Celebrating AI's Fiftieth Anniversary and Continuing Innovation at the AAAI/IAAI-06 Conferences

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> *There is nothing like dream to create the future.*
> *Utopia today, flesh and blood tomorrow.*
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> Victor Hugo (1802–1885), Les Miserables, *1862*

> *The computer is the first metamedium, and as such it has*
> *degrees of freedom for representation and expression never*
> *before encountered and as yet barely investigated.*
>
> *Alan Kay (1940 -)*

The seeds of AI were sewn at the Dartmouth Conference in the summer of 1956. John McCarthy, then an assistant mathematics professor at Dartmouth, organized the conference and coined the name "artificial intelligence" in his conference proposal. This summer AAAI celebrates the first 50 years of AI; and continues to foster the fertile fields of AI at the National AI conference (AAAI-06) and Innovative Applications of AI conference (IAAI-06) in Boston.

In the Beginning …

The computer age was just dawning in 1956. MIT researchers that year built the TX-0, the first general-purpose, programmable computer with transistors. IBM shipped the first magnetic disk storage, the 305 RAMAC, composed of 50 magnetically coated metal platters with 5 million bytes of data. The first experiments were underway at MIT in direct keyboard input to the Whirlwind, breaking the ground for today's keyboards. The introduction of the FORTRAN language was still a year away.

"The summer conference, convened on the campus of Dartmouth College in Hanover, New Hampshire, brought together for the first time many of the early pioneers of cybernetics, automata and information theory, operations research, and game theory," according to the Software History Dictionary Project of the Charles Babbage Institute. "Attendees (of the Dartmouth Conference) adopted the following slogan as a starting point for their discussion, 'Every aspect of learning or any other feature of intelligence can in principle be so precisely described that a machine can be made to simulate it.'" This statement has essentially remained the credo of artificial intelligence research ever since.[1]

Allen Newell, Herbert Simon, and Clifford Shaw first publicly demonstrated their landmark Logic Theorist at the conference. Considered by many to be the first AI program, it was the first time a computer proved abstract statements rather than just performing specific calculations. The Logic Theorist could independently prove 32 of the 58 mathematical theorems in Bertrand Russell and Alfred North Whitehead's *Principia Mathematica*. It ran on the JOHNNIAC computer, created by John von Neumann.

The Dartmouth Conference attendees predicted that much would be achieved in the field by 1970; for instance, that a digital computer would become a chess grandmaster. In fact, it would take seven additional years to achieve this dream for it was not until 1997 that IBM's Deep Blue beat then reigning World Chess Champion Garry Kasparov. Other hypotheses from the conference, like computers understanding spoken language, are still only partially realized.

Artificial intelligence today is a very broad field and encompasses a wide range of research and application endeavors from abduction and agents to vision and the Web.[2] Over the past 50 years there has been tremendous progress in instantiating the dreams of the Dartmouth Conference, including the huge and highly visible AI wins like Deep Blue, and the recent victorious completion of the DARPA Grand Challenge by a Stanford University-built robotic vehicle.

AI Ubiquitous and Pervasive

Perhaps more important and far-reaching than the "big wins" has been the steady, incremental progress of AI —from invention in the labs, to the crossover to early adopters, and finally fanning out into industry and everyday life. AI is ubiquitous. It is not well recognized how thoroughly AI is blended into the fabric of modern society—in space, on land, in water, and in cyberspace.

There are many examples. For instance, most electronic gadgets and home appliances today have fuzzy logic embedded to automatically fine-tune their performance. Walk into many household superstores and you bump into displays of small robot vaccum cleaners. Many of the largest chain stores in the U.S. are powered

DARPA Grand Challenge Winner Sebastian Thrun:

*A Competitor in Three AAAI Mobile Robot
Competitions in the 1990s Returns this Year
to Give an Invited Talk on
"Winning the DARPA Grand Challenge"*

Past AAAI conferences have hosted much seminal work that has since evolved and flourished. Sebastian Thrun, for instance, first competed in the Mobile Robot Competition in 1992. Thrun competed again in 1994 Mobile Robot Competition, this time on the first European team (University of Bonn), winning 2nd place for the "clean up the office" event. Two years later, with his own team from CMU, he shared 1st place for the "clean up the tennis court" event. Last fall he led the Stanford University robotics team that won the $2 million DARPA Grand Challenge

Thrun says he learned a lot from these seminal competitions. "It's a totally different animal to make a robot work once and videotape it, or make it work always, on the push of a button," he says. "Failures during the 1994 competition made me realize we needed a big leap forward in robustness. So I started working on probabilistic algorithms - on which I just published a book." Thrun says his work on probabilistic algorithms was instrumental in the architecture of Stanley, the winning robot. "We used them to make Stanley robust to errors in its various sensors, and Stanley also used probabilistic methods for adapting to the terrain during the Grand Challenge."

"Of course," he continues, "in the early (AAAI Mobile Robot) competitions we were all very naive, and we have made much progress since. The DARPA Grand Challenge was much harder."

He will present an invited talk on "Winning the DARPA Grand Challenge" at this year's IAAI conference. As Thrun says, "This talk will provide insights into the software architecture of Stanford's winning robot 'Stanley.' The robot heavily relied on advanced sensor technology, and advanced artificial intelligence to make sense out of the massive amounts of sensor data acquired by the vehicle. The talk will introduce you into the fascinating world of autonomous robotics, share with you many of the race insights, and discuss with you some of the implications for the future of our society."

"This success (of Thrun's team winning the Grand Challenge) is important to AI applications for two reasons," according to IAAI Conference Chair Bruce Porter. "First, the success is the direct result of creative application of AI technologies - just the sort of innovation that the IAAI conference seeks to showcase. Second, the success opens the door for many new applications and products, both in military and civilian domains."

"Sebastian Thrun's achievement in leading the Stanford Stanley team to victory in the DARPA Grand Challenge is a major breakthrough for intelligent robotics," concurs AAAI President Alan Mackworth. "Like the Web, robotics is another transformative technology. But the promise of robotics has not been fulfilled as rapidly as we had hoped. However, Sebastian's work, both theoretical and practical, shows the way forward to building significant robotic technologies such as assistive robotics for the elderly and disabled. This opens an area of huge potential for AI and robotics researchers."

Thrun says he hopes attendees of his talk will take away "excitement, a new vision for robotics and AI — or just a fun story to tell their friends and students." Porter hopes they come away with "Thrun's passion for innovation, his can-do attitude and his deep understanding of AI technologies."

"AAAI (the organization) has always been very close to my heart," Thrun notes. "In fact, I am a Councilor at AAAI, and I just gave an invited talk 2 years ago." This was shortly after the first DARPA Grand Challenge in which no autonomous vehicle successfully navigated the course and completed the race. At that conference, a reporter from USA Today asked Thrun whether any robot would ever win the DARPA race, and Thrun enthusiastically and confidently assured him that it would happen very soon. He apparently knew of what he spoke.

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in part by rule-based reasoning embedded into software. Any products you purchase that are imported by cargo ship to the U.S., travel U.S. waters more safely, efficiently, and in a more environmentally sound manner due to an intelligent monitoring system deployed by the National Oceanic and Atmospheric Administration and Northrop Grumman.[3]

For several years, NASDAQ has been using an AI-based data mining system that digs through between 8,500 and 18,000 news wire stories, approximately 1,000 quarterly and annual SEC filings from corporations, and evaluates price-volume models for 25,000 securities each day, identifying and linking "items of interest" that may warrant further investigation. The system has raised the red flag on a number of cases (including some very high profile, instantly recognizable cases) to the SEC and Justice Department for further investigation and/or prosecution.

Itemizing all of the intelligent applications now in use would take volumes. Indeed, many are only known to the corporations, government agencies, and other users who protect their "secret sauce" of competitive advantage.

An outstanding sampling of high-impact AI applications can be found in the 18 years of AAAI's Innovative Applications of AI conference proceedings. They demonstrate just how ubiquitous AI has become. This body of applications will be reviewed this summer by Neil Jacobstein, CEO of Teknowledge, in his IAAI-06 invited talk, "Electrifying Knowledge Work: 362 Innovative Applications of Artificial Intelligence 1989-2006."

The AAAI-06 Conference: A Treasure Trove of Accomplishments

Since the American Association for Artificial Intelligence hosted the first National Conference on Artificial Intelligence in 1980, the AAAI conference has been a central forum for AI researchers. The sum of the conferences' proceedings is a treasure trove of accomplishment and evolution in the field.

Each year, the quality of the conference program is due in large part to the generous volunteer efforts of the organizers, who are leaders within the AI field themselves. "One of the joys of belonging to the AAAI community," says Alan Mackworth, AAAI president and director of the University of British Columbia's Laboratory for Computational Intelligence, "is seeing how well our community works together in planning and executing events like AAAI-06 and IAAI-06. All our staff and all our volunteers work incredibly hard to pull off events like this. And this year they've worked harder than ever!

"This is a special year," notes Mackworth. "It's been 50 years since the Dartmouth Conference set the initial AI agenda. We've had a lot of success (and some failure) over those years. As a field we've learned a lot—now's the time to celebrate, to reminisce, to recalibrate and, most importantly, to reset the AI agenda for the next 50 years. Having the conference in Boston, so close to many of the influential AI birthplaces is highly appropriate."

"What stands out for me in this year's conferences is the innovation in their design," Mackworth continued. "Many new forums have been skillfully designed to bring in new people (and keep the older ones!). The theme could well be seen as inclusivity and interactive participation while keeping our traditional high standards for excellence in science and engineering."

In addition to AAAI-06 workshops, tutorials, technical papers, mobile robot competition and exhibition, game competition, intelligent systems demonstrations, exhibitors' showcase, and the collocated Innovative Applications of AI (IAAI-06) conference, there is still much that is new this year:

The AAAI-06 keynote speaker is Tim Berners-Lee, director of the World Wide Web Consortium. "It's a coup to have Tim Berners-Lee as the keynote speaker this year," says Alan Mackworth. "The Web has transformed our society, and AI plays a significant role in that transformation. The synergy between his concept of the semantic web and AI science and technology will further that transformation."

Invited talks at the AAAI-06 conference will be delivered by Karen Myers (SRI International), Dan Roth (University of Illinois at Urbana-Champaign), Pedro Domingos (University of Washington), and Ken Koedinger (Carnegie Mellon University).

IAAI-06 invited speakers include Sebastian Thrun, leader of the Stanford University team that won the DARPA Grand Challenge this past fall (see the sidebar); and Neil Jacobstein, CEO of Teknowledge, whose talk is entitled "Electrifying Knowledge Work: 362 Innovative Applications of Artificial Intelligence 1989-2006." The Robert Engelmore Memorial Award and Lecture for 2006 will be given by Bruce Buchanan, one of the pioneers of knowledge based systems. Buchanan's talk will reflect on what's been learned about formulating knowledge in computer programs, and what challenges lie ahead.

The new AAAI senior members track offers established researchers an opportunity to give a "big picture" talk on a well-developed body of research, an important new research area, or a thoughtful critique of trends in the field. These presentations are in contrast to regular conference papers which usually focus on a specific contribution. Twelve papers have been accepted for this first-time track.

For the first time, AAAI will offer special technical tracks. The first, on artificial intelligence and the Web, will feature the use of AI techniques, systems and concepts on the Web. The second track, on integrated intelligent capabilities, will consist of papers that report on theoretical or empirical studies that highlight the role of integration of multiple components in achieving intelligent behavior.

AAAI member posters is a new forum that will enable AAAI members to present and discuss their work based on a submitted abstract, rather than a regular AAAI paper. This poster session is intended to stimulate cross-fertilization and the free circulation of ideas.

Finally, the AAAI nectar program will give conference attendees an opportunity to learn about results from AAAI's sister conferences, in a new special track featuring 23 papers and 12 posters.

The Innovative Applications of AI Conference: Demonstrating AI's Maturity and Vitality

AAAI initiated the Innovative Applications of AI awards and conference in 1989 to recognize new applications that solved real world problems with substantial bottom line impact. "The IAAI conference holds considerable significance for the 50th anniversary of AI," says Bruce Porter, IAAI-06 conference chair and director of the AI Lab at the University of Texas at Austin. "It's living proof of the maturity and vitality of the field, which has successfully moved from academic research labs to practical applications in many environments."

"The conference will showcase five successful deployments of AI technologies that solve core problems in customer support, manufacturing, procurement, sourcing, hardware verification and power distribution," he explained. "Each one involves a team of AI researchers and engineers identifying a practical problem in their com-

pany, applying AI methods to solve it, and then—and not insignificantly—working with corporate colleagues and customers to put the solution into practice. Some of these applications have resulted in millions of dollars in saved costs or new revenue."

Crossroads of the AI Generations

Attendees of AAAI conferences typically span several generations of AI researchers, academics, and practitioners. During Ray Kurzweil's invited talk at the AAAI/IAAI-02 conference, for example, a sweep of the audience found then-AAAI president Tom Mitchell in the audience. A few rows behind him was John McCarthy, still in his trademark leather sandals, sitting next to a young student with blue hair.

AAAI continues its commitment to nurture the upcoming AI generation. Besides the workshops and tutorials, the conference includes the student abstracts and poster program, the doctoral consortium program, a volunteer program offering a limited number of complimentary technical program registrations, and a scholarship program providing partial travel support.

The AAAI-06/IAAI-06 conferences will continue to nourish and promote AI dreams, innovations, and accomplishments. There will be much to choose from in the conferences' diverse talks, papers, posters, and competitions. There will be much to celebrate in the accomplishments of the past 50 years. There will be much to anticipate in the coming years.

"It's difficult to single out individuals for credit," says AAAI President Alan Mackworth in acknowledging all of the organizers of this year's conferences, "but I must mention the volunteer hard work of the AAAI-06 program committee chairs Yolanda Gil and Ray Mooney, and the IAAI-06 conference chair, Bruce Porter, and all the other volunteer committee members and reviewers. As always, the stalwart work of Carol Hamilton and her staff makes it all possible.

"Among the hallmarks of these conferences are the new opportunities for involvement," Mackworth notes. "In addition to our core academic audi-

ence of professors and senior graduate students, we expect to expand our participation significantly this year. There's a lot more variety of venues. By coming to Boston July 16–20, you will hear and see the very latest breakthroughs in AI science and technology. This presents opportunities for entrepreneurs, new graduate students, and undergraduates to get a jump on the competition! We also expect to see more senior members of the community return for this historic conference.

"Through the interactive poster sessions and the mobile robotics events and the intelligent systems demonstrations you'll have lots of opportunities to discuss the latest developments with their creators. In addition to all the scheduled events with their interactions there'll be all the informal social occasions too. There's a huge advantage in participating in the conference rather than just reading the papers. The networking and contact opportunities allow for much

more realistic assessment of the state of the art and often trigger off successful collaborations. In short, anyone reading this should come to the conferences! It'll be worth it," he concluded.

Notes

1. Charles Babbage Institute, Software History Project, Dartmouth Conference of 1956, http://www.cbi.umn.edu/shp/entries/dartmouthconference.html

2. For a topic listing of a very comprehensive AI library, see AAAI's digital library and the AI Topics, index www.aaai.org/AITopics/html/sitemap.html

3. Vafaie, Haleh and Carl Cecere, "CORMS AI: Decision Support System for Monitoring US Maritime Environment," *Proceedings of Seventeenth Conference on Innovative Applications of AI 2005,* p. 1499, AAAI Press, Menlo Park, CA.