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**Link Weight Prediction Using Supervised Learning Methods and Its Application to Yelp Layered Network**

**Abstract**

Real-world networks feature weights of interactions, where link weights often represent some physical attributes. In many situations, to recover the missing data or predict the network evolution, we need to predict link weights in a network. In this paper, we first proposed a series of new centrality indices for links in line graph. Then, utilizing these line graph indices, as well as a number of original graph indices, we designed three supervised learning methods to realize link weight prediction both in the networks of single layer and multiple layers, which perform much better than several recently proposed baseline methods. We found that the resource allocation index (RA) plays a more important role in the weight prediction than other topological properties, and the line graph indices are at least as important as the original graph indices in link weight prediction. In particular, the success application of our methods on Yelp layered network suggests that we can indeed predict the offline co-foraging behaviors of users just based on their online social interactions, which may open a new direction for link weight prediction algorithms, and meanwhile provide insights to design better restaurant recommendation systems.