

**A Supervisor's Review of PhD Thesis**  
***Resolution-based methods for linear temporal reasoning***  
**submitted by Martin Suda**

The thesis under review deals with methods of automated reasoning for systems evolving in time, namely theorem proving for linear temporal logic.

There are several novel contributions that roughly correspond to chapters of thesis. First, the author presents a novel resolution-based calculus for linear temporal logic (LTL) called labeled superposition - LPSup. This work is further extended to a new algorithm for LTL satisfiability checking called LS4 (Labeled Superposition for LTL with partial model guidance). By employing modern SAT solvers, LS4 is shown to perform very well in practice. A pre-processing technique for LS4 (and other resolution-based provers) based on variable and clause elimination is studied next. The second part of thesis is devoted to study specific problems of reachability in symbolic transition systems. The LS4 algorithm is specialized for these problems and contrasted with Property Directed Reachability (PDR) – a recent algorithm developed for model checking of hardware circuits. The last part is dedicated to application of the developed reachability algorithm to propositional STRIPS planning. The author shows that general SAT calls in PDR can be substituted by specific procedures and proposes PDRplan – a novel automated planner competitive with the state of the art planners.

The thesis is well organized. It shows evolution of the method starting with a general approach for theorem proving for linear temporal logic, improving it, and finally applying it to reachability problems. I appreciate that the author wrote the thesis as a monolithic text (rather than a collection of papers) with clear connections between the results. The proposed methods are well justified theoretically and there are also experimental studies of the algorithms. On the other hand, my major complain is about too abstract way of writing. I would prefer if more motivation was given for notions and methods introduced in the thesis and examples were used to demonstrate them. A few examples given in thesis are always abstract though there are a lot of opportunities to explain the developed ideas and methods practically. This style of writing makes reading much harder especially for non-experts in the area of LTL.

In summary, the thesis clearly demonstrates that the doctoral candidate is capable to do scientific research and to contribute original research results of high quality. The results were published at conferences and JAIR journal. I evaluate the thesis with the excellent grade (summa cum laude).

Prague, May 12, 2015

Prof. RNDr. Roman Barták, Ph.D  
Charles University in Prague