

On-the-fly Race Detection for Programs with Recursive Spawn-Sync Parallelism

Yuxiong He and Junqing Wang

Singapore-MIT Alliance, E4-04-10, 4 Engineering Drive 3, Singapore 117576

Abstract—Detecting data race is very important for debugging shared-memory parallel programs, because data races result in unintended nondeterministic execution of the program. We propose a dynamic on-the-fly race detection mechanism called Parallel Nondeterminator to check for determinacy races during the parallel execution of a program with recursive spawn-sync parallelism. A modified version of Nested Region Labeling scheme is developed for the concurrency relationship test in the spawn-sync parallel structure. Through the identification of Least Common Ancestor in the spawn tree, the Parallel Nondeterminator only needs to keep two read access records and one write access record for each shared location. The work and critical path in the instrumented codes are analyzed as well as time complexity and space requirements. Let N denote the maximum depth of the recursion in the parallel program. The worst case time increased for each spawn and sync operation is $O(N)$ and the time required to monitor any shared memory location is $O(\lg N)$. Moreover, Parallel Nondeterminator is able to execute the race detection code without loss of parallelism of the original program. In summary, the Parallel Non-determinator represents a provably efficient strategy for detecting data races for shared-memory parallel programs.

[Full Text Not Available]