

Generalizations of Markov blankets to understand dependence

Victor Cohen¹ and Axel Parmentier

¹CERMICS, École Nationale des Ponts et Chaussées, Marne-la -Vallée

victor.cohen@enpc.fr

In a probabilistic graphical model on a set of variables V , the Markov blanket of a set of variables B is the minimal set of variables conditioned to which B is independent from the remaining of the variables. We generalize Markov blankets to study how a subset C of $V \setminus B$ of variables of interest is dependent on B . Doing that, we must choose if we authorize variables outside C in the blanket. We therefore introduce the two following generalizations. The Markov blanket of B in C is the minimal subset of C conditionally to which B and C are independent. It is naturally interpreted as the boundary through which B depends on C . And the Markov blanket of B in the direction of C is the nearest set to B among the minimal sets conditionally to which ones B and D are independent. We show that it can be interpreted as the cause of dependence. We illustrate these two concepts and their differences on examples of applications, and provide algorithms to compute them that are linear in the size of the graph. All our definitions and algorithms are provided for directed and undirected graphical models.