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INFERRING MESOSCOPIC STRUCTURE IN COMPLEX NETWORKS WITH MESSAGE PASSING

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Abstract:

Understanding a complex network’s structure holds the key to understanding its function. The physics community has contributed a multitude of methods and analyses to this cross-disciplinary endeavor. Structural features exist on both the microscopic level, resulting from differences between single node properties, and the mesoscopic level resulting from properties shared by groups of nodes. Disentangling the determinants of network structure on these different scales has remained a major, and so far unsolved, challenge. Here we show how multiscale generative probabilistic exponential random graph models combined with efficient, distributive message-passing inference techniques can be used to achieve this separation of scales, leading to improved detection accuracy of latent classes as demonstrated on benchmark problems. It sheds new light on the statistical significance of motif-distributions in neural networks and improves the link-prediction accuracy as exemplified for gene-disease associations in the highly consequential Online Mendelian Inheritance in Man database. Further, we will investigate the theoretical limitations of latent class inference in networks.

Refs.: Reichardt J, Alamino R, Saad D (2011) The Interplay between Microscopic and Mesoscopic Structures in Complex Networks. PLoS ONE 6(8): e21282 P Zhang, F Krzakala, J Reichardt, L Zdeborová, Comparative Study for Inference of Hidden Classes in Stochastic Block Models, http://arxiv.org/abs/1207.2328