OTTO VON GUERICKE UNIVERSITÄT MAGDEBURG

Parallel Computing and I/O

Modelling MPI Communication using Colored Petri Nets

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The Message Passing Interface (MPI) is a widely adopted standard for use in high-performance, distributed memory, parallel computing. Due to its high complexity, caused by complex communication patterns and often unknown numbers of participating processes, both manual and automated error detection for MPI software is difficult. Colored Petri Nets (CPNs) offer a powerful, high-level modelling framework to model complex systems. Arbitrary annotations in a modelling language allow a CPN to model almost anything. They are suited particularly well for modelling distributed systems, making them a good match for MPI software This thesis presents a novel approach for modelling the communication patterns of MPI programs as Colored Petri Nets. It includes a fully-featured CPN implementation, a proposed specification of an intermediate representation for compiling MPI software into CPNs, as well as a proof-of-concept evaluator tool which can analyze the proposed IR and detect a variety of programming errors. The evaluator is as yet incomplete, supporting only a very small subset of the MPI standard, but the modelling approach should transfer to most MPI operations, and the performance of the software is promising. Other approache to modelling and checking MPI software are either slower or defunct.