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Tracking communities with a graph-valued Markov process.

The simple homophily model for random graphs is generalized to a (G, π)-valued Markov process, where G is a graph and π a partition of its vertices into groups. From this, a Bayesian filter is derived which processes a time-varying graph into a probability distribution over the partitions of its vertices at any time. This Bayesian filter is then marginalized to a system of evolution equations for the pairwise group co-membership probabilities of the vertices. It is shown how these pairwise probabilities may be used to generate group partitions with maximal expected utility. The results are applied to the community detection problem in social network analysis, producing (a) an algorithm with state-of-the-art accuracy which provides probabilistic output instead of merely a single group partition, and (b) a generalization which tracks communities in dynamic network data. (Received September 22, 2010)