Stefania Bandini
Sara Manzoni (Eds.)

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AI*IA 2005: Advances in Artificial Intelligence

9th Congress of the Italian Association for Artificial Intelligence Milan, Italy, September 2005, Proceedings

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Preface

This volume collects the papers selected for presentation at the IX Congress of the Italian Association for Artificial Intelligence (AI*IA), held in Milan at the University of Milano–Bicocca (September 21–23, 2005). On the one hand this congress continues the tradition of AI*IA in organizing its biannual scientific meeting from 1989; on the other hand, this edition is a landmark in the involvement of the international community of artificial intelligence (AI), directly involving a broad number of experts from several countries in the Program Committee. Moreover, the peculiar nature of scientific research in artificial intelligence (which is intrinsically international) and several consolidated international collaborations in projects and mobility programs allowed the collection and selection of papers from many different countries, all around the world, enlarging the visibility of the Italian contribution within this research field.

Artificial intelligence is today a growing complex set of conceptual, theoretical, methodological, and technological frameworks, offering innovative computational solutions in the design and development of computer-based systems. Within this perspective, researchers working in this area must tackle a broad range of knowledge about methods, results, and solutions coming from different classical areas of this discipline. The congress was designed as a forum allowing researchers to present and discuss specialized results as general contributions to AI growth.

In order to give a novel perspective in which both theoretical and application aspects of AI contribute to the growth of the area, this book mirrors the structure of the congress, grouping the papers into four main categories: (1) Theoretical Research: Results and Proposals; (2) Theoretical Research: Improvements and Consolidations; (3) Applications: Systems and Prototypes; (4) Applications: Case Studies and Proposals. Within this classification some of the main classical topics of artificial intelligence are presented (agents, knowledge representation, machine learning, planning, robotics, natural language, ...), but here the emphasis is on the ability of AI computational approaches to face challenging problems and to propose innovative solutions.

The book contains 46 full papers (6 for the first category, 18 for the second, 15 for the third, and 7 for the fourth) and 16 short papers (for the four categories, respectively 3, 6, 4, and 3).

Many people contributed to the success of the congress and the creation of this volume, from the initial idea to its implementation. My first acknowledgement is to the General Board of AI*IA which offered me the opportunity to chair this congress. Then I thank the President of the Association (Marco Gori) for starting suggestions, all the scientists who submitted their work, and all Program Committee members and reviewers for their collaboration. A special thanks to Luigia Carlucci Aiello for her indispensable, kind, friendly and continuous con-

sultation on the most heterogeneous aspects I met during the path. Finally, a special thanks also to the University of Milano–Bicocca for hospitality and its generous contribution in the realization of this volume.

A particular acknowledgement to all the people of the Artificial Intelligence Lab (L.INT.AR.) of the University of Milano–Bicocca, and to the "official" Local Organization Committee (Fabio Zanzotto, Federica Sartori, Fabio Sartori, Mizar Luca Federici, Alessandro Mosca, Matteo Palmonari, Davide Ungari) whose work was the fundamental contribution to the actual success of the event. Moreover, I want to thank the Department of Computer Science, Systems and Communication of my university, and those companies that financially supported the congress: AISoftware (F. Gardin), Akhela (P. Ravasio), Aletheia (F. Rebuffo), Gruppo Fabbri (F. Fabbri, A. Caruso), illycaffè (E. Illy, F. Suggi Liverani).

Finally, my gratitude for the constant, indispensable, and precious support in all the development steps of the congress to Sara Manzoni, the co-editor of this volume.

July 2005

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Organization

AI*IA 2005 was organized by the Artificial Intelligence Lab (L.INT.AR.) of the Department of Computer Science, Systems and Communication (DISCo) of the University of Milano–Bicocca, in cooperation with the Italian Association for Artificial Intelligence (AI*IA).

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The Complexity of Action Redundancy

Andrea Ferrara, Paolo Liberatore, and Marco Schaerf

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Abstract. An action is redundant in a planning domain if it is not needed to reach the goal. In this paper, we study the computational complexity of some problems related to the redundancy of actions: checking whether a domain contains a redundant action, what is the minimal number of actions needed to make the goal reachable, checking whether the removal of an action does not increase the minimal plan length, etc.

1 Introduction

Most problems in planning, like plan existence and plan generation, are problems on a fixed planning domain: the initial states, goal, and possible actions are assumed fixed and cannot be modified. This assumption is not always necessary: there are cases in which the domain can be—to some extent—modified. In this paper, we study some problems about the removal of actions from the domain. For example, the problem of whether an action is necessary to reach the goal makes sense whenever there is some gain in not performing an action at all.

It is important to remark that we are not checking whether an action can be removed from a single plan [1,2,3], a problem that arises naturally in the context of plan abstraction [4,5]. Rather, we are checking whether an action can be removed at all from the domain. Such a problem makes sense in several situations:

Design: if the planning instance is the formalization of a system that is yet to be built, it makes sense to consider whether some actions can be removed, as this may correspond to the simplification of the design;

Reliability: in some system, operation must be warranted regardless of faults; since the effect of faults on a planning instance is to make some actions non-executable, then all actions should be redundant to ensure that the system will work properly in all cases;

Solving: the cost of solving a planning instance is often related to the number of possible actions; knowing that a specific action is not really needed may simplify the planning generation problem (this is the motivation behind the work of Nebel, Dimopolous, and Koehler [6].)

It is important to note that solving the problem of action redundancy is done *before* the plan is generated. We are not considering the problem of removing an

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