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Classical Graph Problems on Hereditary Graph Classes

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A graph class is hereditary if it has the natural property of being closed under the vertex deletion operation, consequently, being characterized by a set of forbidden induced subgraphs. In this talk, I will present a few results that I find nice, noteworthy, or particularly important.

In the first part of the talk, I will focus on the time complexity of classical NP-hard problems on those hereditary graph classes which are defined by one or two forbidden induced subgraphs, known as H-free or (H_1, H_2)-free graphs. I will introduce two main open directions: 3-coloring and maximum independent set, in the case of a single forbidden induced subgraph. I will discuss a structural result for graphs without long induced subdivided claws ($S_{t,t,t}$-free graphs), utilizing the so-called extended strip decomposition. This result has become a cornerstone of a recent breakthrough, a quasipolynomial-time algorithm for a maximum weighted independent set in $S_{t,t,t}$-free graphs for any fixed t, among others.

Next, I will present some results for hereditary classes defined by two forbidden induced subgraphs. Specifically, I will discuss a polynomial-time algorithm for 3-coloring ($2P_4$, C_5)-free graphs and an in-depth study of the boundedness of clique-width in atoms (graphs without a clique cut-set) of (H_1, H_2)-free graphs, along with a motivation for focusing on atoms.

In the final part of the talk, we will delve into vertex deletion problems, focusing on the problem of vertex deletion into bipartite permutation graphs—specifically, whether we can remove k vertices from a general graph to obtain a bipartite permutation graph. I will present a fixed-parameter algorithm that originally motivated this study, as well as a 'cute' structural result about a class we call almost bipartite permutation graphs, which, unlike bipartite permutation graphs, allows long induced cycles.