Source-Detection in Networked-Structure Diffusion and Its Application in Contact Tracing

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Abstract

Information propagation in online social networks and disease spreading through real-world social networks are common phenomena in networked structures. We study the epidemic source detection problem in contact tracing networks modeled as a graph-constrained maximum likelihood estimation problem using the susceptible-infected model in epidemiology. In this talk, we first introduce the problem formulation of the source detection problem and results on finite degree regular graphs and regular graphs with cycles. Thereby establishing an algorithm based on weighted graph distance that captures the optimality of this source detection problem. Then, we introduce how we apply the source detection algorithm to a problem arising from digital contact tracing during the COVID-19 pandemic. We compare the efficacy of two contact tracing strategies based on Breadth-first search (BFS) and Depth-first search (DFS) graph traversal. Lastly, we introduce a Graph Neural Network (GNN) learning framework to efficiently approximate the most-likely superspreader iteratively as the contact tracing networked data grows.