Model Checking LTL Properties of High-Level Petri Nets with Fairness Constraints*†

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Abstract

Verification of liveness properties of systems requires in many cases fairness constraints to be imposed on the system. Model checking with fairness constraints has been investigated since the mid-eighties. The paper of Emerson and Lei [1] described how CTL model checking can be extended with fairness constraints for a small cost. Kesten, Pnueli, and Raviv extend in a similar manner LTL model checking for BDDs in [2]. In the context of modeling and analysis with Petri nets, however, fairness constraints have been defined but the results have not been extended to model checking.

Latvala and Heljanko have presented in [3] how Place/Transition nets can be equipped with fairness constraints and how the model checking procedure must be extended to cope with the constraints efficiently.

In this work the approach of [3] is generalized to high-level nets. Coloured Petri nets are extended with fairness constraints on the transitions and the semantics of the fairness constraints are defined with a fair Kripke structure. Model checking linear temporal logic (LTL) properties of the Petri net is facilitated by extending the LTL model checking procedure. The procedure employs Streett automata to cope with the fairness constraints efficiently.

The new procedure has been implemented in the MARIA analyzer [4]. Some experiments are performed to test the implementation and compare it with other

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ways of coping with fairness constraints. The results show that the procedure scales well when compared to alternative approaches.

Keywords: Computer aided verification, Petri nets, model checking, fairness, Streett automata, counterexamples.

References

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