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SLICEWISE DEFINABILITY IN FIRST-ORDER LOGIC WITH BOUNDED QUANTIFIER RANK

Abstract:

For every $q \in \mathbb{N}$ let FO_q denote the class of sentences of first-order logic FO of quantifier rank at most q. If a graph property can be defined in FO_q, then it can be decided in time $O(n^q)$. Thus, minimizing q has favorable algorithmic consequences. Many graph properties amount to the existence of a certain set of vertices of size k. Usually this can only be expressed by a sentence of quantifier rank at least k. We use the color-coding method to demonstrate that some (hyper)graph problems can be defined in FO_q, where q is independent of k.

It is crucial for our results that the FO-sentences have access to built-in addition and multiplication. It is known that then FO corresponds to the circuit complexity class uniform AC^0. We explore the connection between the quantifier rank of FO-sentences and the depth of AC^0-circuits, and prove that $\mathrm{FO}_q \subsetneq \mathrm{FO}_{q+1}$ for structures with built-in addition and multiplication.

http://www.logic.univie.ac.at/
Research_seminar.html