

AAAI 2000 Conference Summary

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The Seventeenth American Association of Artificial Intelligence (AAAI) and the Twelfth Innovative Applications of Artificial Intelligence (IAAI) conferences were jointly held in Austin, Texas, on 30 July through 3 August. They continue to provide a growing wealth of research stretching into many of the areas of AI. Coupled with demonstrations of the emerging and deployed IAAI techniques, the joint conference results in a complete survey of breaking technology.

With the decade's events in high-performance desktops and "invisible" computing, AI has flourished and now expands from its classical cognitive architecture roots into intense gaming and wireless devices. AI successfully reaches these areas with its continuing multidisciplinary collaborations and creativity.

Creativity at the Metalevel

It is creativity that becomes the fundamental element in AI, moving beyond fixed physical systems. We have seen random-combination (neo-Darwinian) approaches, generator-level heuristic search, and numerous other solutions, none of which use the metalevel. Solutions need to move beyond simple generate-and-test fixed methodologies. "The key to building more creative programs is to give them the ability to reflect at the metalevel on their own framework and criteria," AAAI President Bruce Buchanan stated in the conference address. We need more solutions with the ability to

modify their ontology, vocabulary, and criteria, in turn defining the problems for one's self. Through this ability to modify one's own ontology and reference past experience, innovation and creativity in AI will continually grow stronger systems and cross even more domains.

Efficiency

Ontologies continue to become a growing part of AI as information be-

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comes more accessible. Dealing with millions of entities and inference rules is only part of the problem. One must also cope with adding new information to an existing set as well as extracting information from unrestricted texts. Taxonomic subsumption is increasingly evident as one of the solutions in knowledge formation, allowing the ontology to grow in size and accessibility. Methodologies and tech-

niques for bringing strong ontologies for knowledge acquisition are also dominating this area by using existing resources and markups such as XML to carry the semantic meaning and strongly adhere to the ontology. The IAAI paper "Exploiting a Thesaurus-Based Semantic Net for Knowledge-Based Search," by Peter Clark, John Thompson, Heather Holmback, and Lizbeth Duncan of the Boeing Co., demonstrated a concept-based search engine using an AI thesaurus with unambiguous control terms and relationships for ontology links for finding relevance when searching for human experts in the field.

Blending of Techniques

Having crossed paths successfully with AI before, operations research representations, although more tractable, are not as elaborate as AI representations. Operations research allows for mixed-integer programming formulations and, thus, more complex constraints, whereas in AI, constraint-satisfaction problems limit the search. Further combining the two areas exploits more structure and robust scalability and handles uncertainty as well as practical complexities; jointly, new problems and solutions in stochastic decision making and constraint satisfaction are becoming the new goals of the fields.

Constraint satisfaction with scheduling was shown in the IAAI deployed application discussed in "Nurse Rostering at the Hospital Authority of Hong Kong," by Andy Chun of the City University of Hong Kong and Steve Chan, Garbbi Lam, Francis Tsang, Jean Wong, and Dennis Yeung of Advanced Object Technologies Ltd., where hard and soft scoping rules were applied to manage some 45,000 employee shifts across Hong Kong. By employing malleable constraints, the system allowed for each ward's special needs, each staff member's terms of employment, and varying government regulations. Constraint-satisfaction techniques were also shown in "Campus-Wide University Examination Timetabling Application," by Andrew Lim, Ang Chin, Ho Kit, and Oon Chong of the National University



Photo: R. Skalsky.

The 2000 Urban Search and Rescue Event Brought Real-World Navigation and Sensing to AAAI's Annual Robot Competition.

of Singapore, where researchers plan on applying a weighted measuring scheme to the problem of examination scheduling. Both applications show creativity with flexibility yet provide robust solutions.

New Perceptions

It is this deployed tangibility that continually increases AI awareness; growing visibility will continually dispel AI's missed perceptions because the field is commonly not what people think. Successes such as DEEP BLUE and the Mars Pathfinder have made AI more commonplace; Botball, as well as robotics in general, and human-level AI (particularly in computer games) contribute to this visibility, putting real-time action, autonomy, planning, and learning into our everyday roles. The future lies in increasing agent technologies as well as expanding AI web technologies beyond search engines. Managing a large wealth of information, an AI problem for years now, and controlling

electronic commerce will become the key AI web areas on which to concentrate. The answer lies in fusing solutions together, which will yield the "killer app."

Information and Interfaces

Although it's unclear which area of AI will bring such an application, handling the growing leviathan of information for easier retrieval continues to present a strong focus. Combined with the bigger, stronger ontologies, information retrieval and viewing are becoming a large focus in AI everywhere, from databases to TV guides.

Content and constraint retrieval intelligently tailors enormous selections into manageable lists. The conference presented interfaces such as user profiling by the World Wide Web to interactive rule additions; viewing by HTML, as well as the emergingly popular wireless application protocol (WAP), are also quite successful.

In the world of the increasingly in-

visible computer, we will see less user intervention or interaction as the focus moves away from the web browser and becomes part of the television, cell phone, or other more ubiquitous device. The intelligence of a device will reside on nothing more than a smart card. This entity, now independent of the device, will allow for personal notification and personal applications and exhibit intelligent behaviors such as strong anytime agent mobility.

Also a focus on the virtual application will be a variety of traditional and nontraditional AI techniques to provide singular intelligent interfaces across large domains of nonuniform databases. "THEATERLOCI," by Greg Barish, Craig Knoblock, Yi-Shin Chen, Steven Minton, Andrew Philpot, and Cyrus Shahabi of the University of Southern California, showed new ways of information extraction by wrappers using a suboptimal local search with postrefinement. The importance of these well-defined inter-

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faces, as well as extraction techniques, shows a strong presence of AI techniques emerging as solutions to information abundance.

Agents

Agents and agent interaction were again a large presence at the conference. Agent mobility shows new advances in the field where agents gather information such as user data, time-relative queries, and database interaction and maximize limited-bandwidth situations by migration. The IAAI paper entitled "Rapid Development of a High-Performance Knowledge Base for Course of Action Critiquing," by Gheorghe Tecuci, Mihai Boicu, Dorin Marcu, Michael Bowman, Florin Ciucu, and Cristian Levcovici of George Mason University, showed an agent discipline approach learning from an expert and refining a knowledge base to simplify knowledge acquisition. User communication is conducted more naturally, but more formal methods are used internally with the aid of a shell to assist in ontology base management.

Justine Cassell of the Massachusetts Institute of Technology Media Lab presented an embodied conversational agent, ANNA NOVA, that leverages knowledge of conducting conversation and relative intentions to an interface against theories of modality. The goal is to use the body as a tool for presenting availability clues as conversational systems to assist behaviors, timing, and function.

To support the more accessible technologies, "The Emergence Engine: A Behavior-Based Agent Development Environment for Artists," by Eitan Mendelowitz of the University of California at Los Angeles, presented a system created for artists who have no computer science background and want to make computer-based worlds dynamically generated in real time by scripting. These worlds feature high frame rates, stereo sound, and varying modalities. Agent interaction—user to

agent and agent to agent—is dictated by scripting high-level behaviors (including changing weights; creating and destroying agents; playing media; and communicating with, calling, or spawning other scripts). This system has successfully been installed in art exhibits internationally.

"Defining and Using Ideal Team-mate and Opponent Agent Models," by Peter Stone, Patrick Riley, and Manuela Veloso of Carnegie Mellon University, showcased optimal solutions for quick team agent decisions in a large state and action space environment. By using a "what if I shoot now?" approach called ideal model-based behavior outcome prediction (IMBBOP), pass or shoot decisions are made successfully without the need to maintain an extensive model of the opponent. Many of the goals in the prior competitions were used by these breakaways or pass-shoot scenarios given by this technique. Spectators at the RoboSoccer event were aware of the immense success of their technique.

Robotics

An overall push in mobile robotics is the use of multiple robots that perform divide-and-conquer tasks. Coupled with recent advances in adding in situ functions, the robot's overall performance will be enhanced.

Robotics will move toward outdoor navigation and vision navigation techniques for complicated obstacle avoidance, becoming one of robotics main challenges. The field of vision is becoming more empowered with greater technologies, and digital cameras are now competing with traditional film cameras in spatial resolution. Thus, new techniques can extract even more information and detail that are oblivious to human vision. The combination of modified optics and a stronger computational representation will allow for more intelligent and robust systems in the near future.

Embracing these trends, the 2000

Urban Search and Rescue event brought real-world navigation and sensing to AAAI's annual robot competition. Each team's robot navigated through large and small debris fields as well as identified victims and relayed their locations. The heterogeneous course showed varying levels of difficulty requiring adaptive intelligent solutions. THE ROBOT FROM SWARTHMORE COLLEGE emerged victorious. Moving forward in a developing world of robot puppies and nomadic prospectors, the AAAI contest continually challenges and brings the latest technologies forward.

Gaming

One of the newer areas in AI is computer games. Given DEEP BLUE's recent achievements, AI research actively moves forward in two-player perfect-information games but also will show applicable results in other areas of AI. This year, we saw a small host of multiplayer game techniques in the technical papers and doubtlessly will see more in years to come as gaming expands its reach.

High-performance computer gaming with dynamic virtual worlds has become a recent focus in AI and was strongly present at the conference. As graphics computations are preempted from the central processing unit, greater than 5 percent can now be applied toward AI techniques. Here, the need to dynamically respond to goals in both action and role-playing games reaches into many areas of AI (perception, speech processing, scheduling, just to name a few). These games provide several research problems not only in character interaction but also nonplayer characters (commentary, scene rendering, and so on) and will continue to advance toward stronger challenges.

Conclusion

Bringing together disciplines with stronger representations that reference past experiences was the movement seen at AAAI-IAAI 2000. We should see even greater creativity and stronger, more intelligent, more robust solutions next year!