AAAI 96

Thirteenth National Conference on Artificial Intelligence

IAAI 96

Eighth Conference on Innovative Applications of Artificial Intelligence

KDD 96

Second International Conference on Knowledge Discovery and Data Mining

August 2-8, 1996 • Portland, Oregon

Registration Brochure

Conferences Are Sponsored by the American Association for Artificial Intelligence

AAAI–96: A Preview

- Three days of technical paper presentations by top scientists in the field
- An opening keynote address by Tom Mitchell of Carnegie Mellon University
- An exciting series of invited talks on topics ranging from core AI to operations research, neuroscience, linguistics and anthropology
- The AAAI Presidential Address by Professor Randall Davis of Massachusetts Institute of Technology
- A new continuing education program, The Tutorial Forum, where one ticket allows attendance at two days of courses on the latest developments in the hottest subareas of AI
- AAAI–96 / IAAI–96 Joint Exhibition
- AAAI–96 Mobile Robot Exhibition and Competition
- Student Abstract and Poster Program, and associated SIGART/AAAI Doctoral Consortium program
- Workshops (by invitation only)

Each year, the National Conference on Artificial Intelligence provides a unique opportunity for timely interaction and communication among researchers and practitioners from all areas of AI. This year the program committee continued the policy established two years ago to broaden participation at the conference. Once again, the community has responded enthusiastically, submitting over 640 papers. Each paper was reviewed by three reviewers under the supervision of one of twenty-eight senior members of the AI community who supervised broad areas of research. The evaluation criteria recognized a wide range of scientific contributions. Reviewers and senior program committee members were asked to view themselves not as "gatekeepers" looking for reasons to reject papers, but rather as "scouts" looking for interesting papers to accept. Of the 643 papers originally submitted, 5 were withdrawn by their authors, 441 were rejected, and 197 were accepted.

Keeping one's eye on the "AI prize" requires weaving together a broad set of computational disciplines. To this end we invite you to set aside your research for a weekend and plunge into a unique educational adventure. The Tutorial Forum provides an opportunity for researchers to spend two days each year freely exploring exciting advances in disciplines outside their normal focus. We believe this type of forum is essential for the cross fertilization, cohesiveness, and vitality of the AI field. We all have a lot to learn from each other; the Tutorial Forum promotes the continuing education of each member of the AAAI.

The Tutorial Forum structure differs from past tutorial programs in three important ways: first, we've taken down the boundaries between tutorials, with admission allowing participation in up to four (4) consecutive tutorials during the two days. Second, simple arithmetic will show that the per tutorial cost is significantly reduced. Finally, we have invited a wide variety of high-quality, advanced tutorials taught by leading members of the field, on hot topics within and outside of AI. Your active participation is essential to making this educational forum a growing success!

AAAI–96 will also have several other exciting programs. The popular Student Abstract and Poster Program will provide an ideal opportunity for students to present and discuss their work during its early stages, meet some of their peers who have related interests, and introduce themselves to more senior members of the field. The program is open to all pre-PhD students and has in the past drawn over a 100 submissions. It presents a wonderful opportunity for all of us to get acquainted with some of the up-and-coming talent and their new research ideas.

In addition, this year the Student Abstract and Poster Program will be run in cooperation with the SIGART/AAAI Doctoral Consortium program. This will be a small, focused gathering that allows selected students to present their work to a faculty panel. All participants in the Abstract and Poster Program are invited to attend the panel discussions as well.

Recognizing that invited speakers provide a special opportunity to bring people into our community, as well as to highlight important new directions, we have brought a few speakers to the meeting who are engaged in AI-related work, but haven't published before at our meeting. Each of these speakers brings a provocative, fresh perspective to computational aspects of cognition.

In sum, the AI community continued the goal this year of revitalizing the AAAI conference, enhancing its atmosphere of excitement, innovation, controversy, and intellectual engagement. So far, the community and conference committee have made great strides toward achieving that goal. The remaining essential element? *You!* Please join us at AAAI–96.

– Dan Weld and Bill Clancey
Program Cochairs, AAAI–96

AAAI–96 Program Cochairs

William J. Clancey,
Institute for Research on Learning
Dan Weld, *University of Washington*

Associate Chair

Ramesh Patil, *University of Southern California/Information Sciences Institute*

Robot Competition Chair

David Kortenkamp,
NASA Johnson Space Center

Student Abstract and Poster Chair

Maja Mataric *Brandeis University*

Tutorial Chair

Brian C. Williams,
NASA Ames Research Center

Workshop Chair

Subbarao Kamphampati,
Arizona State University

Volunteer Coordinator

Thomas G. Dietterich,
Oregon State University

SIGART/AAAI–96 Doctoral Consortium Organizers

Vibhu O. Mittal,
University of Pittsburgh
Loren G. Terveen,
AT&T Research

Keynote Address:
What Have We Learned about Learning?

Tom Mitchell, *Carnegie Mellon University*

9:00 AM, Tuesday, August 6

The past decade has produced real progress toward understanding how to make machines learn. In ten years we have gone from algorithms that were laboratory curiosities to robust methods with significant commercial value. Machine learning algorithms now learn to control vehicles to drive autonomously on public highways at 70 mph, learn to detect credit card fraud by mining data on past transactions, and learn your reading interests in order to assemble a personally customized electronic newspaper. At the same time, new theoretical results shed light on fundamental issues such as the tradeoff among the number of training examples available, the number of hypotheses considered, and the likely accuracy of the learned hypothesis. And work on integrated learning architectures is beginning to explore issues such as long-term learning of new representations, cumulative learning, and learning to learn.

Where is all this headed? This talk will examine recent progress and open questions in machine learning, suggest some PhD dissertation topics that we should begin on now, and give one person's view on where machine learning might be headed over the next decade.

Tom Mitchell is professor of computer science and robotics at Carnegie Mellon University. He earned his BS degree from the Massachusetts Institute of Technology (1973), and his PhD degree from Stanford University (1979). In 1983 he received the IJCAI Computers and Thought award in recognition of his research in machine learning, and has been a Fellow of the American Association for Artificial Intelligence since 1990. In 1995 he helped found Schenley Park Research, Inc. which pursues commercial applications of data mining and machine learning, and he has recently completed a comprehensive textbook: *Machine Learning* (New York: McGraw Hill, 1996).

Mitchell's current research focuses on new algorithms that combine prior knowledge with observed data to improve learning accuracy, on algorithms for learning over multimedia data, and applications of machine learning to web-based agents, robotics, and data-mining. But his real goal is to apply it to wind surfing.

AAAI Presidential Address

Randall Davis,
Massachusetts Institute of Technology

9:00 AM, Wednesday, August 7

Randall Davis received his undergraduate degree from Dartmouth, graduating summa cum laude, Phi Beta Kappa in 1970, and received a PhD from Stanford in artificial intelligence in 1976. In 1978 he joined the faculty at the Massachusetts Institute of Technology, where from 1979 – 1981 he held an Esther and Harold Edgerton Endowed Chair. He is currently a Professor in the Electrical Engineering and Computer Science Department, as well as Associate Director of the Artificial Intelligence Laboratory. His research focuses on model-based reasoning and engineering problem solving, building programs that work from descriptions of structure and behavior, on a range of problems in design, diagnosis, and repair.

Davis has been one of the seminal contributors to the field of knowledge-based systems, publishing some 40 articles and playing a central role in the development of several systems. He serves on several editorial boards, including *Artificial Intelligence, AI in Engineering,* and The MIT Press series in AI. He is the coauthor of *Knowledge-Based Systems in AI,* and was selected in 1984 as one of America's top 100 scientists under the age of 40 by *Science Digest.* In 1986 he received the "AI Award" from the Boston Computer Society for his contributions to the field. In 1990 he was named a Founding Fellow of the American Association for Artificial Intelligence.

Davis has also been active in the area of intellectual property and software. In 1990 he served as a panelist in a series of workshops on the issue run by the Computer Science and Telecommunications Board of the National Academy of Science, resulting in the publication of *Intellectual Property Issues in Software* in 1991. He later served as a member of the Advisory Board to the US Congressional Office of Technology Assessment study on software and intellectual property, published in 1992 as *Finding a Balance: Computer Software, Intellectual Property, and the Challenge of Technological Change.* In 1990 he served as expert to the Court (Eastern District of NY) in Computer Associates vs. Altai, a software copyright infringement case whose decision resulted in a significant change in the way software copyright is viewed by the courts. He is on the Board of the Massachusetts Software Council and serves as head of its intellectual property subcommittee.


Complete and up-to-date information on the AAAI–96, IAAI–96, and KDD–96 conferences can be found on the world wide web at
http://www.aaai.org/Conferences/conferences.html

Robot Competition Summary

R. Peter Bonasso,
NASA Johnson Space Center

Thomas L. Dean,
Brown University
1:30 PM, Thursday, August 8

Moving Up the Information Food Chain: The MetaCrawler, Internet Softbot, & Web Shopbot

Oren Etzioni,
University of Washington
1:30 PM, Wednesday, August 7
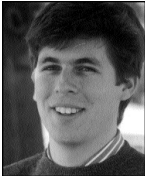
This talk will describe several *softbots*—moderately intelligent agents that use software tools on a person's behalf. A softbot enables a person to state *what* he or she wants. The softbot determines *how* and *where* to satisfy the request.

Brain Dynamics in the Genesis of Trust as the Basis for Communication by Representations

Walter J. Freeman,
University of California, Berkeley
1:30 PM, Tuesday, August 6

A theory of brain dynamics is proposed according to which brains construct representation by actions into the world for communication. The brain patterns constitute meanings, not representations of meanings. Representations have no meaning. They are shaped by meaning in transmitting brains and elicit meaning in receiving brains, if trust has been established.

Representing and Reasoning About Uncertainty

Joseph Y. Halpern,
*IBM Almaden Research Center*
11:20 AM, Tuesday, August 6

In order to reason about uncertainty, we need to have the tools to represent it well. I will discuss one general framework, that incorporates knowledge, time, and probability. This powerful representation tool will be shown to give insight into a wide range of problems, from coordination to knowledge base queries to puzzles like the Monty Hall puzzle.

The Cultural Context of Cognition and Computation

Edwin Hutchins,
University of California, San Diego
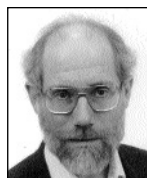8:30 AM, Thursday, August 8
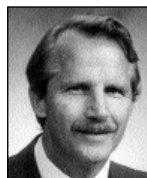
Where does human intelligence reside? Traditionally we have located it within individual human minds. An examination of a culturally-supported, socially-distributed computational system shows that human intelligence involves processes that transcend the boundaries of the individual. Symbolic AI successfully models this distributed intelligence, but may be ill-suited for the problem of modeling individual minds.

Experimental Analysis of Algorithms: The Good, the Bad, and the Ugly

David S. Johnson, *AT&T Research*
3:30 PM, Thursday, August 8

Implementation and experimentation have long been an important part of computer science, but based on the literature it would seem that there is little common agreement on what constitutes *good* experimental research. This talk will propose some guiding principles, illustrating them (both positively and negatively) with examples from the AI and optimization literature.

Refinement Planning: Status and Prospectus

Subbarao Kambhampati,
Arizona State University
3:30 PM, Wednesday, August 7
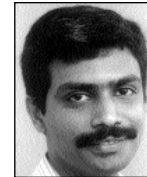
Most current-day AI planning systems operate by iteratively refining a partial plan until it meets the goal requirements. In the past five years, significant progress has been made in our understanding of the spectrum and capabilities of such refinement planners. In this talk, I will summarize our understanding in terms of a unified framework for refinement planning and discuss several current research directions.

Boosting Theory Towards Practice: Recent Developments in the Weak Learning Framework

Michael Kearns,
AT&T Bell Laboratories
4:20 PM, Wednesday, August 7

In the theoretical machine learning framework known as *weak learning* (also called *boosting*), we require that a learning algorithm amplify slight predictive advantages over random guessing into arbitrarily accurate hypotheses. This framework has recently led to several results of interest to machine learning experimentalists, including a proof that top-down decision tree learning algorithms such as C4.5 and CART are in fact boosting algorithms, and the introduction of a new learning algorithm whose empirical performance appears at least competitive with the standard heuristics. In this talk, I will survey these developments, and argue that the weak learning framework may provide fertile ground for interaction between experiment and theory on the topic of practical learning algorithm design and analysis — a topic that has been notoriously elusive for many standard learning models.

The Embodied Mind

George Lakoff,
University of California, Berkeley
10:30 AM, Wednesday, August 7

No Hands Across America—A Chronicle of Recent Progress in Intelligent Vehicles

Dean Pomerleau,
Carnegie Mellon University
2:20 PM, Thursday, August 8

This talk will focus on progress towards self driving cars, with particular emphasis on a new adaptive vision system for autonomous steering, called RALPH (Rapidly Adapting Lateral Position Handler). On a recent trip,

AAAI–96 Invited Panel

Challenge Problems of AI

Bart Selman, Moderator

AT&T Bell Laboratories,

10:30 AM, Thursday, August 8

RALPH was able to drive CMU's testbed vehicle 98.2% of the 2850 miles from Washington, DC to San Diego, CA.

Real-Time Human Gesture Interpretation

Michael Swain,
University of Chicago
2:20 PM, Wednesday, August 7

It is now possible to build computer vision systems that, in real time, watch people and interpret their gestures. The applications for such a system are numerous; I will show how our system, Perseus, is used for human-robot interaction. Perseus is tightly integrated with reactive execution and natural language understanding systems.
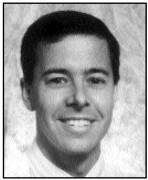
Portland Skyline.
(Photo courtesy Portland Oregon Visitors Association.)

Database Theory and Information Integration

Jeffrey D. Ullman,
Stanford University

10:30 AM, Tuesday, August 6

Several ideas from database theory are beginning to have some impact on problems of integrating information. The theory of conjunctive queries has been extended significantly to support the processing and optimization of queries to global (mediated) views that are expressed logically in terms of existing information sources. Likewise, the theory of acyclic hypergraphs has found new applications guiding the joining of incomplete sources of information.

Science Policy and Politics: Revolution or Evolution

Rick Weingarten,
Computing Research Association

4:20 pm, Tuesday, August 6

Federal support of science has come under severe scrutiny in recent years. The assumptions and processes for deciding priorities are shifting dramatically. These shifts are changing the way the entire scientific research community deals with federal funding issues. Computing research is doubly affected, because these changes are occurring at a time when this field is moving to the forefront in the dialogue. So computing research not only needs to react to the changing political climate, it also needs to assume increasing leadership in overall science policy. But past operating styles, the role model offered by physics, for instance, may not be a good guide to the future. Do we need to become more overtly political? Should the research agenda tie itself more closely to social outcomes? To what extent do we have a special concern with helping develop the research and educational infrastructure—encouraging the creation of the networks, digital libraries, and computational facilities of the future. Should we be speaking out more on information policies that affect how technology is deployed and used? Weingarten will discuss the changing environment and policy roles for the research community, and pose some of these difficult decisions the field will face because of them.

IAAI–96!

The Eighth Annual Conference on Innovative Applications of Artificial Intelligence (IAAI–96) will highlight successful applications of AI technology; explore issues, methods, and lessons learned in the development and deployment of AI applications; and promote an interchange of ideas between basic and applied AI. Case-study papers describe deployed applications with measurable benefits whose value depends on the use of AI technology. Invited talks are organized around the common theme of emerging areas for AI applications. Admission to IAAI sessions is included in the single joint registration fee with AAAI. The schedule is coordinated to allow attendees to move freely between IAAI and AAAI sessions.

IAAI–96 will showcase the most impressive deployed AI applications of the past year. An application is considered deployed if it has been used for a minimum of several months and relied on for operational business decisions. Four categories of innovation are recognized:

- Demonstration of a new technology
- Application of existing technology to a new domain
- Application of existing technology to an old domain in an innovative way
- Demonstration of a novel integration of different technologies.

Taken together, the award winners provide clear evidence of the commercial value of AI

AAAI–96 / IAAI–96 Joint Invited Talk

AI: What Works, and What Doesn't?

Frederick Hayes-Roth, *Teknowledge*

3:30 PM, Tuesday, August 6

AI has been well supported by Government R&D dollars for decades now, and people are beginning to ask hard questions: What really works? What are the limits? What doesn't work as advertised? What isn't likely to work? What isn't affordable? This talk will try to hold a mirror up to the community, both to provide feedback and also stimulate more self-assessment.

Please Join Us for

technology as a key component of complex information systems. The papers are case studies that provide a valuable guide to designing,

building, managing, and deploying systems whose value depends on AI technology. The papers also illustrate the applicability and limitations of various AI techniques. Organizations honored at IAAI–96 will include:

- Brightware, Inc.
- Bull HN Italy
- Fannie Mae
- Frito-Lay
- GTE Laboratories
- Inference Corporation
- The Johns Hopkins University
- Massachusetts Institute of Technology
- NASA
- Pacific Bell
- Price Waterhouse Technology Centre
- Schlumberger
- SIGNAL Versicherungen, Germany
- Swiss Bank Corporation

Please join us and participate in the dialog between basic and applied AI.

– Howard E. Shrobe
Program Chair
– Ted E. Senator
Program Cochair

1996 Conference Chair

Howard E. Shrobe,
Massachusetts Institute of Technology

1996 Conference Cochair

Ted E. Senator,
US Department of the Treasury

Portlandia is the second-largest hammered copper statue in the world. (Photo courtesy Portland Oregon Visitors Association.)

IAAI Invited Talks

A key goal of IAAI–96 is to promote the interchange of ideas between basic and applied AI, in order to make application developers aware of new capabilities that can be enabled by current research and to make researchers aware of needs and constraints of real applications. The invited talk topics include:

- Knowledge discovery and database mining
- AI and computational biology
- AI in airplane design
- Real-World Applications of Planning and Scheduling
- Speech technology and AI and software engineering.

Invited talks will cover the following topics:

- Technical background. What has the AI community been doing in this area?
- What has happened to make AI applications possible and useful?
- What does the current application terrain look like and what are some sample applications?
- What are the remaining technical and institutional roadblocks?
- What should the AI research community address to break these roadblocks?

Please Join Us for KDD–96!

We invite you to join us for the Second International Conference on Knowledge Discovery and Data Mining (KDD-96). With the dramatic advances in data acquisition and storage technologies, the problem of how to turn raw data into useful information has become one of the most daunting problems facing modern society. Having reached sizes that defy even partial examination by humans, modern databases and collections of data sets are literally drowning their users in data. This data firehose phenomenon appears in a wide spectrum of fields including retail and corporate marketing, medical and healthcare, financial markets, and engineering, manufacturing, and science data analysis. Knowledge discovery in databases (KDD) and data mining are areas of common interest to researchers in AI, pattern recognition, statistics, databases, knowledge acquisition, data visualization, high performance computing, and expert systems. KDD–96 follows on the success of KDD–95 held last year in Montréal, and continues the tradition of the KDD workshops from 1989 – 1994, by bringing together researchers and application developers from different areas, and focusing on unifying themes such as the automated extraction of patterns and models from databases, statistical inference, issues of scaling to massive data sets, the use of domain knowledge, managing uncertainty, interactive (human-oriented) presentation, and applications. The KDD conference also includes invited talks, demo and poster sessions, and panel discussions.

– Evangelos Simoudis and Jiawei Han
  Program Cochairs
– Usama Fayyad
  General Conference Chair

KDD–96 Opening Reception

The KDD–96 opening reception will be held August 2 from 6:00 – 8:00 PM in the Oregon Convention Center in conjunction with a poster session. The reception is open to KDD–96 registrants only.

KDD–96 Conference Banquet

A banquet will be held for interested KDD–96 attendees on Saturday evening, August 3, 1996. Information will be sent to KDD–96 registrants as soon as it becomes available. The banquet will require payment of an additional fee.

KDD General Conference Chair

Usama M. Fayyad,
Microsoft

Program Cochairs

Jiawei Han, *Simon Fraser University*

Evangelos Simoudis,
IBM Almaden Research   Center

Publicity Chair

Padhraic Smyth, *University   of California, Irvine*

Sponsorship Chair

Gregory Piatetsky-Shapiro,
GTE Laboratories

KDD Program Committee

Rakesh Agrawal, *IBM Almaden Research Center*
Tej Anand, *AT&T Global Information Solutions*
Ron Brachman, *AT&T Bell Laboratories*
Wray Buntine, *Heuristicrats Research*
Nick Cercone, *University of Regina*
Peter Cheeseman, *NASA AMES Research Center*
Bruce Croft, *University of Massachusetts at Amherst*
Stephen G. Eick, *AT&T Bell Laboratories*
Usama Fayyad, *Microsoft, Inc.*
Dan Geiger, *Technion*
Clark Glymour, *Carnegie-Mellon University*
George Grinstein, *University of Lowell*
David Hand, *Open University*
David Heckerman, *Microsoft Corporation*
Se June Hong, *IBM T. J. Watson Research Center*
Tomasz Imielinski, *Rutgers University*
Larry Jackel, *AT&T Bell Laboratories*
Larry Kerschberg, *George Mason University*
Willi Kloesgen, *GMD*
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Heikki Mannila, *University of Helsinki*
Chris Matheus, *GTE Laboratories*
Sham Navathe, Georgia Institute of Technology
Raymond Ng, *University of British Columbia*
Gregory Piatetsky-Shapiro, *GTE Laboratories*
Daryl Pregibon, *AT&T Bell Laboratories*
Pat Riddle, *Boeing Computer Services*
Ted Senator, *US Department of the Treasury*
Wei-Min Shen, *University of Southern California*
Arno Siebes, *CWI*
Avi Silberschatz, *AT&T Bell Laboratories*
Andrzej Skowron, *University of Warsaw*
Steve Smith, *Dun and Bradstreet*
Padhraic Smyth, *University of California, Irvine*
Ramakrishnan Srikant, *IBM Almaden Research Center*
Sal Stolfo, *Columbia University*
Paul Stolorz, *Jet Propulsion Laboratory*
Alex Tuzhilin, *NYU Stern School*
Ramasamy Uthurusamy, *GM Research Laboratories*
Xindong Wu, *Monash University*
Wojciech Ziarko, *University of Regina*
Jan Zytkow, *Wichita State University*

Harnessing the Human in Knowledge Discovery

Georges Grinstein,
University of Massachusetts at Lowell and The MITRE Corporation

Knowledge, the primary goal of data analysis and exploration, is most often discovered by generating information (structure) from data, and then abstracting non-trivial patterns (rules or associations for example) from the information. The discovery process can be done using visualization, data mining, statistics, neural networks, or mathematical modeling and simulation. Visualization is different from the rest, however, in that it is also the actual mechanism by which the analyses and their results can be presented to the user. In this talk, I will present a brief history of alternative visualizations and how they have been applied to various data visualization problems. The emphasis will be on how exploratory visualization can support the knowledge discovery process, including concept development for database management, database visualizations, and minimally structured dataset visualizations.

Georges Grinstein is professor of computer science at the University of Massachusetts Lowell, Director of the Institute for Visualization and Perception Research and principal engineer with the MITRE Corporation's Center for Air Force C3I Systems. He received his PhD in mathematics from the University of Rochester in 1978. He has chaired

several conferences on visualization, and is a member of IEEE, and ACM.

The Oregon Convention Center is the largest convention facility in the Pacific Northwest. (Photo courtesy Portland Oregon Visitors Association.)

Small Sample Size Paradigm in Statistical Inference

Vladimir Vapnik,
AT&T Research Laboratories

Vladimir Vapnik will describe (from both the theoretical and the applied point of view) a new approach to statistical inference that is based on the minimization of the guaranteed risk for a fixed sample size, which provides a high level of generalization ability and in many cases contradicts the existing classical paradigms.

Vladimir Vapnik, currently a member of the technical staff at AT&T Research Laboratories, is one of the creators of generalization theory in statistical inference, the so-called VC-theory (Vapnik-Chervonenkis theory). In particular, he developed the statistical theory for inference from small sample size (in contrast to classical asymptotic statistics). Vapnik is the author of seven books, including E*stimation of Dependencies Based on Empirical Data* (Springer, 1982), *The Nature of Statistical Learning Theory* (Springer, 1995), and *Statistical Learning Theory* (Wiley, 1996).

Data Integration and Analysis in a Client Server Environment: The Sara Lee Meat Experience

Perry K. Youngs, *Sara Lee Corporation*

The role of marketing research is currently going through dramatic changes in the United States as census based syndicated scanner data is becoming available to retailers and manufacturers. This change is being lead by ECR and category management initiatives that are removing costs from distribution channels. In an attempt to manage the ever increasing amounts of information needed for this endeavor, client server based information systems are being developed with new data warehousing technology. Sara Lee Meats has just successfully implemented the conversion of a main-frame based system to a client-server based system using a three-tier object technology from Information

Advantage, Incorporated and data warehousing technology from Red Brick Systems, Incorporated.

Youngs will discuss Sara Lee Meat's experiences relating to data integration and analysis in a client-server environment.

Perry K. Youngs, in 1988, built a decision support system for all of the 10 domestic Sara Lee Meat based food companies. Youngs is currently located at the Sara Lee Meat Group corporate headquarters in Cordova, Tennessee.

Materializing Views in Data Warehouses

Jeffrey D. Ullman, *Stanford University*

Data warehouses are collections of materialized views of source data. The optimal set of views to materialize depends on the assumed distribution of queries that will be posed about the data. Given a query distribution, a "greedy" approach to selecting materialized views picks a sequence of views, each of which provides the maximum "benefit" (reduction in average query cost), given the set of views previously chosen for materialization. Under a variety of assumptions about the way possible views relate to one another, greedy approaches are guaranteed to come within 63 percent of the optimum benefit. In fact, in some of these cases, such as the important case of a "data cube" storing multidimensional data, it can be shown that no polynomial algorithm can be guaranteed to come closer than 63 percent. This talk presents work of Chandra Chekuri, Himanshu Gupta, Venky Harinarayan, and Anad Rajaraman, as well as the author.

Jeffrey D. Ullman (PhD, Princeton University, 1966), is a professor at Stanford University, and a leading researcher in database systems, knowledge-base systems, theoretical computer science, analysis of algorithms, and programming languages and compilers. He served as the computer science department chair at Stanford University, from 1990 to 1994 and has served on the editorial boards of many journals, including *SIAM Journal Computing, Journal ACM, Journal Computer and System Sciences,* and *Journal Logic Programming.* He is working on the efficient implementation of data cubes for data warehousing and data mining.

Exhibit Program

The exhibit program will offer exhibits and demonstrations by leading suppliers of AI software as well as AI consultants and publishers displaying the latest in AI books and periodicals. At the time of publication, 1996 Exhibitors include:

- AAAI Press
- Academia Book Exhibits
- Angoss Software International, Ltd.
- Elsevier Science Publishers
- Franz, Inc.
- ILOG, Inc.
- Intelligent Automation, Inc.
- Kluwer Academic Publishers
- Lawrence Erlbaum Associates
- The MIT Press
- Morgan Kaufmann Publishers, Inc.
- *PCAI*
- Prentice Hall
- PWS Publishers/ITP
- Real World Interface, Inc.
- Springer Verlag New York, Inc.
- Talarian Corporation
- Wizsoft

Robot Exhibition

The robot exhibition this year will focus on robots interacting with the general conference audience outside of the arena and in an unconstrained manner. This may be as simple as allowing the robot to wander (supervised) around the lobby of the convention center and avoid collisions with attendees. Other robots may wish to distribute some literature or approach people and begin talking. The idea is to get the robots outside of the arena and in amongst people to show that they are safe, robust and autonomous. A special prize will be awarded to the robot that demonstrates the most interesting, unconstrained interaction with conference attendees outside of the arena.

Fifth Annual AAAI Mobile Robot Competition and Exhibition

Following in a long tradition of mobile robot competitions, this year's competition will provide conference attendees with a first hand look at progress in the fields of artificial intelligence and robotics. The competition will consist of two events, one focusing on office navigation and the other on perception and manipulation. There will also be an exhibition in which robots will display skills that are not highlighted in the competition events.

Event 1: Call a Meeting

Wonderful news, the research grant has been approved! The Director would like to schedule a meeting with Professor Gallant and Professor Storm. Please check which conference room is free and inform the three of us: (1) which room is free, and (2) at what time the meeting will start. Please schedule the meeting for as soon as possible.

The robot's first task is to go from the start room (the director's office) to one of the two conference rooms and detect whether the room is occupied or not. If it is occupied, the robot should check to

Established in 1917 and boasting more than 400 varieties of roses, Portland's International Test Gardens are the oldest test gardens in the country. (Photo courtesy Portland Oregon Visitors Association.)

see if the second conference room is available. If the second conference room is also occupied, schedule the meeting in the Director's office.

The robot must inform each of the professors and the Director in which room the meeting will take place, and at what time. The best meeting start time is 1 minute after the last person has been informed about the meeting. This requires the robot to predict, as accurately as possible, at what time it will be able to arrive at the third person's office to inform them.

Event 2: Clean Up the Tennis Court

The robot's task in Event 2 is to clean up a room of tennis balls—including one that is moving! The robot will be placed in a closed room. In the room with the robot will be a small number of tennis balls and one powered "Squiggle" ball that will be moving around. In one corner of the room will be a pen with two gates. Inside the pen will be another powered "Squiggle" ball. The objective is to place all of

the tennis balls and the moving ball into the pen.

Pioneer Square, located in the hear of downtown Portland, features a 25-foot-tall weather machine. (Photo courtesy Portland Oregon Visitors Association.)

Tuesday, August 6

10:30 AM – 12:10 PM
  Session 1: CSP 1: Game-Tree Search
  Session 2: Learning 1: Discovery
  Session 3: Planning 1: The Environment
  Session 4: Uncertainty 1: Foundations
  Session 5: NLP 1: Learning

1:30 PM – 3:10 PM
  Session 6: CSP 2: Temporal Reasoning
  Session 7: Learning 2: Planning
  Session 8: Information Agents
  Session 9: QR 1: Model-Based Reasoning
  Session 10: AI in Art and Entertainment

3:30 PM – 5:10 PM
  Session 11: CSP 3: Data Consistency
  Session 12: Learning 3: Case-Based Reasoning
  Session 13: Planning 2: Handling Uncertainty
  Session 14: KR 1: Belief & Belief Revision
  Session 15: Mobile Robots 1

Wednesday, August 7

10:30 AM – 12:10 PM
  Session 16: CSP 4: Search Control
  Session 17: Learning 4: Reinforcement Learning
  Session 18: Planning 3: Temporal Reasoning
  Session 19: KR 2: Non-Monotonic Reasoning
  Session 20: Vision

1:30 PM – 3:10 PM
  Session 21: CSP 5: Search & Learning
  Session 22: Learning 5: Decision Trees
  Session 23: Multiagent Problem Solving
  Session 24: Uncertainty 2: Bayesian Networks
  Session 25: Knowledge Compilation

3:30 PM – 5:10 PM
  Session 26: CSP 6
  Session 27: Knowledge-Based Systems
  Session 28: Agent Interaction
  Session 29: Abstraction and Hierarchical Reasoning
  Session 30: NLP 2: Semantics & Discourse

5:30 PM – 6:30 PM
  AAAI–96 Student Abstract Poster Session and SIGART/AAAI
    Doctoral Consortium Poster Session

Thursday, August 8

8:30 AM – 10:10 AM
Session 31: CSP 7: Phase Transition
Session 32: Learning 6: Knowledge Bases
Session 33: Negotiation & Coalition
Session 34: KR 3: Knowledge Bases and Context
Session 35: Mobile Robots 2

10:30 AM – 12:10 PM
Session 36: CSP 8: Stochastic Search I
Session 37: Learning 7: Enhancing Efficiency
Session 38: Planning 4: Search
Session 39: QR2: Qualitative Physics
Session 40: Information Retrieval & Natural Language Processing

1:30 PM – 3:10 PM
Session 41: CSP 9: Stochastic Search II
Session 42: Learning 8: Fundamental Issues
Session 43: Multi-Agent Learning
Session 44: KR 4: Description Logics
Session 45: Education

3:30 PM – 5:10 PM
Session 46: Rule-Based Reasoning & Connectionism
Session 47: Learning 9: Inductive Learning
Session 48: KR 5: Reasoning about Action
Session 49: QR 3: Spatial & Functional Reasoning
Session 50: Perception

A complete AAAI–96 program schedule can be found on AAAI's web page (http://www.aaai.org/Conferences/conferences.html)

Monday, August 5

Opening Remarks
Howard E. Shrobe, IAAI-96 Program Chair
8:30 – 8:55 AM

Telecommunication Applications
8:55 – 10:10 AM

Engineering Applications
10:30-11:20 AM

Invited Talk
AI in Aircraft Design
Robert Abarbanel, Boeing Information and Support Services
11:20 am – 12:10 PM
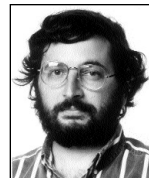
Knowledge and Information Management Applications
1:30 – 3:10 PM

Looking Back & Forward
3:30 – 4:20 PM

Invited Talk
AI in Software Engineering
Douglas R. Smith, Kestrel Institute
4:20 – 5:10 PM

Tuesday, August 6

Finance Applications
10:30 – 12:10 PM

Invited Talk
Speech
George Doddington, National Security Agency / SRI International
1:30 – 2:20 PM

Invited Talk
Planning, What Works?
Mark Boddy, Honeywell Technology Center
2:20 – 3:10 PM

AAAI-96/IAAI-96 Joint Invited Talk
AI: What Works, and What Doesn't?
Frederick Hayes-Roth, Teknowledge
3:30 – 4:20 PM

Wednesday, August 7

Invited Talk

10:30 – 11:20 AM

AI and Computational Biology

Rick Lathrop, University of California, Irvine

Business Operations Applications

11:20 – 1:55 PM

Invited Talk

Knowledge Discovery and Data Mining

Usama Fayyad, Microsoft Corporation

1:55 – 2:45 PM

1996 AAAI Tutorial Forum

The completely revamped AAAI tutorial program for 1996 features fifteen four-hour tutorials that explore hot topics within and outside the AI field. Each tutorial is taught by experienced scientists and practitioners in AI. We encourage all attendees to take advantage of this opportunity to learn about advances in areas outside their personal focus. One low fee will entitle tutorial forum registrants to attend up to four consecutive tutorials and **one** tutorial syllabus. (Additional syallabi can be purchased for an additional fee.)

Tutorials designated "SA" will be held Sunday, August 4 from 9 AM to 1 PM. "SP" tutorials will be held Sunday, August 4 from 2-6 PM. "MA" tutorials will be held Monday, August 5, from 9 AM to 1 PM. "MP" tutorials will be held Monday, August 5 from 2-6 PM.

Tutorials

Track One: Knowledge Acquisition and Information Gathering

- Ontologies: Principles, Applications and Opportunities (SA1)
  Michael Gruninger and Mike Uschold
- Information Gathering and Integration (SP1)
  Craig Knoblock and Alon Levy
- Case-Based Reasoning: Issues and Applications (MA1)
  Evangelos Simoudis and Kevin Ashley
- Knowledge Discovery and Data Mining (MP1)
  Usama Fayyad and Evangelos Simoudis

Track Two: Computation and Adaptation

- Locally Weighted Learning: Algorithms and Applications for Robot and Process Control (SA2)
  Andrew Moore, Stefan Schaal, and Jeff Schneider
- Quantum Computing (SP2)
  Colin P. Williams
- Designing Computational Markets and Multiagent Organizations (MA2)
  Michael Wellman and Tad Hogg
- Genetic Programming (MP2)
  John Koza and David Andre
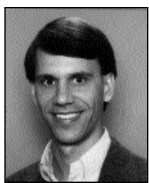
Track Three: Constraints, Logics, and Defaults

- New Methods for Solving Large Constraint and Reasoning Problems (SA3)
  James Crawford and Bart Selman
- Pragmatics of Nonmonotonic Reasoning (SP3)
  Grigoris Antoniou and Miroslaw Truszczynski
- Temporal Reasoning and its Applications in Artificial Intelligence (MA3)
  Lluis Vila, Mark Boddy, and Eddie Schwalb
- Default Reasoning: Between Logic and Probabilities; Concepts, Models and Algorithms (MP3)
  Hector Geffner

Track Four: Synthesizing Behavior

- Knowledge-Based Software Engineering (SP4)
  Lewis Johnson and Michael Lowry
- Partially Observable Markov Decision Processes (MA4)
  Tom Dean and Leslie Pack Kaelbling
- Practical Planning Systems (MP4)
  Steve Chien and Brian Drabble

Case-Based Reasoning: Issues and Applications (MA1)

Evangelos Simoudis and Kevin Ashley

9:00 AM – 1:00 PM, Monday August 5

Case-based reasoning (CBR) has matured as a subdiscipline of AI research and as an AI applications methodology. Researchers are making new strides in using CBR to capture and apply knowledge to guide machine learning. Case-based planning systems are applying databases of thousands of cases to solve new problems. The CBR research community is now addressing questions characteristic of a more mature science, such as appropriate evaluation standards. Applications engineers, meanwhile, are developing a second generation of CBR applications in the areas of "Help Desks," automated assistants for design and diagnosis, and forging new links between CBR applications systems and on-line databases.

This tutorial showcases recent developments in CBR research and applications and focuses on a set of current important issues listed below. The tutorial is designed primarily for professionals already familiar with basic CBR concepts and programs. Our brief introduction to CBR should, however, enable beginners to understand and participate in the discussion of the issues:

- What are the comparative advantages and costs of implementing industrial systems using shells rather than from scratch?
- Does adaptation in CBR really work?
- What are the latest developments in CBR applications for diagnosis and design?
- How can hybrid systems best combine CBR and other reasoning methods?
- How should CBR programs be evaluated?

Kevin Ashley is a faculty member of the graduate program in intelligent systems at the University of Pittsburgh, an associate professor of law, a research scientist at the Learning Research and Development Center, and an adjunct associate professor of computer science. His research interests include case-based and analogical reasoning, argumentation and explanation and designing computer systems for assisting attorneys in law teaching and practice. He is an National Science Foundation presidential young investigator and was a visiting scientist at the IBM Thomas J. Watson Research Center. He received a PhD in computer science from the University of Massachusetts.

Evangelos Simoudis is director of data mining solutions at IBM Research's Almaden Research Center. Formerly, he was a group leader of the data comprehension group at the Lockheed AI Center where, since 1991, he lead research on knowledge discovery in databases, machine learning, case-based reasoning and their application to financial, retail, and fraud detection problems. Simoudis is also an adjunct assistant professor at the Computer Engineering department of the Santa Clara University where he teaches graduate courses on machine learning and case-based reasoning. Simoudis holds a PhD in computer science from Brandeis University.

Default Reasoning: Between Logic and Probabilities; Concepts, Models and Algorithms (MP3)

Hector Geffner

2:00 PM – 6:00 PM, Monday August 5

Defaults are common in everyday discourse yet two problems have prevented the use of defaults in modeling: the problem of giving a meaningful characterization of the legitimate default inferences (the semantical problem) and the problem of computing those inferences (the computational problem). In recent years these two problems have been solved to a significant extent, making default languages in many cases, a convenient alternative to languages based on either classical logic or probabilities. The goal of this tutorial is to provide a coherent and self-contained survey of such work.

We look at default reasoning in two different ways: as an extended form of deductive inference and as a qualitative form of probabilistic inference. In each case, we lay out the main concepts, the intuitions and the inference algorithms. We also establish a crisp connection between the two views that allows us to relate arguments and high probabilities, minimal models and independence assumptions, logic programs and Bayesian networks, etc. We also illustrate how defaults can be used in modeling in areas such as qualitative reasoning, decision making and policy analysis.

The tutorial is intended for people interested in common-sense modeling, including causal, temporal, evidential, and qualitative forms of inference. There are no prerequisites except a basic knowledge of logic and probabilities.

Hector Geffner earned his PhD from the University of California, Los Angeles under the supervision of Judea Pearl with a dissertation on default reasoning that was cowinner of the 1990 ACM Dissertation Award. He then worked as a staff research member at the IBM T. J. Watson Research Center for two years before returning to the Universidad Simon Bolivar in Caracas where he currently teaches. Geffner has served in the program committee of the major AI conferences (AAAI, KR, UAI) and is a member of the editorial board of the *Journal of Artificial Intelligence Research.*

Designing Computational Markets and Multiagent Organizations (MA2)

Michael Wellman and Tad Hogg

9:00 AM – 1:00 PM, Monday August 5

The recent explosion of internet activity and development of software agents heralds a time when autonomous computational processes on wide-area networks will be deployed on behalf of human users. Given their varying goals, capabilities, and resources, computational agents will often find it necessary to coordinate their activities to achieve desired results. The problem facing designers of agents and interaction protocols is how to achieve an allocation of activities and resources that best meets overall objectives, without imposing centralized control. More generally, how can we relate the global behavior of a collection of agents to the local behavior of individuals? Given a large number of autonomous agents, each working with a limited view of the overall situation and perhaps with conflicting goals, under what conditions can we expect to produce good solutions to complex problems?

In this tutorial we address the fundamental problem of coordinating multiple agents through the use of market mechanisms and organizational structures. We present some relevant background in economics and organization theory necessary to understand these systems, leading to some general design methodology for constructing computational economies and organizations. The methods are elaborated through case studies (e.g., networked information services), computational experience, and discussion of key technical issues (e.g., dynamic behavior) underlying multiagent systems.

Michael Wellman is an assistant professor in the Department of Electrical Engineering and Computer Science at the University of Michigan. He received a PhD in computer science from the Massachusetts Institute of Technology in 1988 for his work in qualitative probabilistic reasoning and decision-theoretic planning. Current research focuses on computational market mechanisms for distributed decision making. In 1994, he received an National Science Foundation National Young Investigator award.

Tad Hogg is a member of the research staff at the Xerox Palo Alto Research Center. His research interests include dynamics of multiagent systems, the use of economic mechanisms for resource allocation, cooperative problem solving and analogies with physical phase transitions found in combinatorial search problems. He holds a PhD in physics from Stanford University.
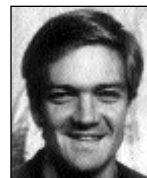
Genetic Programming (MP2)

John Koza and David Andre
2:00 PM – 6:00 PM, Monday August 5

Genetic programming is a domain-independent technique for automatic programming that evolves computer programs that solve, or approximately solve, problems.

Genetic programming has found applications in a wide variety of different areas of artificial intelligence including control, robotics, modeling, design of electrical circuits, system identification, forecasting, empirical discovery, data mining, automatic programming of multi-agent strategies, distributed artificial intelligence, pattern recognition, game theory, optimization, and computational aspects of molecular biology.

Topics include multi-part programs, automatically defined functions, iteration, recursion, memory structures, mental models, architecture-altering operations, cellular encoding, implementation on parallel computers, genetic design of electrical circuits, genetically evolved assembly code, promising application areas for genetic programming, and directions for future research.

Tutorial Level: Intermediate to advanced. The basics of genetic programming will be briefly summarized and the tutorial will concentrate on intermediate and advanced topics.

David Andre, a graduate of Stanford University, is currently a visiting scholar at Stanford University. He has been doing full-time research on genetic programming for three years.

John R. Koza is a consulting professor in the computer science department at Stanford University. He is author of two books from The MIT Press on genetic programming: *Genetic Programming: On the Programming of Computer by Means of Natural Selection* (1992) and *Genetic Programming II: Automatic Discovery of Reusable Programs* (1994).

Information Gathering and Integration (SP1)

Craig Knoblock and Alon Levy
2:00 PM – 6:00 PM, Sunday August 4

Given the rapidly increasing amount of information available on-line, the tasks of locating, accessing, and integrating information from distributed sources has become a critical problem. The goal of an information gathering system is to provide a uniform interface to large collections of information sources that enables users to answer queries without having to find and interact with each available information source. Some of the challenges in building information gathering systems are to efficiently decide which sources can answer specific queries, integrate information from multiple sources and learn about the contents of information sources. This tutorial will outline the problem, describe the existing technologies and their limitations, and then present several state-of-the-art systems that address portions of this problem. Using the example systems the tutorial will explore the research issues in building systems for information gathering, including system architecture, representing information sources, learning descriptions of sources, processing queries, and presenting the results. This tutorial will touch on a variety of research areas, including knowledge representation, machine learning, automated planning, and relevant aspects of database systems, such as query processing and uses of materialized views.

The only prerequisite knowledge assumed for this tutorial is a general familiarity with AI concepts and techniques. We will not assume detailed knowledge of current research in any of the relevant areas.

Craig Knoblock is a senior research scientist at the University of Southern California Information Sciences Institute and a research assistant professor in the University of Southern California Computer Science Department. He received his PhD in computer science from Carnegie Mellon University in 1991. His current research interests are on information gathering and integration, automated planning, machine learning, knowledge discovery, and knowledge representation.

Alon Levy is a member of the Artificial Intelligence Principles Research Department at AT&T Research Laboratories. He received his PhD in computer science from Stanford University in 1993. His research interests are integration of information from multiple sources, hybrid KR languages, database query optimization and reasoning with abstractions. Recently he has been leading the Information Manifold project which provides a uniform interface to a multitude of information sources.

Knowledge-Based Software Engineering (SP4)

Lewis Johnson and Michael Lowry
2:00 PM – 6:00 PM, Sunday August 4

This tutorial will give an overview of the key concepts in knowledge-based software engineering (KBSE). It will identify software engineering tasks that are amenable to knowledge-based solutions, and categorize the various types of knowledge-based systems that might be developed. The current state of the art in KBSE research and development will then be examined in each area of software engineering. The key technologies currently being used in these solutions will then be examined in detail, as well as the technical foundations for these technologies. The tutorial will also outline the contributions of major research programs such as Rome Laboratory's knowledge-based software assistant to development of knowledge-based software engineering technology.

Lewis Johnson is a project leader and research assistant professor at the University of Southern California's Information Sciences Institute. He has been active in KBSE research for a number of years. He was chair of the KBSE–92 conference, and is a member of the KBSE steering committee. He is currently coeditor-in-chief of the Automated Software Engineering journal. He conducts research in applications of artificial intelligence to software engineering as well as to education and training.

Michael Lowry leads the KBSE project at NASA Ames. He has been active in KBSE research for a number of years, and is coeditor of the AAAI Press book *Automating Software Design.* He is a member of the editorial board of the journal *Automated Software Engineering* journal, and will be the program cochair for the KBSE–97 conference. Prior to joining NASA Ames, Lowry was a research scientist at the Kestrel Institute.

Knowledge Discovery and Data Mining (MP1)

Usama Fayyad and Evangelos Simoudis
2:00 PM – 6:00 PM, Monday August 5

Knowledge discovery in databases and data mining combine techniques from learning, pattern recognition, statistics, databases, and visualization to extract knowledge (information) from lower level data (databases). Often used to support human decision-making, prediction, classification, database content summarization, or explain observed phenomena, KDD systems are becoming a necessity for analyzing the large amounts of data collected by numerous schemes from a variety of sources. Successful implementations are currently in use in finance, fraud detection, market data analysis, astronomy, diagnosis, manufacturing, and biology. This tutorial presents a comprehensive picture of KDD research areas. We define basic terms, relation between data mining and KDD process, methods for data preparation/preprocessing. We present data mining techniques from related fields, detailed case-studies, and a guide for developing KDD systems. We address issues in the role of steps in the KDD process such as sampling, selection, projection and dimensionality reduction, extraction of patterns and models, and the use of extracted knowledge. There are no prerequisites other than familiarity with basic concepts in AI.

This tutorial is appropriate for individuals seeking a basic introduction to KDD or starting related work/projects, researchers interested in relevant areas from other fields, and practitioners interested in learning about techniques.

Usama Fayyad is a senior researcher at Microsoft Research. Prior to joining Microsoft, he headed the Machine Learning Group at JPL and was principal investigator on several tasks in targeting automated data analysis in science and NASA data sets. He received a NASA medal (1994) and the 1993 Lew Allen Award for Excellence at JPL. He cochaired KDD – 94 and KDD – 95, is general chair of KDD–96, a coeditor of *Advances in Knowledge Discovery and Data Mining* (AAAI Press 1996), and editor-in-chief of the new journal on this topic (Kluwer).

Evangelos Simoudis is the director of data mining solutions at IBM. Prior to IBM, Simoudis was a group leader at the Lockheed Corporation where he led the development and market introduction of the Recon data mining system. In 1994 Simoudis was awarded Lockheed's Pursuit of Excellence Award. Simoudis holds five patents and is the editor of the *Artificial Intelligence Review.* Simoudis holds a PhD in computer science from Brandeis University, and MS in computer science from the University of Oregon, a BS in electrical engineering from the California Institute of Technology, and a B.A. in physics from Grinnell College. He is cochair of the KDD–96 conference.
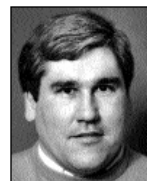
Locally Weighted Learning: Algorithms and Applications for Robot and Process Control (SA2)

Andrew Moore, Stefan Schaal, and Jeff Schneider

9:00 AM – 1:00 PM, Sunday August 4

This tutorial concerns the application of statistical machine learning algorithms, notably locally-weighted regression and memory-based learning, to process control and robot control. There is increasing interest in using these methods for learning to model and control non-linear complex numerical systems such as robots, vehicles, and factories. Recently the amount of data available on-line in factories has increased sharply and there is substantial leverage in methods that make intelligent use of this information. This tutorial provides an introduction and a set of real-world case studies overviewing the use of locally weighted methods for this purpose.

Locally-weighted regression is a statistical learning technique that combines the non-linear data-exploration properties commonly seen in neural networks with well-founded classical and Bayesian statistical analysis. The statistical properties permit machine learning to go beyond prediction, make control decisions, and design experiments for autonomous process optimization and optimal controller design.

The target audience consists of engineers and managers interested in applying statistical machine learning to real control problems, and AI and robotics researchers interested in algorithms for and applications of locally-weighted learning. Attendees are assumed to be comfortable with elementary probability and statistics and common numerical algorithms. An appreciation of control issues is also desirable.

Andrew Moore is an assistant professor of computer science and robotics at Carnegie Mellon University. He has worked in the area of statistical machine learning for six years, applying these methods to processes in the power-distribution, automotive, food-manufacture, and textile industries, as well as to consumer preference prediction.

Stefan Schaal is an adjunct assistant professor of computing at Georgia Institute of Technology and holds an affiliation with ATR Human Information Processing Research Laboratories in Japan. He has researched learning in real-time, concentrating on highly dynamic manipulation tasks such as juggling and devilsticking with an anthropomorphic robot arm.

Jeff Schneider is a postdoctoral scholar in robotics at Carnegie Mellon University. His PhD dissertation topic concerned optimization of dynamic systems using locally-weighted learning methods and intelligent experiment design. He is currently working on applications of machine learning to control and optimization of noisy and/or time varying processes.

New Methods for Solving Large Constraint and Reasoning Problems (SA3)

James Crawford and Bart Selman

9:00 AM – 1:00 PM, Sunday August 4

This tutorial is aimed at AI researchers and practitioners interested in recent work on understanding and solving hard combinatorial search problems. We will focus, in particular, on the body of recent experimental work analyzing the nature of hard problems and on the use of stochastic methods to solve these problems.

Recent work has been characterized by the use of carefully-designed experiments to derive empirical insights into the average-case performance of algorithms on NP-hard problems. This kind of experimental analysis has led to a much better understanding of when, and why, NP-hard problems become hard for existing algorithms, which, in turn has lead to the development of improved stochastic and systematic algorithms. Current methods can handle problem instances with over 10, 000 variables and up to 1, 000, 000 constraints.

Our lectures will cover phase transition phenomena in combinatorial problems, GSAT, WSAT, simulated annealing, tabu search, and a comparison with the state-of-the-art systematic methods. We also discuss how systematic and stochastic methods can complement each other. Finally, we describe several real-world applications in planning, scheduling, diagnosis, and knowledge representation and reasoning.

James Crawford (PhD, University of Texas at Austin, 1990) is currently on the research faculty at the Computational Intelligence Research Laboratory at the University of Oregon. He has published widely on phase transition phenomena for combinatorial problems, and in the development and application of systematic solution methods.

Bart Selman is a principal scientist in the AI Research Department at AT&T Bell Laboratories. He holds a PhD and MS in computer science from the University of Toronto, and a MS in physics from Delft University. His research has covered many areas in artificial intelligence, including tractable inference, knowledge representation, search, planning, default reasoning, constraint satisfaction, and natural language understanding. He has received best paper awards at both the American and Canadian national artificial intelligence conferences, and at the International Conference on Knowledge Representation. His current research projects are on efficient reasoning, stochastic search methods, knowledge compilation, and software agents.

Ontologies: Principles, Applications and Opportunities (SA1)

Michael Gruninger and Mike Uschold
9:00 AM – 1:00 PM, Sunday August 4

Disparate backgrounds, languages, tools, and techniques are a major barrier to effective communication among people, organizations, and/or software systems. In this tutorial, we show how the development and implementation of an ontology (an explicit account of a shared understanding in a given subject area) can improve such communication, which in turn can give rise to greater reuse, sharing, interoperability, and more reliable software.

After motivating their need, we clarify the definition of ontologies and the purposes that they serve. We outline two approaches towards a methodology for developing and using ontologies. We first present a suite of informal techniques concerning such issues as scoping, handling ambiguity, reaching agreement and producing definitions. We then describe a more formal approach which extends these informal techniques. We discuss the role of formal languages and techniques in the specification, implementation and evaluation of ontologies. Finally, we review the state of the art and current practice in this emerging field, considering various case studies, software tools for ontology development, and future prospects.

The goal of the tutorial will be to provide participants with a working knowledge of the field that will enable them to design and implement ontologies for various domains. Familiarity and experience with knowledge representation; familiarity with first-order logic is helpful. Michael Gruninger and Mike Uschold presented a previous version of this tutorial in London in November 1995.

Michael Gruninger has been a research scientist in the Enterprise Integration Laboratory at the University of Toronto since 1993 and is project manager of the Enterprise Engineering Project. Gruninger received a BS in computer science from the University of Alberta in 1987 and his MS in computer science from the University of Toronto in 1989. Gruninger currently supervises the development of TOVE (Toronto Virtual Enterprise) coordinating the design and evaluation of ontologies required for enterprise modeling and integrated supply chain management, and the implementation of this work in a software environment that provides tools for business process reengineering.

Mike Uschold has been active in the ontology field for over a decade—including research, applications and teaching. He is a senior member of technical staff at the Artificial Intelligence Applications Institute (AIAI), The University of Edinburgh. His current activities include the development and application of the enterprise ontology, as well as participating in the ESPRIT Euroknowledge Project, concerned with standardization of ontology technology. Uschold has a PhD in artificial intelligence and a MS in computer science.

Partially Observable Markov Decision Processes (MA4)

Thomas L. Dean and Leslie Pack Kaelbling
9:00 AM – 1:00 PM, Monday August 5

Partially observable Markov decision processes are a class of formal models suitable for controlled stochastic dynamic systems, such as robots, factories, and operating systems. In this tutorial, we will start by describing the basic model and some of the underlying properties of its solution. We will continue by examining methods for solving POMDPs: exact solutions give insight into the structure of the problem, but are intractable; approximate solutions are useful in a variety of context. Next, we will consider the problem of coming up with POMDP models: many algorithms for learning HMMs (hidden Markov models, which are a special case of POMDPs) can be adapted for use in learning POMDPs. Finally, we will address the crucial question of representation: it has been typical to represent state spaces enumeratively, but this representation gives no leverage for handling domains with a lot of structure; compositional representations, such as Bayesian networks and decision trees may make learning and solving POMDPs in structured environments much more efficient and effective. Throughout the tutorial, we will discuss existing and future applications, including mobile-robot navigation, sewer-pipe inspection, target identification, and oil exploration.

Prerequisite knowledge: We do not assume previous knowledge of Markov models, but a working knowledge of basic probability theory and Bayesian network representation will be necessary.

Leslie Pack Kaelbling is an assistant professor of computer science at Brown University. She previously held positions at the Artificial Intelligence Center of SRI International and at Teleos Research. She received an A. B. in philosophy in 1983 and a PhD in computer science in 1990, both from Stanford University. Kaelbling has done substantial research on programming paradigms and languages for embedded systems, on mobile robot design and implementation, and on reinforcement learning algorithms. Her current research directions include integrating learning modules into systems programmed by humans, algorithms for learning and navigating using hierarchical domain representations, and methods for learning perceptual strategies. In 1994 she was selected as a National Science Foundation Presidential Faculty Fellow.

Practical Planning Systems (MP4)

Steve Chien and Brian Drabble

2:00 PM – 6:00 PM, Monday August 5

Automated planning is the generation of a sequence of actions (potentially to a level that can be executed) to achieve some desired world state while obeying the constraints of the domain. Planning systems can be used to automate procedure generation problems in a wide range of areas such as data analysis, distribution logistics, systems engineering, process flow, crisis response, and space payload operations. Automated planning technology can reduce operations costs, decrease manual errors, and thus increase consistency, and reduce dependency on key personnel. This tutorial will cover key issues, problems, and approaches central in fielding automated planning systems with lessons and solutions drawn from the presenters' experience in fielding planning systems for science data analysis, spacecraft payload checkout, and communications antenna operations.

This tutorial will cover the basic concepts in domain-independent artificial intelligence planning including: search, representing planning knowledge, plan and state space planning, operator-based planning and hierarchical task network planning. Advanced concepts such as integrated planning and scheduling, decision theoretic planning, and mixed initiative planning will also be briefly discussed.

Important questions relevant to planning will be covered in the tutorial such as:

- Are planning techniques applicable to my problem? If so, what are the most appropriate planning representations and techniques to use?
- How can I acquire, verify, and maintain my planning knowledge base?
- How can a planning system be embedded into my operational setting?

Steve Chien is technical group supervisor of the Artificial Intelligence Group, at the Jet Propulsion Laboratory, California Institute of Technology where he leads efforts in automated planning and scheduling. His current projects include basic research and deployment of planning systems for automated science analysis, spacecraft mission planning, spacecraft design, maintenance of space transportation systems, and deep space network antenna operations. Chien holds BS, MS, and PhD in computer science from the University of Illinois. He is also an adjunct assistant professor with the Department of Computer Science of the University of Southern California. He is a 1995 recipient of Lew Allen Award for Excellence.

Brian Drabble is a member of Artificial Intelligence Applications Institute at the University of Edinburgh. His current responsibilities include being project leader and coprincipal investigator on the O-Plan project which is part of the $66 million ARPA/Rome Laboratory Planning Initiative. In addition he has been working with a number of clients including Toshiba, Hitachi, European Space Agency, and the British Government, to bring AI planning and scheduling into their organizations and products. He has also presented AIAI's planning and scheduling course to a large number of representatives from industry and commerce.
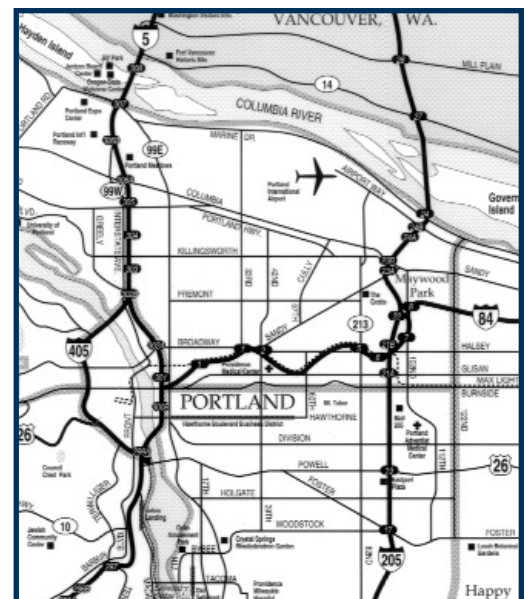
Pragmatics of Nonmonotonic Reasoning (SP3)

Grigoris Antoniou and Miroslaw Truszczynski
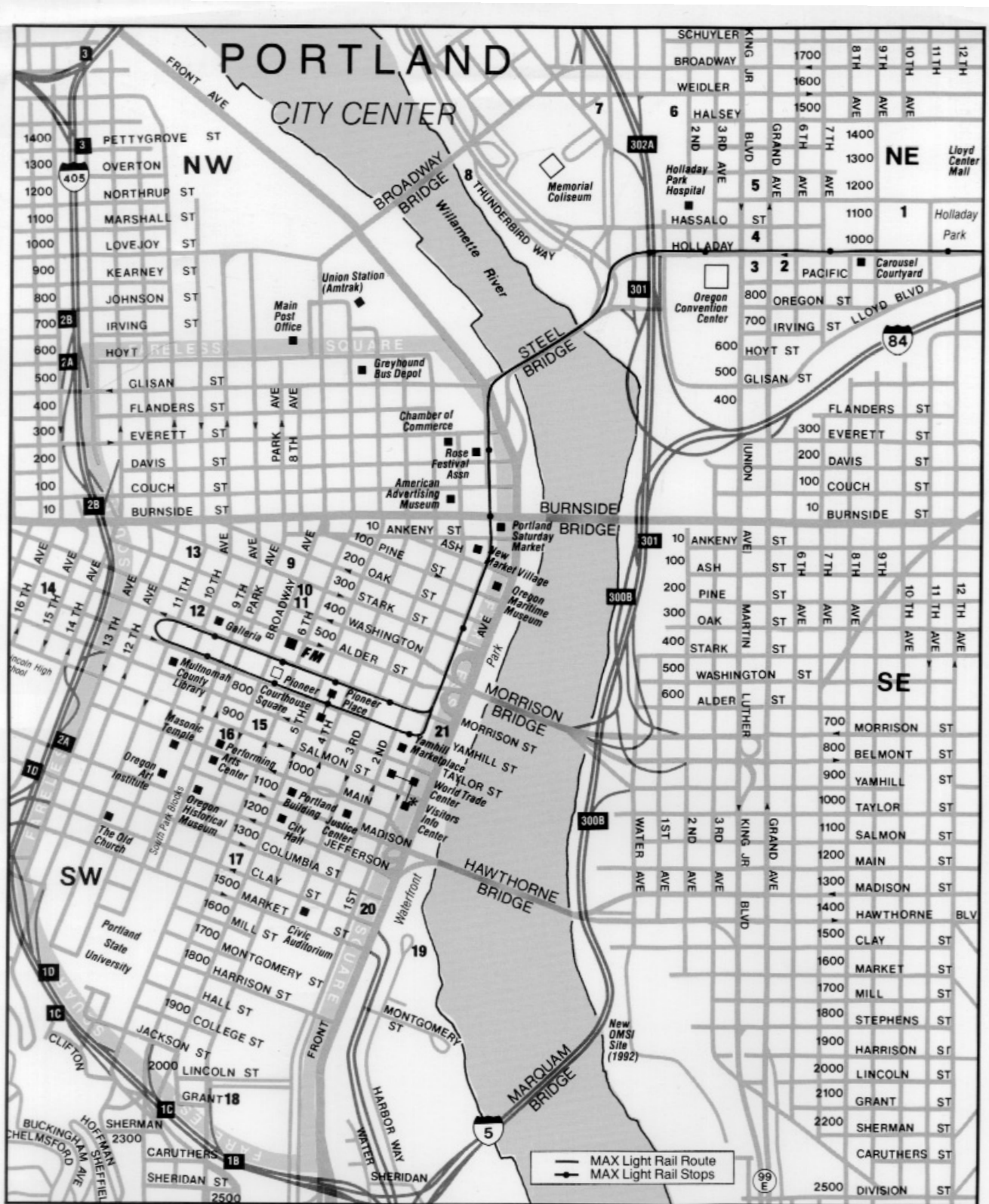
2:00 PM – 6:00 PM, Sunday August 4

In many situations intelligent information systems are faced with incomplete information which is subject to change. In order to operate in a satisfactory way they must make plausible conjectures and be able to modify their knowledge base. Nonmonotonic reasoning provides formal techniques that support these tasks in a principled way. The tutorial will introduce basic concepts of the theory of nonmonotonic reasoning, placing particular emphasis on motivation and applicability rather than on theoretical issues. We will focus on default logic, logic programming and autoepistemic logic. We will base our presentation of nonmonotonic reasoning systems on a recently developed, operational approach. In our presentation, we will stress algorithmic and complexity issues. We will introduce the methodology of programming with nonmonotonic reasoning systems, that is, basic techniques to encode domain knowledge as, say, a default theory or a logic program. We will discuss particular applications of nonmonotonic reasoning to solve problems in operations research and graph theory. Finally, we will discuss and experiment with prototypes of reasoning systems that are based on the principles of nonmonotonic reasoning.

We will assume that the participants have a basic understanding of classical logic and logic programming. No further knowledge is

MORNING	AFTERNOON	EVENING
Friday, August 2		
Registration KDD–96	Registration KDD–96	KDD–96 Opening Reception
Saturday, August 3		
Registration KDD–96	Registration KDD–96	KDD–96 Conference Banquet
Sunday, August 4		
Registration Tutorial Forum Workshops KDD–96 AAAI/SIGART DC	Registration Tutorial Forum Workshops AAAI/SIGART DC	
Monday, August 5		
Registration Tutorial Forum Workshops IAAI–96 AAAI/SIGART DC	Registration Tutorial Forum Workshops IAAI–96 AAAI/SIGART DC	1996 Fellows Dinner
Tuesday, August 6		
Registration AAAI–96 Keynote & Invited Talks IAAI–96 Exhibition / Robot Competition	Registration AAAI–96 Invited Talks IAAI–96 Exhibition / Robot Competition	AAAI–96 Opening Reception
Wednesday, August 7		
Registration AAAI–96 Presidential Address/ Invited Talks IAAI–96 Exhibition / Robot Competition	Registration AAAI–96 Invited Talks IAAI–96 Exhibition / Robot Competition	AAAI-96 Program Committee Student Abstract Poster Session AAAI/SIGART DC Poster Session
Thursday, August 8		
Registration AAAI–96 Invited Talks Exhibition/ Robot Competition	Registration AAAI–96 Invited Talks Exhibition/ Robot Competition	

PORTLAND
CITY CENTER

1 Red Lion/Lloyd Center
2 Econolodge
3 Best Western Inn/Convention Center
4 Holiday Inn/Downtown
5 Comfort Inn
6 Travelodge
7 Best Western Inn/Coliseum
8 Red Lion/Coliseum
9 Benson Hotel
10 Imperial Hotel
11 Hotel Vintage Plaza
12 Governor Hotel
13 Mark Spencer Apartment Hotel
14 Mallory Hotel
15 Portland Hilton
16 Heathman Hotel
17 Portland Inn
18 Red Lion/Downtown
19 Riverplace Hotel
20 Portland Marriott
21 Riverside Inn

— MAX Light Rail Route
— MAX Light Rail Stops

required.

Grigoris Antoniou is a senior lecturer in computing at Griffith University (Australia). His research interest lies in knowledge representation and reasoning, in which area he has been publishing for several years now. Antoniou has given tutorials on nonmonotonic reasoning to audiences from both academia and industry. He is author of a forthcoming book on nonmonotonic reasoning, to be published by The MIT Press.

Miroslaw Truszczynski received his PhD degree from the Technical University of Warsaw in 1980. Since 1984 he has been on the faculty of the University of Kentucky Computer Science Department. Truszczynski is an expert in the area of nonmonotonic reasoning. He is a coauthor of a successful monograph on the subject that was published by Springer-Verlag in 1993.

Quantum Computing (SP2)

Colin P. Williams

2:00 PM – 6:00 PM, Sunday August 4

AI researchers have traditionally been interested in the capabilities of computing machinery. This tutorial covers the principles, capabilities, design and feasibility of quantum computers, a hypothetical new generation of computers that operate in accordance with quantum physics—the most accurate model of reality that is currently known. By exploiting delicate quantum phenomena that have no classical analogs, quantum computers can perform certain computational tasks exponentially faster than any classical computer. Moreover, these same quantum phenomena allow unprecedented tasks to be performed such as teleporting information, breaking supposedly unbreakable codes, generating true random numbers, and communicating with messages that betray the presence of eavesdropping. Such feats may sound like science fiction but are rooted firmly in science fact. The tutorial will describe how AI techniques can contribute to the design of quantum computers and how quantum computers can tackle problems of interest to AI such as propositional satisfiability. The tutorial is intended for researchers who are interested in the ultimate capabilities of machines, the solution of "hard" (NP-complete) problems and the development of new application areas for AI. Beginning graduate students are especially encouraged to attend.

Attendees should have a rudimentary knowledge of Turing machines, the P/NP distinction, combinational logic circuits, and elementary matrix algebra. However, no prior knowledge of quantum physics is assumed.

Colin P. Williams received his PhD in artificial intelligence from the University of Edinburgh in 1989. Before that, Williams was a research assistant to Stephen Hawking in the Department of Applied Mathematics and Theoretical Physics at the University of Cambridge. Williams is currently vice president of Variable Symbols, Inc.—a company specializing in applications of Mathematica® to the financial and engineering communities. He also teaches Mathematica® at Stanford University. Williams' research has covered the connections between physics and computation from qualitative physics to computational phase transitions. Last summer he lectured on quantum computing at the advanced course in AI summer school organized by ECAI and France Telecom.

Temporal Reasoning and Its Applications in Artificial Intelligence (MA3)

Lluis Vila , Mark Boddy, and Eddie Schwalb

9:00 AM – 1:00 PM, Monday August 5

A wide range of tasks in AI, such as prediction, diagnosis, scheduling, planning, and narrative understanding, involve temporal information. This tutorial will explore in some detail the need for temporal representations and inference and the key issues in the design of systems for it, namely, the ontological basis, the formal representation, and the constraint processing methods of inference. We provide a progressively detailed analysis of each of these issues, and discuss the advantages and shortcomings of the different techniques proposed. We then explore the role of a temporal reasoning system in a problem solver. Finally, we discuss the application of temporal reasoning to real-world problems in a wide variety of areas, including diagnosis and trend identification for predictive maintenance, plan recognition , story understanding, and planning and scheduling, with particular emphasis on the last two.

This tutorial will be of interest both for those working on knowledge representation from a theoretical perspective and for those involved in building intelligent systems.

We assume a basic understanding of first-order logics. Some knowledge of constraint satisfaction will be helpful. Familiarity with temporal reasoning formalisms or systems is not required.

Lluis Vila has a research visitor appointment at the University of California, Irvine. He received a PhD in computer science from the Technical University of Catalonia, Spain. His publications list includes the IIIA monograph *On Temporal Representation and Reasoning in Knowledge-Based Systems,* and contributions to the IJCAI conference and *Artificial Intelligence* and *AI Communications* (survey paper) journals.

Mark Boddy is a principal research scientist at the Honeywell Technology Center, in Minneapolis, Minnesota. He received a PhD in computer science from Brown University in 1990. His research interests include temporal reasoning, constraint satisfaction problems, planning and scheduling, and distributed optimization and problem-solving.

Eddie Schwalb is currently completing his PhD at the University of California, Irvine. His contributions are focused on temporal constraint satisfaction. His industrial experience includes automating the design of metal sheet folding. His research interests include temporal reasoning, spatial and geometrical reasoning, constraint satisfaction, planning, and scheduling.

1996 AAAI Workshops
(by invitation only)

Agent Modeling
Contact: Milind Tambe; tambe@isi.edu
Sunday, August 4

AI and Agriculture and Natural Resources
Contact: Richard Olson; olson@csrumsu.ars.ag.gov
Sunday-Monday, August 4-5 (two-day workshop)

Computational Cognitive Modeling:
Source of the Power
Contact: Charles Ling; ling@csd.uwo.ca
Monday, August 5

Detecting, Repairing, and Preventing Human-Machine Miscommunication
Contact: Susan McRoy; mcroy@cs.uwm.edu
Sunday, August 4

Entertainment and AI/Alife
Contact: Hiroaki Kitano; kitano@csl.sony.co.jp
Sunday, August 4

Integrating Multiple Learned Models for Improving & Scaling Machine Learning Algorithms
Contact: Sal Stolfo; sal@cs.columbia.edu
Monday, August 5

Intelligent Adaptive Systems
Contact: Ibrahim Imam; imam@aic.gmu.edu
Sunday, August 4

Internet-based Information Systems
Contact: Alex Franz; cmf@pdp.crl.sony.co.jp
Monday, August 5

Knowledge Based Document Planning
Contact: Karl Branting; karl@index.uwo.edu
Monday, August 5

Modeling and Reasoning with Function
Contact: James K. McDowell;

mcdowelj@cps.msu.edu
Sunday, August 4

Spatial and Temporal Reasoning
Contact: Frank Anger; fanger@nsf.gov
Sunday, August 4

Structural Issues in Planning and Temporal Reasoning
Contact: Tom Dean; tld@cs.brown.edu
Monday, August 5

Theories of Action and Planning: Bridging the Gap
Contact: Chitta Baral; chitta@cs.utep.edu
Sunday-Monday, August 4-5 (1-1/2 day workshop)

Validation and Verification of KBS
Contact: Jim Schmolze; schmolze@cs.tufts.edu
Monday, August 5

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Your AAAI–96/IAAI–96 program registration includes admission to all sessions, invited talks,

the AAAI–96 Joint Exhibition, the Student Abstract Poster Session, the AAAI–96 opening reception, and the AAAI–96/IAAI–96 Conference *Proceedings.* Onsite registration will be located in
>   Concourse A, lower level
>   Oregon Convention Center
>   777 Northeast Martin Luther King Jr. Boulevard
>   Portland, Oregon 97212

Early Registration
(Postmarked by June 7)
>   *AAAI Members*
>   Regular $395   Students $120
>
>   *Nonmembers*
>   Regular $450   Students $165

Late Registration
(Postmarked by July 5)
>   *AAAI Members*
>   Regular $445   Students $145
>
>   *Nonmembers*
>   Regular $500   Students $190

On-Site Registration
(Postmarked after July 5 or onsite.)
>   *AAAI Members*
>   Regular $495   Students $170
>
>   *Nonmembers*
>   Regular $550   Students $215

KDD-96 Registration Fees

Your KDD–96 program registration includes admission to the KDD–96 sessions, the KDD–96 invited talks, the AAAI–96 Exhibition, the KDD–96 opening reception, and the KDD–96 conference *Proceedings.*

Early Registration
(Postmarked by June 7)
>   *AAAI Members*

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Nonmembers
Regular $245   Students $115

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