

AAAI-06 / IAAI-06 Highlights

AAAI's National and Innovative Applications Conferences Celebrate 50 Years of AI

Sara Reese Hedberg

■ The Twenty-First National Conference on Artificial Intelligence and the Nineteenth Innovative Applications of Artificial Intelligence Conference commemorated fifty years of artificial intelligence research in Boston, Massachusetts this past July.

For the AI researchers and practitioners who convened in Boston on July 16–20, 2006 for the AAAI sponsored Twenty-First National Conference on Artificial Intelligence (AAAI-06) and the Eighteenth Innovative Applications of AI Conference (IAAI-06), there was an atmosphere of celebration, collegiality, and continued innovation. The celebration of the first 50 years of AI began the previous week at the Dartmouth Conference on Artificial Intelligence: The Next Fifty

Years. The celebration then moved to Boston where a huge turnout of AAAI fellows—from founding luminaries to 2006 fellow inductees—reported a great weekend meeting prior to the AAAI conference full of discussions and reflection in honor of AI's fiftieth anniversary. The scientists shared their “group think” at a panel at the main conference. Chaired by AAAI past president Bruce Buchanan, the panel summarized the fellows’ reassessing milestones in AI, and striving to understand new problems on the horizon, which if solved would provide a leg up on the next decade of research.

Conference Radiates Vibrance

“Conference attendance and enthusiasm were both way up this year,” noted AAAI president Alan Mackworth,

“which tells me there is renewed vigor in the field; and lots of new and exciting recruits in the form of new students and researchers. There were lots of new faces.”

“The conference radiated a sense of vibrance that was quite fitting for a fiftieth anniversary gathering of AI researchers and practitioners,” remarked AAAI president-elect Eric Horvitz. “The meeting showed strong attendance from a wide span of ages and backgrounds. It sported a set of high-quality papers and associated presentations that demonstrated the breadth and depth of AI to address difficult AI challenges. There was a fun game playing competition, and a separate exhilarating poker competition.” The highly popular Mobile Robot Competition and Exhibition as always drew big crowds at the conference (a report on this competition will be published in an upcoming issue of *AI Magazine*).

“Attendance for the conference was 1,200,” according to Carol Hamilton, AAAI executive director. “This reflects the upward trend that we have seen during the last two years with paper submissions and conference participation. The introduction of several new programs during the past two years, including special tracks on AI and the web and integrated intelligence, as well as the nectar and senior member papers, is a significant factor in this trend.” Senior member papers are a way to collect reflections about areas of work by leaders in the field. Nectar papers are compilations and summaries of results presented previously at “sister” conferences in an attempt to provide an integrative pull back to the core of ideas being generated by affiliated conferences. Other innovations included AAAI member abstract and poster sessions, and a poker competition.

World Wide Web Creator Tim Berners-Lee Is Keynote Speaker

AI is having a significant impact on the web. For instance, recent AAAI conferences have seen talks by senior researchers at Google on the company's use of AI. Yahoo! has hired two



Tim Berners-Lee Tells AAAI-06 Attendees that He Would like the Semantic Web to be a Bus into Which We Could Plug the Whole of AI Technology ... a Place for AI Agents and Algorithms to Romp.

AI pioneers: data mining pioneer Usama Fayyad is now the chief data officer and senior vice president at Yahoo, and Ron Brachman is vice president of worldwide research operations. Further, this year's conference included a new special track on AI and the web, and Google, Yahoo! and Ask.com all sponsored this year's conference.

In light of this vital link, the creator of the world wide web and now director of the World Wide Web Con-

sortium, Tim Berners-Lee, was this year's keynote speaker. "It's a coup to have Tim Berners-Lee as the keynote speaker this year," noted 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." Berners-Lee delivered a lively, thought-provoking talk focused on his vision of the emerging semantic

web and the role of AI. He began by acknowledging that "the semantic web owes a huge amount to AI." He mentioned the role the AI community has played in developing the OWL web ontology language, and the new effort underway involving the rule interchange format¹ to introduce reusable rules on the web. "I would like the semantic web to be a bus into which we could plug the whole of AI technology," he stated, "... a place for AI agents and algorithms to romp."

Invited Talks Well Received

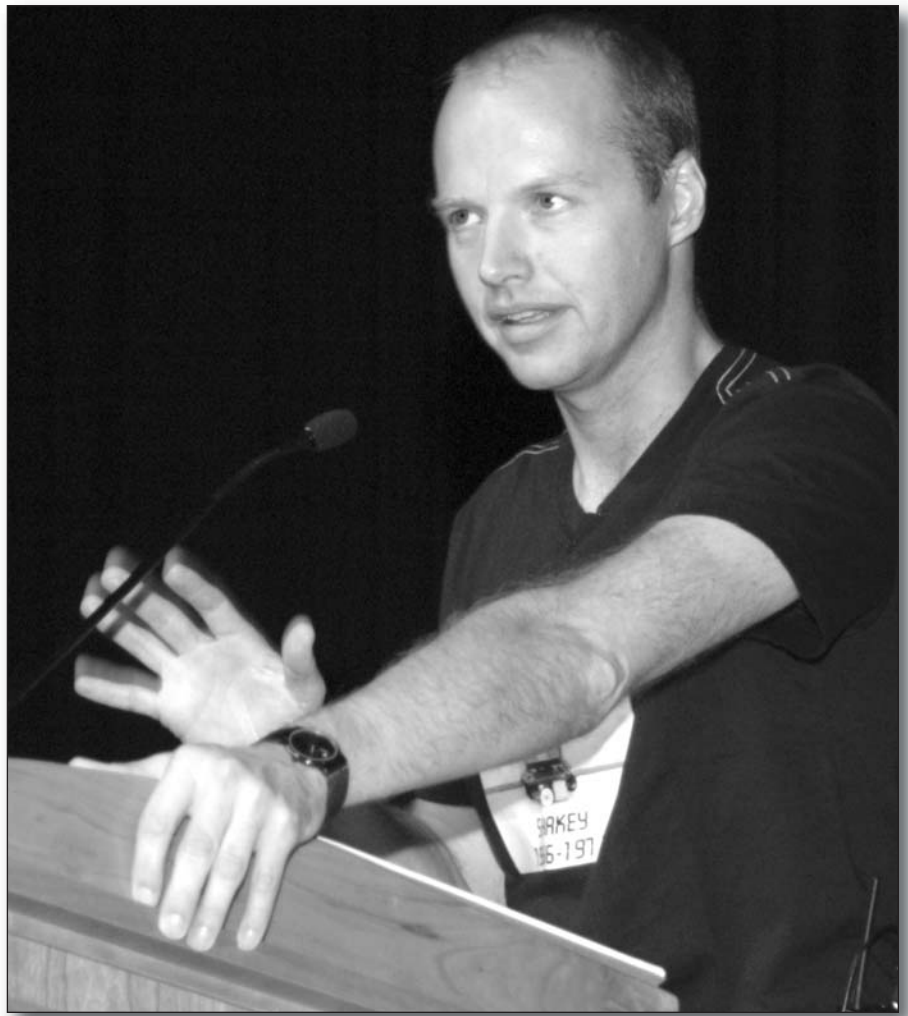
Eric Horvitz summarized what many felt about this year's invited talks. "The invited talks were quite energizing and engaging, including the talk by Sebastian Thrun on the DARPA Grand Challenge, the presentation by Karen Meyers on the large-scale CALO effort, and Pedro Domingo's remarks on the prospects and directions for meshing logic and uncertainty" as well as Dan Roth's talk on natural language, and Ken Kiesinger's remarks on cognitive tutors.

IAAI invited speaker Sebastian Thrun began by celebrating how far robotics has come, noting that Shaky had just turned 40.² He explained that the DARPA Grand Challenge was in response to Congress's National Defense Authorization Act of 2001, which set the goal that by 2015 one-third of the operational ground combat vehicles of the Armed Forces be unmanned.

Thrun recounted the technical evolution of Stanley, his DARPA Grand Challenge winning vehicle. He was quick to emphasize that "this was not Stanley's victory." The accomplishments were far more widespread. "Five robots finished the race," he said. "About ten teams—with a little tweak here or there—could have finished." He also paused to admire some of the technical achievements of other competitors, such as the fallen motorcycle that righted itself during a qualifying round.

Looking ahead, Thrun spoke of the next autonomous vehicle challenge, the Urban Challenge scheduled for November 3, 2007 in which autonomous ground vehicles must safely complete a 60-mile urban area course in fewer than six hours. "This is a fantastic AI opportunity," he exclaimed. "It is a much more difficult testbed."

Taking a broader view of the autonomous vehicle efforts, Thrun pointed out how thousands of lives lost in roadside bombings in Iraq could be saved with autonomous vehicles. Further, in the US, 42,000 people die each year in traffic accidents, the same number as in all of the Vietnam



Invited Speaker Sebastian Thrun Is Optimistic about the Role of Autonomous Ground Vehicles.

war. He suggested this number could be decreased significantly through autonomous vehicles.

Sharing a vision of the future of commuting, he cited a figure that today the average commute is 1.25 hours per day per work person—time better spent in more productive pursuits while the car drives itself. While currently 8 percent of the highways are taken up by cars, 92 percent is free because we need room between cars. Thrun speculated that if through autonomous vehicles we increased highway throughput by taking up 16 percent of the highway, that would double the road capacity without building more roads.

Shortly after AAAI-06, Stanley

became part of an exhibit at the Smithsonian's National Museum of American History in Washington, DC showcasing the future of automated highways and smart cars.

Outstanding Group of Innovative AI Applications

"This year's Innovative Applications of AI conference," according to organizer Bruce Porter, "indicates that AI applications are succeeding in the real world, generating substantial value, both for companies and for society." There was a fascinating range of applications this year—from CombineNet's group auction system that saved \$1.8 billion dollars, to IBM's hardware



Teknowledge CEO Neil Jacobstein Comments on How Far AI Applications Have Come Since 1989.

design verification system used for the Xbox and various IBM and Apple computers (saving IBM \$100 million over 10 years), to security systems to protect computer infrastructures and the national food supply, to a system to digitally preserve ancient Chinese architecture being torn down in the country's rush to modernize.

During the eighteen years of this conference, some 362 applications have been recognized. Together, they show the breadth and depth with which AI has penetrated the fabric of modern life. They are running operations, and assisting engineers and managers under the ground, on the ground, in the ocean, in the air, and in space. They can be found assisting insurance underwriters, financial

traders, F-18 pilots, engineers, genomic researchers, and NASA scientists.

While these applications represent the myriad ways AI research is being employed, together they are but the tip of the iceberg in terms of actual deployed applications. Many of the applications in use today are embedded in consumer electronics, in corporations' "secret sauce" where they are closely guarded competitive advantages, or in classified government operations. Consequently, the IAAI winners an important source of information on evolving trends in deployed AI systems.

Neil Jacobstein, chief executive officer and president of Teknowledge, perhaps best summarized today's state of

AI applications in his IAAI invited survey talk "Electrifying Knowledge Work: 362 Innovative Applications of Artificial Intelligence, 1989–2006." Jacobstein recalled the early days of deployed intelligent systems in the 1980s and early 1990s, when applications ran on stand-alone workstations. By contrast, he said, one of this year's IAAI award-winning applications from CombineNet is saving \$1.8 billion annually and running on a server farm. "We're not in Kansas any more," he quipped.

Deployed Application Winners

Since 1989, the American Association for Artificial Intelligence has recog-

nized true innovation in the application of AI to real world problems through the Innovative Applications awards. Each of these applications must be fully deployed and have demonstrated, measurable return on investment.

CombineNet, Inc.

Sourcing professionals buy several trillion dollars worth of goods and services yearly. CombineNet's award-winning application introduces a new paradigm, called expressive commerce for sourcing. The company has hosted \$16 billion of sourcing using the technology, and created \$1.8 billion of hard-dollar savings in lowered procurement costs. It enables buyers to pool their procurement needs to achieve economy of scale savings, and suppliers to reduce their costs accordingly. It combines highly expressive human negotiation with electronic reverse auction so that supply and demand are expressed in far greater detail than traditional electronic auctions, and are algorithmically cleared. The system has a fast tree search algorithm. The savings were measured compared to the prices that the buyer paid for the same items the previous time the buyer sourced them (usually 12 months earlier.) This does not normalize the savings by taking into account that during the same period, the prices in the largest segment, transportation, generally increased by 6 to 9 percent. Further, the savings does not include those obtained by suppliers, nor those stemming from reduced effort and compression of event timelines from months to weeks or even days. There are also the more intangible benefits, such as better supplier relationships, and redesign of the supply chain.

IBM Haifa Research Laboratory

IBM's constraint-based random stimuli generation for hardware verification application verifies hardware designs prior to their casting in silicon. It has been used in the development of numerous IBM Power processors, IP-series servers; Cell and Microsoft's Xbox core processors and systems, and various processors of Apple computers. IBM estimates that this system has



Former AAAI President Bruce Buchanan Receives Engelmores Award from AI Magazine Editor David Leake. Buchanan Presented the Engelmores Lecture on "What Do We Know About Knowledge."

saved the company more than \$100 million during the last decade in direct development costs and reduced time-to-market. The application uses AI for the verification of its processors and systems, generating tests or stimuli, for simulating hardware designs. It ensures that the hardware implementation conforms to the specification before starting the expensive fabrication of silicon. An early version of this technology was an IAAI award winner in 1994. AI techniques were only rudimentarily implemented then. The

ensuing decade-plus of experience has resulted in much more sophisticated AI and great success in deployment. The current system has become the standard in processor verification within IBM and has become a repository of extensive processor verification knowledge across multiple IBM labs and many processor architectures and implementations. IBM reports that it allows comprehensive reuse of knowledge, rapid reaction to changes, and gradual reduction in the need for human experts.

General Electric Global Research

GE's case-based reasoning system was created to support customers who purchased appliances from the company. This has greatly improved customer satisfaction and saved GE \$44.5 million between 2000–2005 due to reduced cost of visits of field service technicians to customers' homes. When a customer calls GE for help, a call-taker uses the system to diagnose the problem, and step the customer through its solution. The system has been in use by 300 call-takers since 1999, resulting in a 20 percent increase in the probability that the customer's problem can be solved over the phone.

Ford Motor Company, Global Manufacturing Engineering Systems

The machine translation for manufacturing system translates Ford's vehicle assembly build instructions from English to German, Spanish, Dutch, and Portuguese to support assembly plants in Europe, Mexico, and South America. To date, over 5 million Ford records have been translated from English into the target languages. Now deployed for 7 years, it makes vast amounts of dynamic information available within 24 hours of the process sheet being written and completed. While the translations are not as good as human translators, the system is highly accurate (the English / German is over 90 percent correct).

Hong Kong University of Science and Technology, South China University of Technology, Red Jasper Ltd., and Philips Electronics

The transportation procurement and bid optimization system (TPBOX) for Philips Electronics automates and optimizes procurement of courier services. Philips typically procures courier services for more than 2,500 shipping lanes annually. Deployed in 2005, this intelligent software with its optimization engine has resulted in significant cost and time savings in analyzing and optimizing procurement decisions.

Columbia University and Consolidated Edison

This award winning application uses machine learning techniques as the foundation of ranker for open-auto maintenance scheduling (ROAMS) to identify weak links in the almost one thousand 13.8kV-27kV energy distribution feeder cables that supply electricity to the boroughs of New York City. In Manhattan, rankings are updated every 20 minutes and displayed on distribution systems operators' screens. A separate system makes season predictions of failure susceptibility. The feeder failures, known as "open autos" are a significant maintenance problem. A year's development effort has resulted in a system that demonstrates high accuracy: 75 percent of the feeders that actually failed over the summer of 2005 were in the 25 percent of feeders the system ranked most at-risk. By the end of the summer, the 100 most susceptible feeders as ranked by the ML system were accounting for up to 40 percent of all feeder failures that occurred each day. The system also identifies the factors underlying failures, providing insights into the feeder system.

Emerging Application Winners

In addition to deployed applications, AAAI recognizes highly innovative new applications which are still under development but which hold great promise and are intriguing uses of various AI techniques. This year AAAI recognized 15 emerging innovative applications.

University of Washington and Microsoft Research

Current popular route planning systems (Windows Live Local, Yahoo! Maps, Google Maps, and so on) generate driving directions using a static library of roads and road attributes. They ignore both the time at which a route is to be traveled and the preferences of the driver. The University of Washington and Microsoft Research have devised a working prototype, named TRIP, that includes a set of

methods for including driver preferences and time-variant traffic condition estimates in route planning. Their prototype uses a large database of GPS traces logged by drivers, and learns time-variant traffic speeds for every road in a widespread metropolitan area. TRIP also leverages a driver's past GPS logs when responding to future route queries to produce routes that are more suited to the driver's individual driving preferences. Using experiments with real driving data, the authors demonstrate that the routes produced by TRIP are measurably closer to those actually chosen by drivers than are the routes produced by routers that use static heuristics.

Massachusetts Institute of Technology, Teknowledge

Much of the infrastructure of modern society is controlled by software systems that are vulnerable to attacks. AWD RAT is a DARPA-funded project that aims to protect systems and enable them to self-diagnose and recover after compromise. The emerging system is a middleware system that is designed to provide survivability to both new and legacy applications as an infrastructure to which an application may be tethered. It provides survivability properties such as error detection, fault diagnosis, backup, and recovery. It uses cognitive techniques to provide the system with the self-awareness necessary to monitor and diagnose its own behavior. AWD RAT gains visibility into the execution of an application system and compares the application's actual behavior to that which is expected. Discrepancies between intended and actual behavior are diagnosed using model-based diagnosis techniques. Recovery is guided by decision theoretic methods. The system has been tested on an example application system, a graphical editor for constructing mission plans. It has been demonstrated effective in detecting, containing and recovering from compromises that might arise from a broad variety of attack types. It works from models of what the application should be doing rather than a library of specific attack types.

Carnegie Mellon University, US Department of Agriculture

Emerging patterns in food complaints is a statistical data mining component of the consumer complaint monitoring system, designed to help the food safety officials efficiently and effectively monitor incoming reports of adverse effects of food on consumers. The reports are collected in a passive surveillance mode from various sources such as consumer telephone calls to federal, state, or local health departments, as well as the Food and Drug Administration. Each year in the US, there are 76 million recorded cases of food-borne illness, and about 5,000 of them are terminal. The attacks of September 11, 2001 brought special attention to the vulnerability of the US food supply system. This application is being envisioned as one of the key components of the nationwide biosecurity protection infrastructure. It has been accepted for use and is currently going through the final stages of deployment to monitor meat, poultry, and egg products. The application is an instance of the generic Tip Monitor, illustrates the applicability of this approach, and suggests it could be useful in other domains.

Zhejiang University

Zhejiang University's intelligent system models ancient Chinese complex architectures. It uses an ontology based approach to analyze the styles of different architectures. The system has been successfully applied in the digital heritage project for ancient architectures in southeast China. Most ancient Chinese buildings are wooden, so the original goal is to build geometric models of endangered architectures.

University of Hartford, University of Connecticut, and Amherst College

As part of a larger Machine Ethics Project, researchers at the University of Hartford, University of Connecticut, and Amherst College are developing an ethical advisor that provides guidance to health care workers faced with ethical dilemmas. Their work explores machine ethics, which is concerned with the behavior of machines towards human users and other

machines. This work may also function as a model for creating machines that can follow more general ethical principles in any domain.

ICT, University of Southern California

ICT's system is a modular and generic architecture for explaining the behavior of simulated entities. As AI systems and behavior models in military simulations become increasingly complex, it has been difficult for users to understand the activities of computer-controlled entities. Such simulations are used for training and as predictive tools. ICT is using domain independent, modular software to develop explanation facilities for virtual humans, a Department of Defense project designed to teach soft skills such as leadership, teamwork, negotiation, and cultural awareness.

Samsung

Samsung's experimental system is exploring a novel user interface for handheld mobile devices that recognizes hand grip patterns and launches the appropriate applications. The working prototype is provided with an array of capacitive touch sensors and a 3-axis accelerometer underneath the exterior cover. The goal is to provide users with an intuitive and natural user interface that adapts to the personalized hand grip patterns of the user. The prototype uses pattern recognition techniques for identifying the users' hand grips from the touch sensors.

Bar-Ilan University and Harvard University

Bar-Ilan and Harvard have devised an experimental system that includes a novel negotiation protocol for cellular networks, which intelligently improves the performance of the network. The proposed reactive mechanism enables the dynamic adaptation of the base stations to continuous changes in service demands, thereby improving the overall network performance. The system uses a distributed agent-oriented local negotiation mechanism for cellular network simulations, which can affect the real-time adaptation of deployed cellular net-

works. It includes clusters and intro-cluster negotiation, as well as an investigation of the nature of the committed offers. Experimental results show the applicability of the proposed method in two distinct scenarios. The negotiation protocol initiated a change in the pilot power between two base stations; and it appears that better performance was achieved when the sum of differences between the pilot power before and after the change was positive.

A-Life Medical, Inc. and Partners HealthCare Systems Inc.

AM-Extractor is a prototype product that supports health care providers in meeting requirements to report evidence-based quality measures to various governmental and independent regulatory agencies. This computerized system automates the process of abstracting appropriate facts from a patient's medical record to provide the data for these measures. It uses natural language processing (NLP) and a rule-based approach. An evaluation of a deployed system used for hospital inpatient cases is discussed. The results show the NLP performed with high accuracy across multiple types of medical documents, and user productivity improved significantly. Challenges remain in the areas of availability of electronic patient data and a model for large-scale deployment and support.

University of Alberta

The University of Alberta has designed a general-purpose framework for making various machine-learned classifiers used in data mining and knowledge discovery systems more transparent. It provides explanation of a classifier's reasoning, which can facilitate end-user acceptance and confidence in the system. So far, the developers have demonstrated using ExplainD on example applications that use several different classifiers. The system generates a simply graphical explanation of the classification process to provide visualizations of the classifier decisions, and evidence for the decisions. It also offers the capability to speculate on the effect of changes to the data, and to drill down and audit the sources of the evidence.



IAAI Paper Submissions Are Due January 23, 2007

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[www.aaai.org/
Conferences/IAAI/
iaai07.php](http://www.aaai.org/Conferences/IAAI/iaai07.php)*

Music Technology Group

This sequential covering evolutionary algorithm for expressive music performance uses an evolutionary approach to model the knowledge applied by a musician when performing a piece in order to produce an expressive performance. The system extracts a set of acoustic features from standard Jazz recordings and provides a symbolic representation of the musician's expressive performance. It then applies a sequential covering evolutionary algorithm to the symbolic rep-

resentation, generating an expressive performance computational model capable of endowing a computer-generated music performance with the timing and energy expressiveness that characterizes human generated music.

University of Nebraska-Lincoln

The University of Nebraska-Lincoln application implements a computer-supported cooperative learning system in education, I-MINDS. It consists of a set of teacher agents, group agents, and student agents. While the individual agents possess individual intelligent capabilities, what is novel is the multi-agent intelligence and coalition (group) formation. I-MINDS supports student participation and collaboration, helping the instructor manage large, distance classrooms, forming student groups in a structured cooperative learning setting. I-MINDS has been deployed experimentally in an introductory computer science class in the spring and fall of 2005. It was compared against traditional, face-to-face collaboration. Results showed students using I-MINDS performed (and outperformed in some case) as well as students in traditional settings.

University of Maryland Baltimore County

The University of Maryland's application applies AI search and information visualization techniques to school redistricting. This is a multicriteria optimization problem in which competing objectives must be considered, such as school capacity, busing costs, and socioeconomic distribution. Tools help end users generate, evaluate, and compare alternative school assignment plans that represent different tradeoffs in the decision space. It uses heuristic search methods. Preliminary testing has been done on the population data from the Howard County, Maryland school district. Plans are underway to work with the superintendent's office in an effort to release an alpha version of the system for use during the 2006-07 redistricting process.

USC ISI, SRI International, and Stanford University

The CALO Query Manager addresses

the problem of integrating and querying information residing in heterogeneous knowledge sources with different query-answering capabilities. It employs a hybrid reasoning architecture, reusable ontology, and a query planner. This query manager is part of a larger multidisciplinary project called CALO (cognitive assistant that learns and organizes), funded by DARPA to create cognitive software systems that can reason, learn from experience, be told what to do, explain what they are doing, reflect on their experience, and respond robustly to surprises. The current project is targeted at developing personalized cognitive assistants in an office environment where knowledge about e-mail, schedules, people, contact information, and so on is distributed among multiple knowledge sources. This emerging application has been tested and empirical results demonstrate its efficiency.

University of Arizona

Context-aware power management in WLANs addresses some of the energy consumption and balancing issues inherent in mobile devices. It takes a unique approach to the problem because it tunes the power characteristics of the network interface based on high-level behavior—the user's interaction with running applications, instead of the more typical low-level monitoring of application behavior. The system uses simple machine learning techniques such as *K*-means coupled with correlation of clusters with observed device activity, to distinguish different usage patterns. The developers suggest that this approach will improve accuracy and respond to new demands better due to the proactive nature of the resource allocation/configuration it enables.

Notes

1. www.w3.org/2005/rules/.
2. www.sri.com/about/timeline/shakey.html

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