

# Bayesian Networks: The Edge Addition Method to Convert a Directed Acyclic Graph into a Polytree

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**Abstract:** Here we present our simple “edge addition” method to convert a directed acyclic graph (DAG) into a polytree. This is important especially for the study of the Bayesian networks. Currently, the most popular method to analyze a Bayesian network is to convert it into a junction tree, which do not retain the edge directionality as in a polytree. If a network can be converted into a polytree, this task can be carried out more efficiently. Basically, we first delete a sufficient number of edges in a DAG to make it a polytree. Then the deleted edges are added back, one at a time. Each edge addition creates at most one easily identified loop in what would otherwise be a polytree. This loop is immediately converted into a polytree, thus the overall polytree structure is regained, before another edge is added back. After all edges have been added back, the DAG is converted into a polytree. To convert a loop into a polytree, some nodes in it are combined into possibly overlapping macro-nodes.

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