The 2003 International Conference on Automated Planning and Scheduling (ICAPS–03)

Enrico Giunchiglia, Nicola Muscettola, and Dana Nau

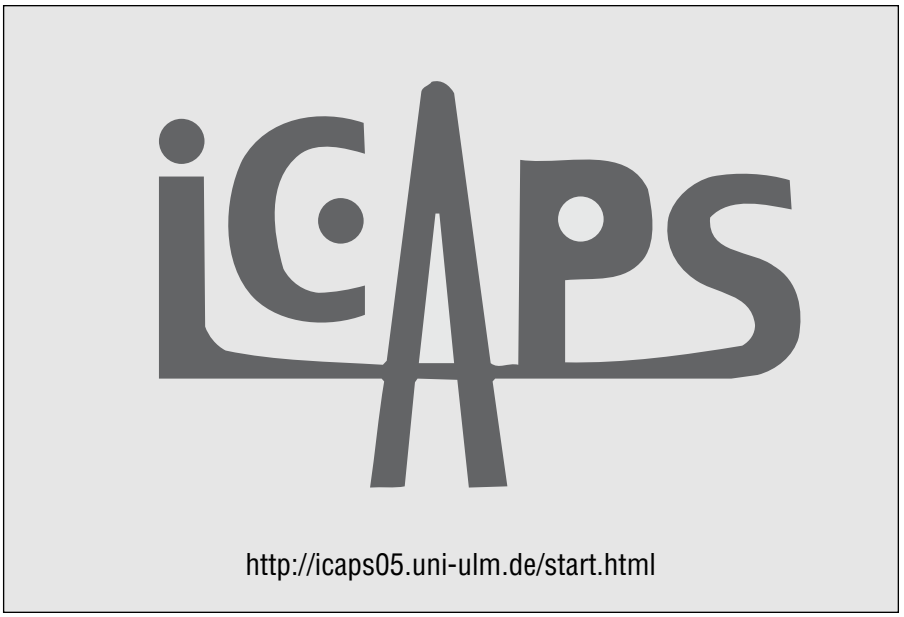
■ The 2003 International Conference on Automated Planning and Scheduling (ICAPS-03) was held 9 to 13 June 2003 in Trento, Italy. It was chaired by Enrico Giunchiglia (University of Genova), Nicola Muscettola (NASA Ames), and Dana Nau (University of Maryland). Piergiorgio Bertoli and Marco Benedetti (both from ITC-IRST) were the local chair and the workshop-tutorial coordination chair, respectively.

The International Conference on Automated Planning and Scheduling (ICAPS) is the premier international forum for researchers and practitioners in automated planning and scheduling. It is the result of merging two highly successful biennial conferences: (1) the International Conference on AI Planning and Scheduling (AIPS) and (2) the European Conference on Planning (ECP)—which alternately occurred beginning in 1991.

The ICAPS-03 technical program took place from 11 to 13 June 2003. It featured 30 paper presentations, which were selected from 98 papers that were submitted, for an acceptance ratio of about 30 percent. Two awards were given: one for the best basic research paper and one for the best applied research paper. The recipients of these awards were "Exploiting a GRAPHPLAN Framework in Temporal Planning" by Derek Long and Maria Fox (both from Durham University) and "Decision-Theoretic Group Elevator Scheduling" by Daniel Nilovski and Matthew Brand (both from Mitsubishi Electric Research Laboratories). Long and Fox proposed an extension to GRAPHPLAN to handle temporal planning. In their approach, the graph is used to represent the purely logical structuring of the plan, and temporal constraints are managed separately with a linear constraint solver. Nilovski and Brand presented a dynamic programming algorithm for exact calculation and minimization of expected waiting times of all passengers using a bank of elevators. Empirical comparison with a state-of-the-art scheduler shows that their algorithm reduces waiting times by 30 to 40 percent under heavy traffic and rarely underperforms the benchmark scheduler with light traffic. Their algorithm is currently under industrial testing in Japan.

In addition, the technical program was highlighted by three invited talks. The first talk, entitled "1001 Ways to Skin a Planning Graph for Heuristic Fun and Profit," was given by Subbarao Kambhampati (Arizona State University). Kambhampati discussed how to extract heuristics from planning graphs to control search in different planners (state space, plan space, disjunctive) and for different planning problems (classical, metric temporal, conformant, and conditional). Malik Ghallab (LAAS-CNRS), the second speaker, presented his work entitled "Plan-Based Robot Control." Ghallab started from the observation that automated planning techniques do not seem today to be a critical component of robotics research, one reason being that the "elementary actions" considered in automated planning are at too abstract a level, too far away from the low-level sensorimotor primitives of a robot. Then, he showed how it is possible to decompose each abstract action into a complex closed-loop control of sensorimotor primitives. Douglas Smith (Kestrel Institute) was the third and last invited speaker of the technical program. Smith's talk was entitled "Automated Synthesis of High-Performance Planners and Schedulers" and focused on how to apply program synthesis technology to produce high-performance planners and schedulers. More specifically, he presented PLANWARE II, a system that uses a domain-specific specification formalism to model complex resource systems, and program schemas instantiation to yield fast, customized search and propagation code. In his talk, he also surveyed the technological progress on synthesizing scheduling algorithms and the various applications that have been developed.

The 30 accepted papers covered the full spectrum of topics in AI planning and scheduling and represented the latest theoretical and empirical advances in the field. In the schedule and the proceedings, the papers were classified into the following categories: (1) methods for planning and scheduling; (2) temporal planning; (3) acquisition of domain and control knowledge; (4) planning and control; (5) planning and the web; (6) sensing, uncertainty, and incom-



plete information; (7) systems and applications; and (8) scheduling.

In comparison with previous years, this year there was a bit more emphasis on planning with incomplete information and on applications of planning and scheduling, which came as no surprise. Planning with incomplete information is one of the hottest topics, and the ICAPS call for papers explicitly asked for papers reporting on successful deployed applications of planning and scheduling.

The program also featured 13 system demonstrations and 33 posters given by the students in the Doctoral Consortium. The system demonstrations and the posters were held concurrently in a same room, with food and beverages being served. The result was an extremely successful two-hour session, with wide participation and long-lasting discussions at each poster and system demonstration.

On 9 to 10 June, there were two days of workshops and tutorials. The five workshops were as follows:

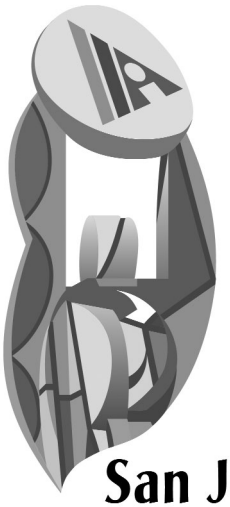
"The Competition: Impact, Organization, Evaluation, Benchmarks," organized by Stefan Edelkamp and Jörg Hoffmann (both of University of Freiburg), was driven by the questions on how best to proceed with the competition event, particularly what other language extensions are needed to enable realistic modeling, how future benchmark domains should be created and chosen to drive the field into a fruitful direction, and what evaluation criteria—specifically for hand-tailored planners—are appropriate in the competition context.

"Planning under Uncertainty and Incomplete Information" organized by Marco Pistore (University of Trento), Hector Geffner (ICREA—Universitat Pompeu Fabra), and David Smith (NASA Ames Research Center), focused in particular on the strong dualism that currently exists between the qualitative and the quantitative techniques for modeling and planning in domains with uncertainty. Overcoming this dualism, for example, by defining common benchmarks and plan-quality measures to allow for a comparison of the two approaches, has been recognized as one of the hot issues in the field of planning under uncertainty and with incomplete information.

"Workshop on PDDL" was organized by Derek Long (University of Durham), Drew McDermott (Yale University), and Sylvie Thiebaux (Australia National University). PDDL was originally developed by McDermott and the committee of the first planning competition and is now the de facto standard language for describing planning domains. The workshop enjoyed many lively discussions, several of which were about the stewardship of PDDL: how can the future development of PDDL be best managed and how can we influence the roles it plays. A question was posed about the extent to which PDDL should be seen as directly tied to the competition series. Another question was about the role of PDDL, ranging from modeling language to the low-level machine language of planners. There was even a strongly debated question about whether there were good reasons to agree on a standard language at this stage. Other key issues under debate were about the pressing extensions for PDDL and some technical issues about PDDL semantics.

"Plan Execution" was organized by Alex Coddington. The discussions that took place in the workshop focused on two themes: (1) how to evaluate systems that both plan and execute—what evaluation metrics can be used to measure the success of an agent that plans and executes in environments that might be dynamic and unpredictable, where execution errors might arise, and how the International Planning Competition can be extended to include systems that plan and execute—and (2) domain-independent or domain-specific plan-execution architectures—which of these two approaches is the most effective and how much commonality there is between executives in different domains and whether it is enough to build an effective domain-independent executive.

"Planning for Web Services" was organized by Jose Luis Ambite (USC Information Sciences Institute), Craig Knoblock (University of Southern California), Sheila McIlraith (Stanford University), Mike P. Papazoglou (Tilburg University), Biplav Srivastava (IBM India Research Labs), and Paolo Traverso (ITC-irst). The issues raised and discussed in this workshop were mainly related to the role of planning for web services. In particular, the trade-offs between online, dynamic web service composition and off-line web service composition were analyzed. Although it was recognized that planning can play an important role for the online dynamic web service composition, the challenge is to make it practically usable for applications.



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The four tutorials were (1) "Timed Automata for Planning and Scheduling," given by Oded Maler (Verimag); (2) "Resource-Bounded and Time Critical Reasoning," given by Lloyd Greenwald (Drexel University) and Shlomo Zilberstein (University of Massachusetts at Amherst); (3) "Practical Approaches to Handling Uncertainty in Planning and Scheduling," given by Christopher Beck (University College Cork) and Thierry Vidal (LGP/ENIT); and (4) "Model Checking—A Hands-On Introduction," given by Alessandro Cimatti (ITC-irst), Pistore, and Marco Roveri (ITC-irst). All four tutorials had good attendance and involved lively discussions.

The conference had 180 participants, and we were pleased that more than 60 of them were students. We believe that the reasons for such a wide participation from students included the Doctoral Consortium (in which 34 students participated) and the colocation with the International Summer School on AI Planning, held on 14 to 20 June. The conference proceedings are available from AAAI Press.

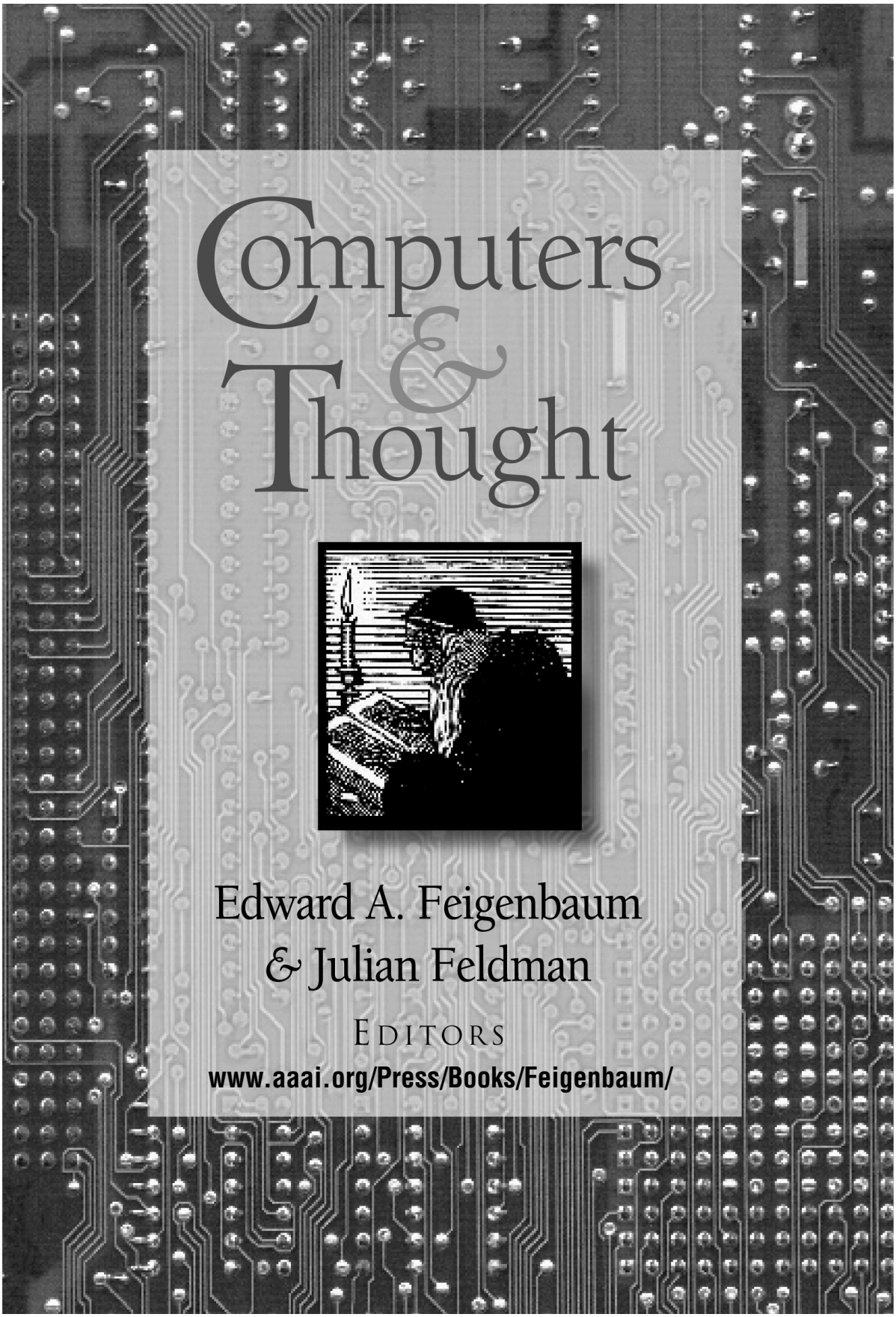
We want to acknowledge the many contributors who provided support for ICAPS. Among them, we would like to mention the European Network of Excellence in AI Planning (PLANET) and the National Aeronautics and Space Administration (NASA) for their generous contribution to the Doctoral Consortium.

The next ICAPS conference will be held on 3 to 7 June 2004, in Whistler, British Columbia, Canada. The chairs will be Shlomo Zilberstein (University of Massachusetts at Amherst), Sven Koenig (Georgia Institute of Technology), and Jana Koehler (IBM, Zurich, Switzerland).

Enrico Giunchiglia is an associate professor in the Department of Communication, Computer, and System Sciences at the University of Genova. He received a laurea degree (1989) and a Ph.D. in computer engineering (1992) from the University of Genova. His main interests are in the area of knowledge representation, planning, formal verification, and automated reasoning.

Nicola Muscettola is the principal scientist for autonomy at the Computational Sciences Division of NASA Ames Research Center. Muscettola received all his degrees from the Politecnico di Milano, Milano, Italy. He was the architect and project lead for the Planner/Scheduler module of the *Deep Space 1 Remote Agent* that flew in May 1999. He is the architect of the intelligent distributed execution architecture (IDEA), a re-engineering and rationalization of the remote agent architecture, extending it to multi-agent system with real-time guarantees. In 2003, Muscettola received the NASA Exceptional Service Medal for being one of the principal technologists for the remote agent.

Dana Nau (nau@cs.umd.edu) is a professor at the University of Maryland in the Department of Computer Science and the Institute for Systems Research. His research interests include AI planning and searching, and computer-integrated design and manufacturing. He received his Ph.D. from Duke University in 1979, where he was an NSF graduate fellow. He has more than 250 technical publications; (see www.cs.umd.edu/users/nau for a list). He has received the NSF Presidential Young Investigator award, an Outstanding Faculty award, several "best paper'" awards, and several awards for the performance of his AI planning and game-playing programs in international competitions. He is a fellow of AAAI.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