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Full homomorphisms to trees

Given two graphs G and H, a full homomorphism from G to H is a function $\varphi\colon V_G \to V_H$ which preserves adjacencies and non-adjacencies. When a full homomorphism exists from G to H we say that G is fully H-colourable; the full H-colouring problem is the problem of deciding whether an input graph G admits a full H-colouring for a fixed graph H. In 2008, Feder and Hell proved that there are always finitely many minimal obstructions to the full H-colourability problem, and moreover, the order of any such minimal obstruction is at most $|V_H| + 1$. Thus, there is a brute force polynomial time algorithm to solve the full H-colouring problem.

In this talk we consider the full H-colouring problem when H is a tree; in particular, we are interested in the optimal time for recognizing a fully H-colourable graph. We present a linear time algorithm to solve the full H-colouring problem when H is a path. We also define the class of *fully tree-colourable graphs* as the family of graphs admitting a full homomorphism to some tree, and exhibit a characterization in terms of minimal induced subgraphs for such a class.