



Descriptive complexity of the full Henkin logic

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Comments: t.b.a.

Henkin's partially ordered quantifiers (also known as Henkin quantifiers) were initially introduced as mathematical exercise, but are the subject of lively discussion among various disciplines, including linguistics (branching quantification), philosophy of mathematics (IF-logic), and game theory (semantic games with imperfect information). In this paper, we take up the descriptive complexity of Henkin quantifiers. This topic was initially studied by Blass and Gurevich (1984), with regard to the logic, H , that results from prefixing first-order logic by one Henkin quantifier. We concern ourselves with the logics that are closed under boolean operations $Bcl(H)$, first-order quantification $Fcl(H)$, and Henkin quantification L^* . Our main observation is that the full Henkin logic L^* falls within the complexity class P^{NP} ; in fact, if we enrich L^* with a linear order, it captures full P^{NP} . From this observation it follows that on finite linearly ordered structures (i) $Fcl(H)$ and L^* are equally expressive and that (ii) $Bcl(H)$ and L^* are equally expressive implies that the polynomial time hierarchy collapses to its third level. The latter result can be considered the finite structure answer to a question raised by Mostowski (1995).