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Lectures on Runtime Verification

Introductory and Advanced Topics

Springer

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Preface

Runtime verification (RV) is a lightweight, yet rigorous, formal method for the monitoring and analysis of the runtime behavior of software and hardware systems. RV complements classic exhaustive verification techniques (such as model checking and theorem proving) with a more practical approach that analyzes a single execution trace of a system. At the price of a limited execution coverage, RV can give very precise information on the runtime behavior of the monitored system. RV is now widely employed in both academia and industry both before system deployment, for testing, verification, and debugging purposes, and after deployment to ensure reliability, safety, robustness, and security.

The interest in this field of research has grown since 2001 when the first international workshop on RV was organized. This venue has occurred each year since then, becoming a conference in 2010. In 2014, we initiated the International Competition on Runtime Verification (CRV) with the goal of fostering the comparison and evaluation of software runtime verification tools. In the same year, an European scientific network for the Cooperation in Science and Technology (COST) on “Runtime Verification Beyond Monitoring (ARVI)” was approved and funded within the European framework program Horizon 2020. ARVI currently includes the participation of scientists from 26 European countries and Australia. In 2016, together with other partners of ARVI, we also started to organize the first of a series of schools on RV. Our aim is to train researchers from academia and industry introducing them first to the basic concepts and then to the advanced topics in this exciting research area.

The idea of this volume originated from the need to have a book for students to support their training with several tutorials on different aspects of RV. The volume has been organized in seven chapters and the topics covered include an introduction on runtime verification, dynamic analysis of concurrency errors, monitoring events that carry data, runtime error reaction and prevention, monitoring of cyber-physical systems, runtime verification for decentralized and distributed systems, and an industrial application of runtime verification techniques in financial transaction systems.

Each paper has been reviewed by two reviewers and the editors. The editors would like to thank the reviewers: Thomas Arts, Ebru Aydin Gol, Andreas Bauer, Christian Colombo, Raymond Hu, Jan Kofron, Zhaodan Kong, Laura Nenzi, Gordon Pace, Rahul Purandare, Giles Reger, Oleg Sokolsky, Shmuel Ur.

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