the references in a publication. Furthermore, out model can be extended to evaluate the degree of cooperation and competition in an academic learning network.

3. Ownership model

In this section, we first introduce the concept of an academic learning network. Then we present the definition of our proposed ownership model and illustrate an academic network with the proposed ownership model.

3.1. Academic learning network

The concept of an academic social network is that people are connected with each other by sharing their knowledge. Hence, in an academic learning network, in additional to the knowledge itself, there are other two significant elements: knowledge worker and knowledge organization, since knowledge provider can be an individual or a group of people. Furthermore, the interactions of these knowledge providers reflect various degree of relationships among them.

3.1.1. Knowledge worker

Individual researchers in an institution or graduate students in a university have their own research interests. These individuals are instances of knowledge workers. If several knowledge workers share common research interests or other common features, they form a knowledge worker class. A knowledge worker class is a type of abstracted knowledge worker.

3.1.2. Knowledge organization

Knowledge organization can be regarded as an aggregate of knowledge workers, e.g. universities or research institutes are made out of different types of knowledge workers. We can further distinguish different types (classes) of knowledge organizations, such as a university medical school or a research institute on human-computer interaction.

3.1.3. Examples of academic learning networks

Fig. 1a shows an example of an academic learning network. Ben and John are individual researchers and they have the same research interests, so they will be classified as the same type of knowledge worker (KW_1). Mike belongs to another type of knowledge worker (KW_2). All of them are the members of an institution which means they are in the same knowledge organization (KO_1). Researchers publish their

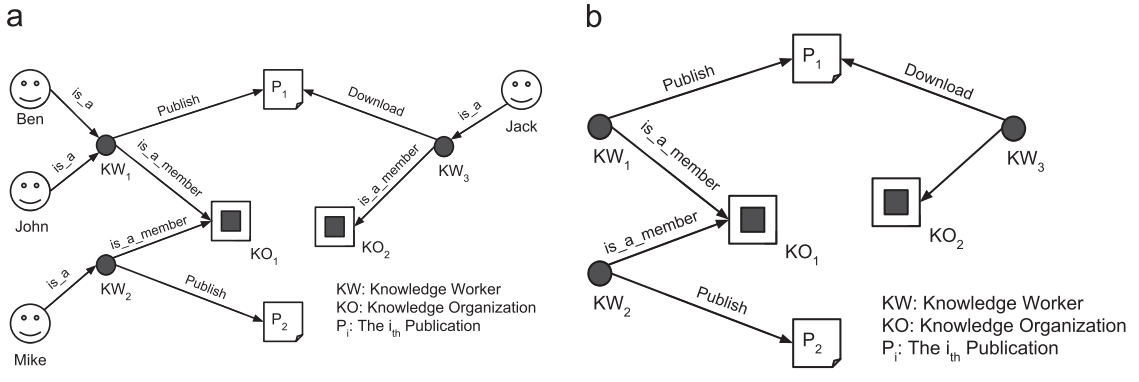

Fig. 1. Examples of academic learning network. (a) an example of academic learning network and (b) an example of abstracted academic learning network.