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*Minimum Degree and Treewidth: Algorithm, Complexity and Structure*

How densely can a network be connected while still maintaining a certain level of simplicity in its structure? And how difficult is it to add connections to a network so that every vertex has enough connections, without making the overall structure too complicated?

In this talk, we explore these questions through the mathematical study of graphs, which provide a way to represent networks of interconnected objects. We focus on two competing requirements: ensuring that every vertex has a minimum number of connections, while keeping the network structurally simple. We measure this simplicity using a concept called treewidth, which, roughly speaking, captures how closely a network resembles a tree.

We first determine exactly when it is possible to construct a connected network that meets these requirements with the smallest possible number of edges. Time permitting, we will investigate a related problem: given an existing network, what is the minimum number of new connections needed to ensure that every vertex has sufficiently many connections while keeping its structure simple?