Mathematics > Combinatorics

The characteristic imset polytope for diagnosis models

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In 2010, M. Studen\'y, R. Hemmecke, and Linder explored a new algebraic description of graphical models, characteristic imsets. Compare with standard imsets, characteristic imsets have several advantages: they are still unique vector representative of conditional independence structures, they are 0-1 vectors, and they are more intuitive in terms of graphs than standard imsets. After defining characteristic imset polytope as the convex hull of all characteristic imsets for a given set of nodes, they also showed that a model selection in graphical models, which essentially is a problem of maximizing a quality criterion, can be converted into an integer programming problem on the characteristic imset polytope. However, this integer programming problem is very hard in general. Therefore, here we focus on diagnosis models which can be described by Bipartite graphs with a set of m nodes and a set of n nodes for any $m, n \in \Z_+$, and their characteristic imset polytope. In this paper, first, we will show that the characteristic imsets for diagnosis models have very nice properties including that the number of non-zero coordinates is at most is $n \cdot (2^m - 1)$, and with these properties we are able to find a combinatorial description of all edges of the characteristic imset polytopes for diagnosis models. Then we prove that these characteristic imset polytopes are direct products of n many (2^m-1) dimensional simplicies. Finally, we end the paper with further questions in this topic.

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