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Luca de Alfaro (Eds.)

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Preface

This volume contains the papers presented at CONCUR 2005, the 16th International Conference on Concurrency Theory. The purpose of the CONCUR series of conferences is to bring together researchers, developers, and students in order to advance the theory of concurrency and to promote its applications. This year's conference was in San Francisco, California, from August 23 to August 26.

We received 100 submissions in response to a call for papers. Each submission was assigned to at least three members of the Program Committee; in many cases, reviews were solicited from outside experts. The Program Committee discussed the submissions electronically, judging them on their perceived importance, originality, clarity, and appropriateness to the expected audience. The Program Committee selected 38 papers for presentation. Because of the format of the conference and the high number of submissions, many good papers could not be included. Although submissions were read and evaluated, the papers that appear in this volume may differ in form and contents from the corresponding submissions. It is expected that many of the papers will be further revised and submitted to refereed archival journals for publication.

Complementing the contributed papers, the program of CONCUR 2005 included invited lectures by Rajeev Alur, Luca Cardelli, Dawson Engler, and Christos Papadimitriou. Rajeev Alur's and Dawson Engler's lectures were jointly for CONCUR 2005 and SPIN 2005, one of 11 affiliated workshops that enhanced the program:

- BioCONCUR: Concurrent Models in Molecular Biology
- DisCoVeri: Distributed Algorithms Meet Concurrency Theory
- EXPRESS: Expressivity in Concurrency
- FIT: Foundations of Interface Technology
- FOCLASA: Coordination Languages and Software Architectures
- GETCO: Geometric and Topological Methods in Concurrency
- GT-VC: Graph Transformation for Verification and Concurrency
- INFINITY: Verification of Infinite-State Systems
- MoChArt: Model Checking and Artificial Intelligence
- SecCo: Security Issues in Concurrency
- SPIN: Model Checking of Software

We would like to thank the members of the Program Committee for their hard and expert work. We would also like to thank the CONCUR Steering Committee, the workshop organizers, the external reviewers, the authors, and the local organizers for their contributions to the success of the conference. Finally, we gratefully acknowledge the generous support received from Cisco Systems and from Microsoft Research.

Martín Abadi and Luca de Alfaro

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Static Analysis Versus Model Checking for Bug Finding

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Abstract. This talk tries to distill several years of experience using both model checking and static analysis to find errors in large software systems. We initially thought that the tradeoffs between the two was clear: static analysis was easy but would mainly find shallow bugs, while model checking would require more work but would be strictly better — it would find more errors, the errors would be deeper and the approach would be more powerful. These expectations were often wrong. This talk will describe some of the sharper tradeoffs between the two, as well as a detailed discussion of one domain — finding errors in file systems code — where model checking seems to work very well.

The Benefits of Exposing Calls and Returns

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Regular languages have robust theoretical foundations leading to numerous applications including model checking. Context-free languages and pushdown automata have been indispensable in program analysis due to their ability to model control flow in procedural languages, but the corresponding theory is fragile. In particular, non-closure under intersection and undecidability of the language inclusion problem disallows context-free specifications in model checking applications.

In the recently proposed definition of *visibly pushdown languages*, the set of input symbols is partitioned into *calls*, *returns*, and *local* symbols, and the type of the input symbol determines when the pushdown automaton can push or pop or swap. Exposing the matching structure of calls and returns is natural in associating a language with a sequential block-structured program or a document format with nested tags. When calls and returns are exposed in this manner, the language can be defined by a (stackless) finite-state *alternating* automaton that can jump from a call to the matching return. The resulting class of VPLs has many appealing theoretical properties:

Closure Properties: it is closed under a variety of operations such as union, intersection, complementation, renaming, concatenation, and Kleene-*;

Robustness: it has multiple equivalent characterizations using context-free grammars, using the monadic second order (MSO) theory over words augmented with a binary matching predicate, and using Myhill-Nerode-like characterization by syntactic congruences;

Decidability: problems such as language inclusion and equivalence are decidable for visibly pushdown automata (VPA);

Determinization: nondeterministic VPAs can be determinized;

Minimization: under some restrictions, deterministic VPAs can be minimized yielding a canonical VPA; and

ω -VPLs: most of the results generalize to the class of languages over infinite words defined by visibly pushdown automata with Büchi acceptance condition.

After reviewing the theory of VPLs, we show how it allows enhancing the expressiveness of specification languages used in software model checking. The *temporal logic of calls and returns* (CaRet) integrates Pnueli-style temporal modalities with Hoare-style reasoning by pre/post conditions, in a single algorithmic framework. Besides the standard global temporal modalities, CaRet admits the *local-next operator* that allows a path to jump from a call to the *matching* return. This operator can be used to specify a variety of non-regular properties such as