# Directed acyclic graphs on network data

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**Abstract:** The traditional directed acyclic graph (DAG) model assumes data are generated independently from the underlying joint distribution defined by the DAG. In many applications, however, individuals are linked via a network and thus the independence assumption does not hold. We propose a novel Gaussian DAG model for network data, where the dependence among individual data points (row-wise covariance) is modeled by an undirected graph. Under this model, we develop a maximum penalized likelihood method to estimate the DAG structure and the row correlation matrix. The algorithm iterates between a decoupled lasso regression step and a graphical lasso step. We show with extensive simulated and real network data, that our algorithm improves the accuracy of DAG structure learning by leveraging the information from the estimated row-wise correlations. Moreover, we demonstrate that the performance of existing DAG learning methods can be substantially improved via de-correlation of network data with the estimated row-wise correlation matrix from our algorithm.