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Graph Representation Learning: Where Probability Theory, Data Mining, and Neural Networks Meet

My talk starts by turning back the clock to 1979-1983, introducing the ideas that culminated with the fundamental representation theorem of graphs (the Aldous-Hoover theorem). I will then show how these ideas connect to a probabilistic interpretation of matrix factorization methods, explaining why matrix factorization is fundamentally not as expressive as it could be to describe finite graphs. I will then turn to early machine learning attempts to represent graphs and how these attempts connect to graph mining algorithms. I will introduce the concept of representation learning with graph neural networks (GNNs) and explain its connections to statistical graph models and the Weisfeiler-Lehman isomorphism test. Finally, I will introduce a newly proposed general framework for graph representation learning using deep neural networks, which is directly rooted in the ideas that gave us the Aldous-Hoover representation theorem. This new representation framework points to novel graph models, new approaches to make existing methods scalable, and provides a unifying approach connecting matrix factorization, graph mining algorithms, and graph neural networks. I will end my talk with a few open problems.
This talk is in part based on joint work with Ryan Murphy, Balasubramanian Srinivasan, and Vinayak Rao.

Bruno Ribeiro is an Assistant Professor in the Department of Computer Science at Purdue University. He obtained his Ph.D. at the University of Massachusetts Amherst and did his postdoctoral studies at Carnegie Mellon University from 2013-2015. His research interests are in deep learning and data mining, with a focus on sampling and modeling relational and temporal data.

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