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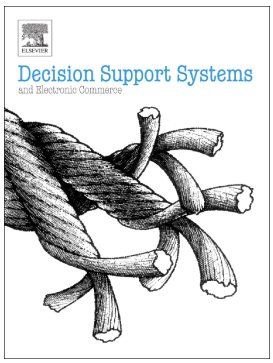

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ACCEPTED MANUSCRIPT

Detect Potential Relations by Link Prediction in Multi-Relational Social Networks

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Abstract Potential relation detecting on social network has become more important for decision making in many business disciplines, such as marketing, business strategy, human resources development, finance planning, business transformation, insurance policy design, and tourism management. People are used to seeking useful information from the relationships among social members to support their decisions on investment, partner seeking and marketing. Corporations are seeking opportunities to leverage them for "word of mouth" advertising based on the relations between the customers. When we collect and observe relationships between people, missing or redundant relations unavoidably occur since the time and cost restrictions in market or social investigation prevent us to discover all the relations. Moreover, since the social relations are changing constantly, current social relations may disappear, and new relations will be established. Many trade and social networks consist of multiple types of relations between the individuals. This paper presents an efficient method to detect the potential and future social relations between individuals in multi-relational social networks using link prediction. First, we calculate the belief of each individual by belief propagation on each type of relations. Based on the belief vectors, the similarities between various types of relations are computed to measure their mutual influence. Based on the similarities between various types of relations, we model link prediction as the problem of matrix completion by optimizing its max-norm constrained formulation. We propose a projected gradient descent optimization algorithm which is scalable to large size networks. Empirical results on real multi-relational social networks demonstrate that the predicting results of

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