R. Ramanujam
Sandeep Sen (Eds.)

FSTTCS 2005: Foundations of Software Technology and Theoretical Computer Science

LNCS 3821

25th International Conference
Hyderabad, India, December 2005
Proceedings

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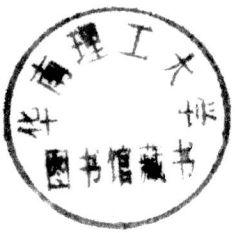

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Preface

This year marks a milestone in the history of FST&TCS, which first took place in 1981. We would like to take this opportunity to express our appreciation of the foresight and commitment to excellence shown by the early organizers of the conference. The conference is now organized by IARCS (Indian Association for Research in Computing Science), and the conference has been the foundation on which the IARCS community has been built.

To commemorate the *Silver Jubilee* of FST&TCS, we had an extra day to accommodate special sessions and a larger number of invited speakers. As in previous years, we were fortunate to have a number of highly eminent researchers giving plenary talks. It gives us great pleasure to thank Manindra Agrawal, Tom Henzinger, Russell Impagliazzo, Raimund Seidel, Natarajan Shankar, Joel Spencer and Igor Walukiewicz for agreeing to give talks and for contributing to this volume.

This year's conference attracted 167 submissions with authors from 29 countries. Except for some papers which were deemed to be out of scope by the Program Committee (PC), each submission was reviewed by at least three members of the PC, with help from many external reviewers. With 466 reviews at hand, the PC deliberated for more than two weeks before finally selecting the 38 papers included in this volume. We thank all the reviewers for their invaluable help. The PC members put in a great deal of hard work to select the best papers from the submissions. We express our gratitude to all PC members for doing an excellent job. Special thanks are due to Kamal Lodaya for managing the conference software as well.

FST&TCS included two pre-conference workshops: one on *Algorithms in Networking* coordinated by Amit Kumar (IIT Delhi) and Aravind Srinivasan (University of Maryland), and another on *Software Verification* coordinated by P. Madhusudan (University of Illinois at Urbana Champaign) and Sriram Rajamani (Microsoft Research). We thank the organizers as well as the speakers at the workshops for contributing so significantly to the program.

The conference was held at the International Institute of Information Technology, Hyderabad, and the satellite workshops at the adjoining campus of the University of Hyderabad. We thank the Organizing Committee for taking on the responsibility. We gratefully acknowledge the infrastructural help provided by our institutes, the Institute of Mathematical Sciences, Chennai, and the Indian Institute of Technology, Kharagpur.

We thank Springer for their continued support of FST&TCS over the years in publishing the proceedings.

December 2005

R. Ramanujam and Sandeep Sen
Co-chairs, Program Committee,
FST&TCS 2005

CALL FOR PAPERS

Conference on
FOUNDATIONS OF SOFTWARE TECHNOLOGY
and
THEORETICAL COMPUTER SCIENCE

Sponsored by

National Centre for Software Development and Computing Techniques (NCSDCT)

December 11-12, 1981 Bangalore, India

Contributed papers are invited for the first conference scheduled to be held at The Indian Institute of Science, Bangalore, India.

Topics : The following list of possible topics illustrate the intended scope of the conference :

Foundations of Software Technology, programming methodology, program correctness, programming languages (design, implementation, environment), operating systems, abstract software specifications.

Theoretical Computer Science : complexity of algorithms, automata theory, formal languages, theory of computation.

The conference is being organized to provide a forum for discussion at an advanced level of research topics of current interest in the areas indicated above. The conference will provide an opportunity to staff members and advanced level research students in institutions in India that have specialized post-graduate computer science programmes, for presenting their ongoing research work and plan future research/teaching activities.

The technical contents of the conference will be planned and organized by a committee comprising :

Dr. M. Joseph (NCSDCT, Bombay)
Dr. R. K. Shyamasundar (NCSDCT, Bombay)
Prof. S. V. Rangaswamy (IISc, Bangalore)
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Submission of Papers : Authors are requested to inform
Dr. R. K. Shyamasundar
NCSDCT
Tata Institute of Fundamental Research
Homi Bhabha Road, Bombay 400 005, India
of their intent to present a paper with a 200 words abstract before **May 15, 1981.**

Two copies of the complete version of the paper must be sent to the same address as above before **July 31, 1981.**

Authors will be notified of acceptance/rejection by **September 15, 1981.**

25 Years of FST&TCS

This Conference ... is the first of its kind being held in India and it is hoped that this would be the start of a series of such conferences to serve as a forum for discussing at an advanced level ...

Thus began the foreword to the proceedings of FST&TCS 1981. The conference aimed to provide a forum for computer science in India, a window to the rest of the world and, above all, a challenging environment in which critical analysis would ensure that high quality was scrupulously maintained. FST&TCS has fulfilled these early hopes, and may also claim to have set a standard for other computer science conferences in the region.

In 1981, there were many unknowns and neither the financial requirements nor participation from peers was assured. R. Narasimhan of Tata Institute of Fundamental Research (TIFR) provided unstinted support in all forms including funds and encouragement. Robin Milner looked past our shaky start (with flaky microphones and a projector that worked some of the time) and urged us to persevere. Maurice Nivat, the Keynote Speaker of FST&TCS 1981 and also Editor-in-Chief of the journal Theoretical Computer Science at that time, offered to bring out special issues of the journal from selected papers from the conference: this brought academic rigor as well as international visibility. From 1984 onwards, the proceedings have been published in the LNCS series by Springer. Many distinguished computer scientists have been invited speakers and have also contributed as reviewers.

Over the years, the series has redefined its goals. The focus has moved away from some of the areas that were seen as important 20 years ago. There is today altogether less focus on software technology and a great deal more on foundations. FST&TCS has also been an important step in the growth of many careers in India: many of the research students who hesitatingly submitted papers and even more hesitatingly presented them are now senior computer scientists with established reputations. In many ways, the maturing of FST&TCS has mirrored the maturing of computer science in India. The satellite workshops of the conference on state-of-the-art topics and special tutorial workshops have greatly helped to further research in India, especially for graduate students whose ability to travel abroad for conferences is limited.

Finally, we must thank all those (from India and abroad) who submitted papers, for sharing with us the belief that a conference like this was worth having and long overdue.

Thus ended the preface in 1981 and initiated the long journey that has taken us to 2005 with no fears of faltering.

December 2005

Mathai Joseph and R.K. Shyamasundar
Editors, FST&TCS 1981 Proceedings

Organization

The 25th (*Silver Jubilee*) FST&TCS conference was held at the International Institute of Information Technology, Hyderabad during December 15–18, 2005. The associated workshops were held at the University of Hyderabad, India on December 13 and December 14, 2005.

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Krishnendu Chatterjee[1] and Thomas A. Henzinger[1,2]

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Abstract. Much recent research has focused on the applications of games with ω-regular objectives in the control and verification of reactive systems. However, many of the game-based models are ill-suited for these applications, because they assume that each player has complete information about the state of the system (they are "perfect-information" games). This is because in many situations, a controller does not see the private state of the plant. Such scenarios are naturally modeled by "partial-information" games. On the other hand, these games are intractable; for example, partial-information games with simple reachability objectives are 2EXPTIME-complete.

We study the intermediate case of "semiperfect-information" games, where one player has complete knowledge of the state, while the other player has only partial knowledge. This model is appropriate in control situations where a controller must cope with plant behavior that is as adversarial as possible, i.e., the controller has partial information while the plant has perfect information. As is customary, we assume that the controller and plant take turns to make moves. We show that these *semiperfect-information turn-based games* are equivalent to *perfect-information concurrent games*, where the two players choose their moves simultaneously and independently. Since the perfect-information concurrent games are well-understood, we obtain several results of how semiperfect-information turn-based games differ from perfect-information turn-based games on one hand, and from partial-information turn-based games on the other hand. In particular, semiperfect-information turn-based games can benefit from randomized strategies while the perfect-information variety cannot, and semiperfect-information turn-based games are in NP $\cap$ coNP for all parity objectives.

1 Introduction

Games on graphs. Games played on graphs play a central role in many areas of computer science. In particular, when the vertices and edges of a graph represent the states and transitions of a reactive system, then the synthesis problem (Church's problem) asks for the construction of a winning strategy in a game played on a graph [2,17,16,15]. Game-theoretic formulations have also proved useful for the verification [1], refinement [11], and compatibility checking [6] of reactive systems. Games played on graphs are dynamic games that proceed for

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