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A Framework for On-line Timing Error Detection in Software Systems

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Abstract

On-line timing error detection entails gathering and analyzing monitoring data to pinpoint deviations from the expected timing behavior of a given software system. Current solutions for system monitoring and runtime analysis present several practical drawbacks that limit their usability in real industrial systems, such as the need of kernel-level probes or the coarse per-node/per-process monitoring granularity. This paper proposes a novel framework for timing error detection that capitalizes on the systematic interleaving of logging instructions across the functional code in order to overcome above limitations. The paper faces the practical challenges related to the specification and implementation of a log weaving technique, detection algorithms, and a data centralization platform to collect and analyze fine-grained execution traces in distributed systems. We experiment the proposed framework in two real-world critical information systems from the Crisis Management and the Air Traffic Control domains. Results show that our framework achieves 95% timing error coverage and allows reconstructing error trends with high statistical confidence at negligible performance overhead.

Keywords: On-line monitoring; Timing errors; Error detection; Event logging; Critical information systems.

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