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Probabilistic Transitive Closure of Fuzzy Cognitive Maps: Algorithm Enhancement

A *fuzzy cognitive map* (FCM) is made up of factors and direct impacts. In graph theory, a bipolar weighted digraph is used to model an FCM; its vertices represent the factors, and the arcs represent the direct impacts. Each direct impact is assigned a weight in $[0, 1]$ as well as a sign (positive or negative). In the model considered in this work, each weight is interpreted as the probability of the impact. A directed walk from factor F to factor F' is interpreted as an indirect impact of F on F'. The *probabilistic transitive closure* (PTC) of an FCM (or bipolar weighted digraph) is a bipolar weighted digraph with the same set of factors, but with arcs corresponding to the indirect impacts in the given FCM and the weight of each arc equal to the probability of the indirect impact.

FCMs can serve as effective tools to study problems in various fields. They can be used to represent structured knowledge in science, engineering, and the social sciences. Transitive closure provides valuable new information for its corresponding FCM. Unfortunately, computing the PTC of an FCM is computationally hard.

In this talk, we describe a new enhancement of existing algorithms for computing PTC. We show how one can use a separating vertex to reduce the input digraph into smaller components, and how to recover the PTC of the original digraph from the PTCs of the smaller components.

This is joint work with my supervisor, Mateja Šajna.