The Fourth International Conference on Artificial Intelligence Planning Systems

June 7-10

Carnegie Mellon University

Pittsburgh, Pennsylvania, USA

http://www.cs.cmu.edu/~aips98/

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Manuela Veloso, Carnegie Mellon University
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Workshops Chair: Steve Chien, Jet Propulsion Laboratory

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Artificial Intelligence Planning Systems

Planning and scheduling problems pervade our lives — from manufacturing and processing, to military logistics, space missions, robotics, information retrieval, etc. The goal of the AIPS '98 conference is to bring together AI researchers in planning and scheduling who are making fundamental contributions to the theoretical frameworks and the practical applications that propel this field forward.

The conference will feature single-track presentation of 27 high-quality papers, selected by rigorous peer review. In addition, three renowned speakers will provide their perspectives on important areas relevant to planning. For the first time this year, AIPS will include a set of one-day workshops, to be held the day before the technical conference, and a planning systems competition, to demonstrate competing approaches to planning.

AIPS continues as the premier conference for showcasing new results in this expanding and challenging field. We invite you to join us and share that excitement at Carnegie Mellon, for the Fourth International Conference on Artificial Intelligence Planning Systems, June 7-10, 1998.

James Allen
Conference Chair
AIPS '98

Reid Simmons
Manuela Veloso
Stephen Smith
Program Chairs
AIPS '98

Workshops

W1: Planning as Combinatorial Search: Propositional, Graph-Based, and Disjunctive Planning Methods

Organizers: Henry Kautz (AT&T Labs), Avrim Blum, (Carnegie Mellon University), Subbarao Kambhampati (Arizona State University), Bart Selman (Cornell University)

Recently very efficient planning systems have been built around local search, graph search, A* search, dynamic programming, integer programming, and other general combinatorial search techniques. This workshop will examine the common threads that link these different efforts and look for new ways that mature combinatorial algorithms from different areas of computer science can be fruitfully applied to AI planning systems.

The workshop will include panels, invited talks, discussions, and a few short paper presentations. We will identify several major common themes for panels and discussions based on the research statements from participants. Some of the issues we will discuss include:

- Trade-offs in translations of planning problems into other formalisms, such as propositional satisfiability or integer programming
- Unifying frameworks, such as disjunctive planning
- Comparisons of general search engines and specialized planning systems; Cross-disciplinary benchmark test-beds
- The role of heuristic and domain-specific knowledge when the "planner" is a general combinatorial search engine
- The relationship between model-based planning and diagnosis and general combinatorial algorithms

For more information: http://www.research.att.com/~kautz/aips98ws/

W2: Integrating Planning, Scheduling and Execution in Dynamic and Uncertain Environments

Organizers: Ralph Bergmann (University of Kaiserslautern), Alexander Kott, (Carnegie Group, Inc.)

Integration of planning, scheduling and execution is an increasingly important area of research. We are starting to see the deployment of planning/scheduling systems, robotic and software agents in domains such as manufacturing, information retrieval, transportation, military operations, and space explorations. They all function in dynamic, uncertain, and incompletely known environments.

Such environments pose a number of challenges to planning/execution systems. They must interleave planning, scheduling, and execution, and must do so in a way that takes account of the passing time. They must form plans and schedules that are robust with respect to changes that can be anticipated as likely to occur. And they must be able to modify previously formed plans and schedules, in compliance with the most recent available information, attempting minimum disruption of earlier plans and still aiming for the most effective possible use of resources and achievement of goals.

This workshop will explore these problems in depth by bringing together different researchers from related areas. Workshop topics will include:

- Rigorous formulations of the planning/scheduling/execution problems in dynamic and uncertain environments
- Ontologies and representations
- Models, algorithms, and architectures for planning/scheduling in dynamic and uncertain environments
- Learning issues
- Real-world applications and implemented systems

Co-organizers are Daniel Borrajo, James Hendler, Craig Knoblock, Hector Munoz-Avila, David J. Musliner, Martha E. Pollack, Manuela Veloso and Frank Weberskirch.

For more information:
http://wwwagr.informatik.uni-kl.de/~bergmann/AIPS98WS/

W3: Knowledge Engineering and Acquisition for Planning: Bridging Theory and Practice

Organizers: Leliane Nunes de Barros (LSI, University of Sao Paulo), Richard Benjamins, (University of Amsterdam, The Netherlands), Yuval Shahar (Stanford University), Austin Tate (AIAI, University of Edinburgh), Andre Valente (Information Science Institute)

Many planning techniques and algorithms exist. However, for someone who wants to engineer a practical planning system for a particular domain, it is not that straightforward to select which technique or algorithm to use. If we want sophisticated planning research to find its way into the real world, we have to provide concrete support for engineers of planning systems to bridge the gap between theory and practice.

Such support can take the form of guidelines for relating planning techniques to particular domains, reusable libraries of plan domain descriptions, plan/process editors, knowledge acquisition tools to analyze and model planning problems, tools to configure planners from reusable planning components, etc. This workshop will address the area of providing support for building practical planning systems. The workshop format will consist of paper presentations, discussion, and demonstrations of software tools for knowledge acquisition and engineering. Topics to be addressed include:

- Analysis of knowledge used in planning (domain knowledge, problem-solving knowledge)
- Ontologies and schemas of plans and planning processes, and their use in knowledge acquisition and engineering
- The use of reusable and modular planning components
- Case studies reporting on the knowledge engineering and acquisition process of constructing planners for concrete applications
- Knowledge acquisition tools for planning (including software demos)

For more information: http://www.iiia.csic.es/~richard/aips.html

W4: Interactive and Collaborative Planning

Organizers: George Ferguson (University of Rochester), Karen Myers (SRI International), Stephen Smith (Carnegie Mellon University)

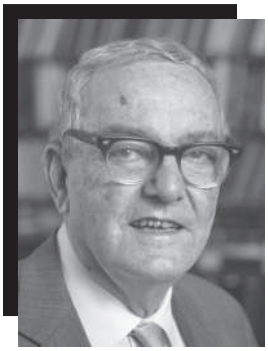
Planning has long been a key problem for AI research. Recent technological developments are making it possible to build planning systems in realistic domains that can solve hard problems quickly. Nonetheless, there seems to be a clear need to integrate these automated systems with the abilities of human planners and decision-makers. There will always be problems that are too hard for the automated planners to solve, or for which it is too difficult for the human users to formulate their requirements precisely enough for the automated systems to use effectively. Even in planning systems with more autonomy, issues of tasking, authority and reporting require that these systems interact with humans at some point.

Thus, having the human "in the loop" is both a practical necessity and an intellectual opportunity. The ultimate goal of interactive and collaborative planning systems is for humans and computers working together to be able to solve harder problems than either could solve alone. This workshop will bring together researchers from Computer Science and related fields to discuss the foundations, trends, and future prospects for building planning systems that interact and collaborate with people. Topics to be addressed include:

- Mixed-initiative planning
- Incremental planning
- Plan visualization
- Architectures for interactive planning systems
- Collaborative environments and mechanisms
- Automated support for groups of human decision makers
- Use of plan explanation and plan recognition in collaborative systems

For more information: http://www.cs.rochester.edu/u/ferguson/aips98/

Invited Speakers



HERBERT A. SIMON: Insights into Human Problem Solving and AI Planning

Herbert A. Simon's research has ranged from computer science to psychology, administration, and economics. The thread of continuity through all his work has been his interest in human decision-making and problem solving processes, and the implications of these processes for social institutions. In the past 25 years, he has made extensive use of the computer as a tool for both simulating human thinking and augmenting it with artificial intelligence.

Born in 1916 in Milwaukee, Wisconsin, Simon was educated in political science at the University of Chicago (B.A., 1936, Ph.D., 1943). He has held research and faculty positions at the University of California (Berkeley), Illinois Institute of Technology, and since 1949, Carnegie Mellon University, where he is Richard King Mellon University Professor of Computer Science and Psychology. In 1978, he received the Alfred Nobel Memorial Prize in Economic Sciences, and in 1986 the National Medal of Science.

Simon's writings include *Administrative Behavior, Human Problem Solving*, jointly with Allen Newell, *The Sciences of the Artificial, Scientific Discovery,* with Pat Langley, Gary Bradshaw, and Jan Zytkow, and *Models of My Life* (autobiography).

MICHAEL P. GEORGEFF: Planning Revisited: Uncertainty, Change and Limited Resources

Michael P. Georgeff is the Director of the Australian Artificial Intelligence Institute (AAII), one of Australia's foremost research and development organizations for advanced information technology. He is also a Professorial Associate at the University of Melbourne. Dr. Georgeff was previously a Program Director of the Artificial Intelligence Center at SRI International. He was also a member of Stanford University's Center for the Study of Language and Information, a select group of philosophers, computer scientists, and linguistics whose aim is to explore the frontiers of human and machine cognition.

Dr. Georgeff has a B.Sc. in Physics and Mathematics from Melbourne University, Australia, a B.E. in Aeronautical Engineering from Sydney University, and a Ph.D. from Imperial College, London. His major interests are in the design of software systems suited to uncertain, dynamic environments, distributed real-time systems, planning and simulation, and the philosophy and theory of rational computational "agents." He has published over 80 major articles, books, and book chapters in these areas.

Dr. Georgeff currently serves as President of the Board of the International Joint Conference on Artificial Intelligence, and was chair of IJCAI 1997. He is a Fellow of the American Association for Artificial Intelligence, a Fellow of the Australian Computer Society, a member of the Association for Computing Machinery, and a member of the New York Academy of Sciences.

CRAIG BOUTILIER: Stochastic Sequential Decision Problems: What AI Has to Offer

Craig Boutilier is an Associate Professor of Computer Science at the University of British Columbia and a member of the Laboratory for Computational Intelligence. He received his Ph.D. in 1992 from the University of Toronto. His research interests are in planning and sequential decision making, Markov decision processes and reinforcement learning, probabilistic reasoning, multiagent systems, and knowledge representation schemes for actions and preferences. He is an Associate Editor of the International Journal of Artificial Intelligence Research. He is currently on sabbatical leave at the University of Toronto, supported by an Izaak Walton Killam Research Fellowship.

Planning Competition

For the first time, AIPS will host a planning systems competition. The goal is to foster development of state-of-the-art planning systems and to encourage the comparison of competing approaches to planning. The competition will be comprised of three tracks: The first two focus on general approaches to operator-based planning for different operator languages. Planners will be evaluated based on how many problems are solved, how quickly the plans are produced, and the length of the resulting plans. The third track focuses on planners for solving problems in a transportation planning domain. The list of current participants is available off the conference web page: http://www.cs.cmu.edu/~aips98/. For more information, contact Drew McDermott (mcdermott@cs.yale.edu).

Preliminary Schedule of Events

Sunday, June 7

8:00-9:00 AM Breakfast and Registration

9:00-10:15 Workshops

10:15-10:30 Break

10:30-12:00 Workshops

12:00-1:30 Lunch

1:30-3:15 Workshops

3:15-3:30 Break

3:30-5:00 Workshops

Monday, June 8

8:00-8:45 Breakfast and Registration

8:45-9:00 Welcome

9:00-10:00 Invited Speaker: **Herbert Simon** - Insights into Human Problem Solving and AI Planning

10:00-10:20 Break

10:20 - 12:00 Session: Robotics and Agents

Sven Koenig, Reid Simmons, "Solving Robot Navigation Problems with Initial Pose Uncertainty Using Real-time Heuristic Search"

David Wilkins, Karen Myers, "A Multiagent Planning Architecture"

Michael Beetz, Henrik Grosskreutz, "Causal Models of Mobile Service Robot Behavior"

Manuela Veloso, Martha Pollack, Michael Cox, "Rationale-Based Monitoring for Planning in Dynamic Environments"

12:00-1:30 Lunch

1:30 - 2:45 Session: Classical Algorithms

Alessandro Cimatti, Marco Roveri, Paolo Traverso, "Strong Planning in Non-Deterministic Domains via Model Checking"

Corin Anderson, David Smith, Daniel Weld, "Conditional Effects in Graphplan"

Fahiem Bacchus, Yee Whye Teh, "Making Forward Chaining Relevant"

2:45-3:15 Break

3:15 -4:30 Session: Satplan + Logic

Henry Kautz, Bart Selman, "The Role of Domain-Specific Knowledge in the Planning as Satisfiability Framework"

Amol Mali and Subbarao Kambhampati, "Encoding HTN Planning in Propositional Logic"

Erica Melis, "The 'Limit' Domain"

4:30-5:30 Panel: **Workshop Summaries**

6:00-8:00 Reception

Preliminary Schedule of Events

Tuesday, June 9

8:00-9:00 Breakfast

9:00-10:00 Invited Speaker: **Craig Boutilier -** Stochastic Sequential Decision Problems: What AI Has to Offer

10-10:20 Break

10:20 - 12:00 Session: Decision-Theoretic Planning

Stephen Majercik and Michael Littman, "MAXPLAN: A New Approach to Probabilistic Planning"

Richard Goodwin, Reid Simmons, "Search Control of Plan Generation in Decision-Theoretic Planners"

Thomas Dean, Kee-Eung Kim, Robert Givan, "Solving Planning Problems with Large State and Action Spaces"

Liem Ngo, Peter Haddawy, Hien Nguyen, "A Modular Structured Approach to Conditional Decision-Theoretic Planning"

12:00-1:30 Lunch

1:30 - 2:45 Session: Learning

Karen Haigh and Manuela Veloso, "Planning, Execution and Learning in a Robotic Agent"

Eugene Fink, "How to Solve it Automatically: Selection Among Problem Solving Methods"

Ricardo Aler, Daniel Borrajo, Pedro Isasi, "Genetic Programming of Control Knowledge for Planning"

2:45-3:00 Break

3:00- 4:15 Session: Scheduling

Carla Gomes, Bart Selman, Ken McAloon, Carol Tretkoff, "Randomization in Backtrack Search: Exploiting Heavy-Tailed Profiles for Solving Hard Scheduling Problems"

Amedeo Cesta, Angelo Oddi, Stephen Smith, "Profile Based Algorithms to Solve Multiple Capacitated Metric Scheduling Problems"

Lloyd Greenwald, Thomas Dean, "A Conditional Scheduling Approach to Designing Real-Time Systems"

4:30-6:00 Planning Systems Competition

7:00-10:00 River Cruise Banquet

Wednesday, June 10

8:00-9:00 Breakfast

9:00-10:00 Invited Speaker: **Michael Georgeff -** Planning Revisited: Uncertainty, Change and Limited Resources

10:00-10:20 Break

10:20 - 12:00 Session: Applications

Jose Ambite and Craig Knoblock, "Flexible and Scalable Query Planning in Distributed and Heterogeneous Environments"

Silvia Miksch, Robert Kosara, Yuval Shahar, Peter Johnson, "AsbruView: Visualization of Time-Oriented, Skeletal Plans"

Javier Contreras, Matthias Klusch, Jerome Yen, "Multi-Agent Coalition Formation in Power Transmission Planning"

Austin Tate, Jeff Dalton, John Levine, "Generation of Multiple Qualitatively Different Plan Options"

12:00-1:30 Lunch

1:30 - 2:45 Session: Classical Algorithms

Jana Koehler, "Solving Complex Planning Tasks Through Extraction of Subproblems"

Keith Golden, "Leap Before You Look: Information Gathering in the PUCCINI Planner"

Eugene Fink and Jim Blythe, "A Complete Bidirectional Planner"

2:45-3:45 Panel (TBA)

3:45 Conference Ends

Air Transportation

The Pittsburgh International Airport is a USAirways hub, and is also served by Delta, Northwest, Continental, United, American and British Airways. The airport is located approximately 21 miles from Oakland/CMU. USAirways is offering AIPS '98 participants a 10% discounted fare for First or Business Class reservations, and a 5% discount for unrestricted coach fares. An additional 5% discount is available with either reservation when tickets are purchased 60+ days in advance. Valid reservation dates are June 4 to 13, 1998. Please mention Gold File Reference number 39130555 when making reservations.

Ground Transportation Options

1. Port Authority Transportation (public buses) - (412-442-2000). PAT's Airport Flyer (28X Bus) travels between the airport and Oakland. The Oakland stop is at South Bellefield Avenue, a short walk to the Holiday Inn and Pittsburgh Athletic Associaton. Service on the 28X Airport Flyer is from 5:30 a.m. to 12:30 a.m. daily, at 45 minute intervals. The trip takes 45-60 minutes and costs $1.95 per person (no change given). Boarding is at the lower level at the ground transportation bus stop.

2. Airlines Transportation Co. - (412-471-8900). Purchase ticket from attendant at their location in the baggage claim area of the airport. The cost is $12.50 per person one way, or $21 round trip. The bus departs the baggage claim area on the hour from 9 a.m. to 10 p.m. weekdays. The Oakland stop is the Holiday Inn.

3. Yellow Cab Service - approximately $33 per trip, plus gratuity (in the United States, 10-15% is suggested). Follow ground transportation signs in the airport. Cabs are always waiting and available.

4. First Class Limousine Service - (412-462-8000). $37.95 per trip (includes gratuity). Call several days in advance and give them your flight arrival information. They will have a driver waiting for you in the terminal's "arriving passengers" area.

All prices are accurate as of January, 1998.

Accommodations

Special rates are available for AIPS '98 conference participants if reservations are secured by the deadlines stated. For other reservation options, see http://www.travelbase.com

Lodging

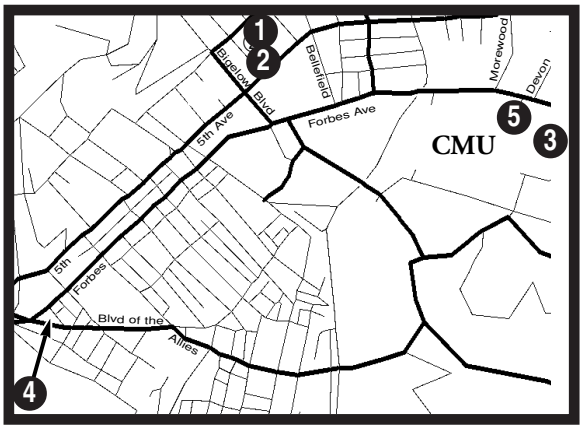
1 Holiday Inn Select University Center
100 Lytton Avenue
Pittsburgh, PA 15213
(412) 682-6200
AIPS '98 Rate $103 + 14% tax
Parking $12/night
Reservation Deadline: May 18, 1998
free local shuttle to CMU

2 Pittsburgh Athletic Association
4215 Fifth Avenue
Pittsburgh, PA 15213
(412) 621-2400
CMU Rates $70/single, $90 suites
Parking $6/night
Reservations upon availability
free local shuttle to CMU

3 CMU Dormitory Housing
Resnik Hall West Wing (new facilities)
(412) 268-2139
AIPS '98 Rate-Single: $157.50/week, $31.50/night
Double: $118/week, $23.50/night (per person).

4 Hampton Inn
Forbes & Craft Avenues
Pittsburgh, PA 15213
(412) 681-1000
CMU Rate $75/night, free parking
free airport & local shuttle

Area Map



5 CMU University Center, Conference Venue

Conference Registration Form

Name:_____

Affiliation:_____

Address: _____

_____

City, State, Zip Code:_____

Country: _____

Phone:_____

E-mail: _____ Fax: _____

Campus Housing

Campus housing will be provided in the new Resnik Hall West Wing. All rooms are air conditioned and are shared accommodations with 2 doubles, 1 single, 1 bath per unit. Linen service is included. Private units can be reserved for couples/families. *Payment is due in full with your reservation.* **DEADLINE FOR RESERVATIONS (INCLUDING PAYMENT) IS MAY 1.**

Arrival Date/Time:_____

Departure Date/Time:_____

_____ Male _____ Female _____ Non-Smoking _____ Special Accommodations

_____ Single

_____ Double If sharing, please provide roommate's name: _____

The River Cruise Banquet on Tuesday, June 9 is included with the registration fee.

_____ Yes, I will be attending the banquet and will need transportation.

_____ Yes, I will be attending the banquet, but will NOT need transportation.

_____ No, I am not able to attend the River Cruise Banquet. (Sorry, no refund available)

Please reserve _____ additional banquet tickets at a cost of $40/ticket.

Continued on the next page.

Workshops will be organized in 4 parallel tracks. Please select only one track:

_____ W1-Workshop on Planning as Combinatorial Search: Propositional Graph-Based, and Disjunctive Planning Methods

_____ W2-Workshop on Integrating Planning, Scheduling and Execution in Dynamic and Uncertain Environments

_____ W3-Workshop on Knowledge Engineering and Acquisition for Planning: Bridging Theory and Practice

_____ W4-Workshop on Interactive and Collaborative Planning

	Early Registration (by May 8, 1998)	**Late Registration** (after May 8, 1998)	
Conference Only:	**$225**	**$275**	_____
Student:	**$125**	**$150**	_____
Workshop Only:	**$100**	**$125**	_____
Student:	**$ 50**	**$ 75**	_____
Workshop & Conference:	**$275**	**$325**	_____
Student:	**$150**	**$175**	_____
Campus Housing: _____ Nights at _____ ($31.50 Single, $23.50 Double)			_____
Additional Banquet Tickets _____ at $40/ticket			_____
University Parking Pass _____ Days at $5/day:			_____
TOTAL Payment Due:			**$** **=======**

Method of Payment: Check (made payable to CMU) Visa MasterCard

Name as it appears on credit card: _____

Card No: _____ Exp. Date: _____

Cardholder's Signature: _____

Mail with payment to: AIPS '98, Computer Science Dept., Carnegie Mellon University, 5000 Forbes Ave., Pittsburgh, PA 15213-3891. Fax with credit card payment to (412) 268-5576. Inquiries to: jean@cs.cmu.edu, or call (412) 268-3802.

AIPS ’98 logo created by Rachael Nass
Brochure and poster designed by Debra Zuzindlak

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