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"Bayesian Nonparametrics for Sparse Dynamic Networks"

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Abstract: In graphs setting, sparsity is defined in terms of the rate with which the number of edges grows as the number of nodes increases. In a sparse graph the number of edges grows sub-quadratically in the number of nodes so that, in the limit, two nodes chosen at random are very unlikely to be linked. While sparsity is a property found in many real-world network datasets, most of the popular Bayesian models used in network analysis account for dense graphs, i.e. the number of edges grows quadratically in the number of nodes. The fundamental reason for this misspecification is the classical representation of the graph as a random exchangeable array, i.e., the adjacency matrix. Exchangeability in the graphs domain has been historically defined as the distribution invariance to the permutation of the order that the nodes appear, i.e., relabelling the nodes does not change the distribution of the graph and is known as vertex-exchangeability. However, as a corollary of the Aldous-Hoover theorem, exchangeable random arrays are dense or empty and thus not appropriate for most real applications. In an attempt to account for sparse graphs, several models have been proposed but with undesirable properties. These are models that give up either exchangeability or projectivity. In their recent work, Caron and Fox proposed a model that represents graphs as infinite point processes giving rise to a class of sparse random graphs. For the associated notion of exchangeability of point processes, Kallenberg provides a representation theorem as the continuous space counterpart of the Aldous-Hoover theorem. In this talk, we are interested in the dynamic domain and aim to model probabilistically the evolution of sparse graphs over time. Towards that, we build on the model proposed by Caron and Fox and extend it to time series settings. We describe a fully generative and projective approach for the construction of dynamic sparse graphs.

This is a joint work with Dr. Francois Caron and Prof. Yee Whye Teh from the University of Oxford.

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