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Report of the advisor on Raheleh Jalali Keshavarz's thesis *Proof systems: A study on Form and Complexity.*

Raheleh was employed in the Institute of Mathematics and was working on my ERC project FEALORA. Her thesis is based on results of 3 articles: *Universal Proof theory: Semianalytic rules and interpolation,* joint work with A. A. Tabatabai, (under review), *An exponential lower bound on proofs in focused calculi,* (published), and *Proof complexity of substructural logics,* (ready to be submitted). The thesis deals with proof theory of propositional logics. A common theme is Craig's interpolation theorem. In the first part of the thesis the interpolation property is investigated in proof systems with semianalytic deduction rules. The main result is a uniform method to prove a stronger form of interpolation, the uniform interpolation property. In the second part Raheleh sudied the focused calculi, a concept introduced by Rosalie Iemhoff. This part complements negative results about systems that do not have the interpolation property by showing that there are systems that do have this property, but proofs of some tautologies in these systems are exponentially long. The lower bounds are based on an extension of the exponential lower bounds on intuitionistic and some modal logics of Pavel Hrubeš. In the third part Raheleh studies the complexity of proofs in substructural logics (essentially, extensions of the Lambek calculus). She was able to prove exponential lower bounds for all natural intuitionistic versions and for some classical version without the cut rule. The main tool is again Hrubeš's monotone interpolation.

The thesis contains a number of new interesting and nontrivial results. I am glad that Raheleh contributed to the research into proof complexity, which is one of the main topics studied in our group.

It is my pleasure to recommend the thesis for the PhD title.

Prof. Pavel Pudlák