CONSAT: A Parallel Constraint Satisfaction System

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Abstract. In this paper we describe the parallelisation of a medium-size symbolic fixed-point computation, CONSAT. CONSAT is a constraint satisfaction system that computes globally consistent solutions. The parallel version of CONSAT is implemented using abstractions from a parallel programming toolbox we developed. The toolbox is intended for novice parallel programmers, and programs based on abstractions from this toolbox may be executed on both uniprocessors and shared-memory multiprocessors without modifications. We explain how parallelism is introduced, and how concurrent accesses to shared data structures are handled. We will also describe the performance of CONSAT on sample inputs.

Keywords: Constraint satisfaction, fixed-point computation, parallel programming

1. Introduction

A fixed-point computation is characterised by the abstract algorithm: "X ← A; Repeat A ← $f(X)$ until no change in X". In this paper we describe a medium size symbolic fixed-point computation, CONSAT. CONSAT is a constraint system that computes globally consistent solutions [6]. The parallel version of CONSAT is implemented using abstractions from a parallel programming toolbox we developed [7]. The toolbox is intended for novice parallel programmers, and programs based on abstractions from this toolbox may be executed on both uniprocessors and shared-memory multiprocessors without modifications. We explain how parallelism is introduced, and how concurrent accesses to shared data structures are handled. The parallel implementation of the toolbox is written in CMU [4], a commercial implementation of the multiprocessing feature of SPUR Lisp [10], and currently runs on Sequent Symmetry multiprocessors. We describe the performance of parallel CONSAT on sample inputs, and survey related work in constraint satisfaction.

CONSAT is a challenging symbolic application for parallel programming systems because it is a medium-size system (of about 8,000 lines of Common Lisp) that has been developed without consideration for parallel implementations. The system seems to involve many independent and therefore parallelisable computations, yet it is very difficult to obtain good parallel performance. The computations are

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