

Title:

Teaching a new dog old tricks: causal inference by string diagram surgery

Abstract:

String diagrams are a simple kind of diagram involving boxes connected by wires, which give a convenient tool for visualising and reasoning about composed processes in many contexts. In the context of probabilistic processes (i.e. stochastic matrices / conditional probability distributions), string diagrams of a certain form can be used to define and manipulate Bayesian networks. I will talk about the string-diagrammatic representation of Bayesian networks and also define an operation corresponding to a Pearl-style "do" intervention in terms of "string-diagram surgery". As in the classical approach to causal identification, if a string diagram satisfies certain conditions, the resulting interventional distribution can be computed from purely observational data via (the string diagram analogue to) "back-door adjustment". I will show a simple criterion that can be stated purely in terms of factorisability of a diagram into n-combs and give an example of calculating the appropriate adjustment by means of a technique we call comb disintegration. This turns out to be equivalent (in the semi-Markovian case) to a well-known criterion based on confounding components given by Tian and Pearl. Hence, string diagrams provide a generalisation of this classical criterion to non-semi-Markovian and (possibly) non-classical models.