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Interleaving-tree based fine-grained linearizability fault localization. (English)

Summary: Linearizability is an important correctness criterion for concurrent objects. Existing work mainly focuses on linearizability verification of coarse-grained traces with operation invocations and responses only. However, when linearizability is violated, such coarse-grained traces do not provide sufficient information for reasoning about the underlying concurrent program faults. In this paper, we propose a notion of critical data race sequence (CDRS), based on our fine-grained trace model, to characterize concurrent program faults that cause violation of linearizability. We then develop a labeled tree model of interleaved program executions and show how to identify CDRSes and localize concurrent program faults automatically with a specific node-labeling mechanism. We also implemented a prototype tool, FGVT, for real-world Java concurrent programs. Experiments show that our localization technique is effective, i.e., all the CDRSes reported by FGVT indeed reveal the root causes of linearizability faults.

For the entire collection see [Zbl 1425.68009].

MSC:
68N19 Other programming paradigms (object-oriented, sequential, concurrent, automatic, etc.)

Keywords:
linearizability; bug localization; concurrency; testing

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