

# A Review of the Twenty-Second SOAR Workshop

Frank E. Ritter and Isaac G. Council

The work presented at the SOAR workshop illustrated several trends that should be of interest to those outside the SOAR community and some of the issues that SOAR is grappling with that other groups developing unified theories of cognition or AI programming languages might find interesting as well.

SOAR workshops are currently held annually in late May or early June. Recently they have been held at the University of Michigan and at the University of Southern California's Information Sciences Institute (USC/ISI), two of the largest SOAR sites. They are held on a Saturday and Sunday, with a tutorial or two on the preceding Friday.

This year the workshop was preceded by two days of tutorials: an introductory tutorial on Thursday and a more advanced tutorial on Friday. The tutorials were held at the University of Michigan's Advanced Technology Lab and at the workshop site. The workshop was held just off campus at Soar Technology, a four-year-old startup company that produces SOAR systems for industry and government. We think this is a good sign because it indicates a certain maturity of SOAR. This site also indicates that the largest SOAR site, at least as indicated by speakers at the workshop, is now a research and development company.

The SOAR workshop assumes that the audience is already familiar with SOAR (thus the tutorials). The talks are short, sometimes as short as 5 minutes, rarely longer than 15 minutes.

The proceedings typically are just copies of the slides used for the presentations, but sometimes more extensive prose or examples are included. In the last several years, these "slides" have been put up on the web.<sup>1</sup>

There were 37 talks this year as well as a discussion session with 57 attendees. The speakers came from 11 sites (including 2 from Britain), but the talks were not evenly distributed because 13 came from Soar Technology, 10 from Michigan, 4 from USC/ISI, and 2 from Pennsylvania State Uni-

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■ SOAR is one of the oldest and largest AI development efforts, starting formally in 1983. It has also been proposed as a unified theory of cognition (Newell 1990). Most of its current development is as an AI programming language, which was evident at the Twenty-Second SOAR Workshop held at Soar Technology near the University of Michigan in Ann Arbor on 1-2 June 2002.

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versity. Seven sites made one presentation, sometimes involving multiple researchers. The community is thus primarily at the three large sites but with numerous small sites.

## Highlights of the Workshop

There were numerous interesting pieces of work that we organized into 10 themes: (1) architecture modification, (2) learning, (3) multiagent sys-

tems, (4) computer-generated forces, (5) games, (6) interfaces for programs, (7) interfaces for modelers and users, (8) reuse, (9) models of eyes and hands, and (10) robotics. This is our take on the workshop, and it reflects our biases and interests.

The proceedings, based on a short discussion at the end of a session, will continue to include just slides, not full papers, providing a very good yearly summary but with some obvious defects. The format provides a lightweight way to describe ongoing work as well as projects that are about to start, which encourages collaboration.

## Architecture Modification

One talk that stood out was about adding working memory decay to SOAR (Mike James, University of Michigan). A SOAR model of the tower of Hanoi was run in a version of SOAR modified to include decay of memory objects. The resulting behavior was compared to existing data. The predicted reaction times of the model in the modified architecture correlated 0.986 with reaction times to move each disk collected from human subjects. The behavior of a comparable ACT-R model of the tower of Hanoi correlated 0.995, virtually identically well.

Another interesting project was to examine how to include a range of behavioral moderators into the SOAR architecture by adding a connectionist substrate (Randy Jones, Soar Technology and Colby College). This substrate will include measures of pain-pleasure, arousal, and confusion-clarity of the situation.

Some work was introduced that explored *forgetting*, examining what happens to response time if learned rules that are not used are discarded after various amounts of time (Bill Kennedy, George Mason University). The system appeared to get slower as more was learned but sped up if very infrequently learned rules were deleted. It did not speed up if unused rules were deleted just a short time after being learned. Removal of learned rules has not been optimized in SOAR, making this result hard to interpret. What was interesting is

that the results to us appear to be consistent with Doorenbos's results that show a small rate of slowdown as new rules are learned (Doorenbos, Tambe, and Newell 1992).

## Learning

There were several projects that included new approaches or types of learning. These projects, some in an early stage, integrated learning by observation using inductive logic programming (Tolga Konik and John Hawkins, both of University of Michigan), learning through self-explanation (Jones), reusing and testing of the previous symbolic concept acquisition model in ACT-R (Robert Wray, Soar Technology), making of learning and behavior more robust (Jennifer Kiessel, Paul Nielsen, and Jonathan Beard, all of Soar Technology), the learning of how to recover from lack of knowledge but with some domain-specific yet slightly general knowledge (Kiessel), and a project attempting to discover errors in behavior by having agents catch their own errors (Scott Wallace, University of Michigan).

## Multiagent Systems

Many of the projects that were about modeling human or agent behavior also concerned themselves with multiple agents, including models of teamwork, communication between agents, and motivation of other agents (Andrew Nuxoll, University of Michigan, and James Beisaw and Glenn Taylor, both of Soar Technology). Another interesting project examined conflict resolution and the possible dilemmas that can arise when problem solving is not rational (Tony Kalus, University of Portsmouth).

## Computer-Generated Forces

The largest current (but certainly not only) application of SOAR is for *computer-generated forces*, that is, modeling humans and combat vehicles in military simulations. In addition to being the application domain of several other talks, work was presented on modeling urban combat with SOAR in ONE SAF (a simulation tool for synthetic environments) and in a variety of other projects (Douglas Reece, Sci-

ence Applications International Corporation; Wray; Michael van Lent, Institute for Creative Technologies; Jones; Beisaw; and Wallace).

## Games

Laird believes that computer games are an important and useful application for AI models.<sup>2</sup> Several folks working with Laird presented work on creating SOAR models for populating computer games, including a haunted house game (John Laird, University of Michigan) and military tactics games, both as an individual in a first-person shooter like UNREAL TOURNAMENT as well as small squad games (van Lent). Agents are being built to serve as opponents and sometimes assistants and colleagues. Exploratory work is being conducted that aims to put SOAR into the role of an interactive story director (Brian Magerko, University of Michigan) as well as provide directable characters within the story (Mazin Assanie, University of Michigan). Some work was presented dealing with interfacing SOAR to the UNREAL game environment (Devvon Stokes and Alex Kerfoot, both of University of Michigan).

## Interfaces for Programs

Several talks reported projects that provide various types and levels of application program interfaces (APIs) to SOAR. These APIs are to support projects that need to embed SOAR and provide a more uniform and steady approach to building tools that work with and for SOAR. None have been released, but two are promised shortly (Jens Wessling, Soar Technology, and Douglas Pearson, Three Penny Software).

## Interfaces for Modelers and Users

Many in the SOAR community are realizing that interfaces for teaching users and developing SOAR models (broadly defined) need to be improved. Several of the papers were about user interfaces or had aspects related to user interfaces. Several groups are working on extending programmer interfaces to SOAR (Brian Harleton, University of Michigan, and Jacob Crossman, Soar Technolo-

gy). Interface usability concerns were addressed with a task analysis (Frank Ritter, Pennsylvania State University), a new toolkit for creating displays for SOAR models was presented (Taylor), and at least two groups are working on adding explanation capabilities to SOAR (van Lent and Isaac Councill, Pennsylvania State University).

## Reuse

One of the main reasons for working within a cognitive architecture, according to Newell, is to encourage theory cumulation and reuse. In a cognitive architecture such as SOAR, because theories are represented as programs, production rules (knowledge), or changes to the architecture (primitive capabilities), this reuse has to mean at least the reuse of ideas, but more likely needs to mean the reuse of systems and knowledge sets. We believe that reuse has been a continual problem in SOAR.

There are examples of reuse within the SOAR community, and a few were presented here. A theory of concept acquisition was reused and is being extended to match a large pot of data for a cognitive model comparison exercise (Wray).

NL-SOAR, a theory of how natural language is realized in SOAR, continues to be developed (Deryle Lonsdale, Brigham Young University). When it is complete, and available, it can be a widely used (and thus reused) theory of natural language understanding.

More than one of the speakers reported a new and clearly useful tool for writing, editing, and augmenting SOAR code. The last speaker was asked what the take-home message was. Was it that the tool would be released or that notes on the technique would be made available, or was he just teasing us? For far too many reports (including one of ours), it appears that the answer was that we are just being teased.

## Models of Eyes and Hands

A model was reported that interacted with an interface based on the picture on the screen (van Lent). Image processing was used to derive environmental structure, that is, where buildings were and where doorways

were in a synthetic environment. This spatial map was then used in several ways to generate motion through the environment.

Interaction based on working through the display is a useful step for making SOAR less dependent on instrumented ties to particular interfaces. This approach appears to be similar to St. Amants' SEGMAN approach (St. Amant and Riedl 2001), but the approach discussed by van Lent is still tied lightly to this synthetic environment.

## Robotics

A SOAR model is being prepared to fly an unmanned air vehicle in the United Kingdom (Bill Smith, BlueBear Systems Research). The plane has been selected, and the initial SOAR model is currently generating and flying routes in a simulation. This simulation is exciting because it shows another application of SOAR as an autonomous agent. Also reported with this project was a clever hack for quickly loading information into SOAR by parsing a map database into SOAR rules that augment SOAR's initial working memory with the contents of the database as SOAR starts up. Another talk introduced a small robot whose small head (about 32K of random-access memory!) was filled with SOAR and was able to follow a line on the speaker's table (Waterson).

## The Future

Work on SOAR continues to present new applications and new algorithms for learning and behavior in a variety of areas. In this sense, work with SOAR is progressing and rightfully has the attention of people who do not directly use SOAR.

Cognitive models, in addition to the AI projects, are still occurring within SOAR. There were models of concept acquisition, natural language recognition, and problem solving. This work has not disappeared; it just appears in slightly different form.

One of the papers compared SOAR with respect to beliefs, desires, and intentions architectures and GOMS (John and Kieras 1996), noting many commonalities of component

structure, particularly how these perspectives share similar architectural components on the problem-space level (Jones). The analysis highlighted several aspects of behavior that might currently be missing from many of these approaches, such as parallel active goals.

At the same time, there are areas where Newell's dream is not being realized; these areas are difficult for all groups working on cognitive architecture, and the answers are not easy. Theory cumulation, model reuse, and interfaces that promote the spread and uptake of this scientific approach are important, we believe (we also work in the area of human and computer interaction, so we are particularly interested in these issues). Newell said, and we agree, that science like politics is the art of the possible. Cognitive modeling needs to be more possible. A few good things in SOAR that other communities can emulate include a variety of mailing lists,<sup>3</sup> the help that often arises from diverse members of the community requesting the lists, the annual workshop, central source code maintenance, a web site,<sup>4</sup> and a frequently asked questions list.<sup>5</sup>

If you would like to know more, the proceedings are online at the SOAR web site. A tutorial was offered at the Cognitive Science Conference at George Mason University on 7 to 10 August 2002.<sup>6</sup> If you would like to learn more in a hands-on format, a tutorial will perhaps be held at the International Conference on Cognitive Modeling in Bamberg, Germany, in April 2003.<sup>7</sup> More will be offered at the next SOAR workshop, to be held at the University of Michigan in 2003. It will be SOAR's twentieth anniversary, so extended tutorials and commentaries are being planned, a festival of SOAR perhaps.

## Notes

1. SOAR Workshop 21 (2001): ai.eecs.umich.edu/soar/workshop21/talks/; SOAR Workshop 20 (2000): www.isi.edu/soar/soar-workshop/proceedings.html. The 2002 proceedings are at www.soartech.com/Soar22/SoarWorkshop22.html.
2. J. Laird and M. van Lent. 2001. Interactive Computer Games: Human-Level AI's Killer Application. ai.eecs.umich.edu/peo-

ple/laird/papers/AI-games.pdf.

3. soar-requests@umich.edu for inquiries and subscriptions.
4. ai.eecs.umich.edu/soar/.
5. acs.ist.psu.edu/soar-faq/.
6. hfac.gmu.edu/~cogsci/cogsci.html.
7. iccm2003.ppp.uni-bamberg.de.

## References

- Doorenbos, R.; Tambe, M.; and Newell, A. 1992. Learning 10,000 Chunks: What's It Like Out There? In Proceedings of the Tenth National Conference on Artificial Intelligence, 830–836. Menlo Park, Calif.: American Association for Artificial Intelligence.
- John, B. E., and Kieras, D. E. 1996. The GOMS Family of User Interface Analysis Techniques: Comparison and Contrast. *ACM Transactions on Computer-Human Interaction* 3(4): 320–351.
- Newell, A. 1990. *Unified Theories of Cognition*. Cambridge, Mass.: Harvard University Press.
- St. Amant, R., and Riedl, M. O. 2001. A Perception/Action Substrate for Cognitive Modeling in HCI. *International Journal of Human-Computer Studies* 55(1): 15–39.

**Frank E. Ritter** helped start The School of Information Sciences and Technology, a new interdisciplinary academic unit at Pennsylvania State University to study how people process information using technology and train leaders for the digital economy. Ritter earned his Ph.D. in AI and psychology, an M.S. in psychology from Carnegie-Mellon University, and a BSEE (with honors) from UIUC. His e-mail address is frank.ritter@psu.edu.

**Isaac G. Councill** is a graduate student in Pennsylvania State University's new School of Information Sciences and Technology. He earned his B.A. in psychology at the University of North Carolina at Asheville. His e-mail address is igc2@psu.edu.

# Calendar of Events

## September 2002

SEPTEMBER 24–27

### Engineering of Intelligent Systems (EIS'2002). Malaga, Spain

- *Contact:*  
Nicole Elzebroek  
NAISO Natural and Artificial Intelligence Systems Organization  
Parabool 160  
Sliedrecht 3364 DH The Netherlands  
Voice: 31 184-496999  
E-mail: eis2002@global-conf.org  
www.icsc-naiso.org/conferences/eis2002

SEPTEMBER 29

### Ubicomp-2002 Workshop on Cognitive Aids. Stockholm, Sweden

- *Sponsor:*  
The Fourth International Conference on Ubiquitous Computing
- *Contact:*  
Henry Kautz  
University of Washington  
Computer Science and Engineering  
Sieg Hall, Box 352350  
Seattle, WA 98195  
Voice: 206-543-1896  
E-mail: kautz@cs.washington.edu  
www.cs.washington.edu/homes/kautz/ubicog

## November 2002

NOVEMBER 4–7

### LISA Forum Europe and Annual Meeting. Heidelberg, Germany

- *Sponsors:*  
SAP, WH&P
- *Paper Submission Deadline:*  
October 15, 2002
- *Contact:*  
Alison Rowles  
SMP-M Events  
Le Saugy  
Fechy 1173 Switzerland  
Voice: 41-21 807 1675  
E-mail: alison@smp-m.com  
www.lisa.org/events/2002europe/

NOVEMBER 8–10

### The 2002 Fall Symposium Series. Cape Cod, MA

- *Sponsor:*  
American Association for Artificial Intelligence
- *Contact:*  
AAAI  
445 Burgess Drive  
Menlo Park, CA 94025  
Voice: 1-650-328-3123  
E-mail: fss@aaai.org  
www.aaai.org/Symposia/Fall/2002/fss-02.html

NOVEMBER 18–20

### IASTED International Conference on Information and Knowledge Sharing (IKS 2002). St. Thomas, US Virgin Islands

- *Sponsors:*  
IASTED, University of the Virgin Islands
- *Contact:*  
Katherine Ruelle  
IASTED—International Association of Science and Technology for Development #80, 4500 - 16th Avenue NW  
Calgary, AB T3B 0M6 Canada  
Voice: 403-288-1195  
E-mail: calgary@iasted.com  
www.iasted.org/conferences/2002/vi/iks.htm

NOVEMBER 24–26

### The Fifth International Conference on Discovery Science (DS2002). Luebeck, Germany

- *Contact:*  
Ken Satoh  
National Institute of Informatics  
2-1-2 Hitotsubashi  
Tokyo 101-8430 Japan  
Voice: 81-3-4212-2554  
E-mail: ksatoh@nii.ac.jp  
www.dfki.de/~lange/ds2002.html

NOVEMBER 24–26

### The Fifth International Conference on Discovery Science (DS2002). Luebeck, Germany

- *Contact:*  
Ken Satoh  
National Institute of Informatics  
2-1-2 Hitotsubashi

Tokyo 101-8430 Japan  
Voice: 81-3-4212-2554  
E-mail: ksatoh@nii.ac.jp  
www.dfki.de/~lange/ds2002.html

## December 2002

DECEMBER 16–17

### JURIX 2002: Fifteenth Annual International Conference on Legal Knowledge and Information Systems. London, UK

- *Sponsors:*  
The JURIX Foundation, The Institute of Advanced Legal Studies, UK, The Faculty of Law, King's College London, UK
- *Paper Submission Deadline:*  
September 23, 2002
- *Contact:*  
Aspassia Daskalopulu  
King's College London  
Computer Science  
The Strand London WC2R 2LS UK  
Voice: +44-(0)207 848 2987  
Fax: +44-(0)207 240 1071  
E-mail: jurix02@dcs.kcl.ac.uk  
www.dcs.kcl.ac.uk/staff/aspasia/jurix02

DECEMBER 18–21

### International Conference on Knowledge-Based Computer Systems. Mumbai, India

- *Contact:*  
KBCS-2002 Secretariat  
National Centre for Software Technology  
Knowledge Based Computer System  
Gulmohar Cross Rd No. 9, Juhu  
Mumbai 400 049 India  
Voice: 91-22-6201606  
Fax: 91-22-6210139  
E-mail: kbcs@ncst.ernet.in  
www.ncst.ernet.in/kbcs2002

## January 2003

JANUARY 12–15

### The Seventh International Conference on Intelligent User Interfaces. Miami Beach, FL

- *Sponsors:*  
ACM, SIGART, SIGCHI, AAAI, BCS-HCI, RedWhale Software Corporation, Microsoft Corporation
- *Paper Submission Deadline:*  
October 4, 2002
- *Contact:*  
David Leake  
Indiana University Computer Science  
150 S. Woodlawn Avenue  
Bloomington, IN 47405  
Voice: 812-855-9756

Fax: 812-855-4829  
 E-mail: leake@cs.indiana.edu  
 www.iuicnf.org/

## March 2003

MARCH 9–12

**Computer Applications in Health Care. Melbourne, FL**

- *Sponsors:*  
ACM, SIGAPP
- *Contact:*  
Valentin Masero, University of Extremadura, Computer Science Department, Avda. Universidad, s-n, Caceres 10071 Spain  
Voice: 34-927257806  
E-mail: vmasero@unex.es  
webepcc.unex.es/vmasero/compahec/

## April 2003

APRIL 23–26

**ICEIS 2003—Fifth International Conference on Enterprise Information Systems. Angers, France**

- *Paper Submission Deadline:*  
October 15, 2002
- *Contact:*  
ICEIS-2003 Secretariat ESEO - ecole Superieure d' electronique de l' Ouest 4, rue Merlet de la Boulaye - BP926 - 49009 Angers CEDEX 01 France  
Voice: 33-2 41 86 67 19  
E-mail: secretariat@iceis.org  
www.iceis.org

## June 2003

JUNE 23–26

**Sixteenth International Conference on Industrial and Engineering Applications of Artificial Intelligence and Expert Systems IEA/AIE-2003. Loughborough, England, UK**

- *Sponsors:*  
International Society of Applied Intelligence ISAI, Southwest Texas State University (SWT), Loughborough University (LU)
- *Paper Submission Deadline:*  
November 12, 2002
- *Contact:*  
Paul Chung, Loughborough University, Dept. of Computer Science, Loughborough Leicestershire LE11 3TU England, UK  
Voice: 44-0 1509 222543  
Fax: 44-0 1509 211586  
E-mail: p.w.h.chung@lboro.ac.uk  
gradients.lboro.ac.uk/iea2003aie

JUNE 24–27

**NAISO Conference on Information Technologies in Environmental Engineering (ITEE'2003). Gdansk, Poland**

- *Contact:*  
Ms Asia Koerten, NAISO The Netherlands (Operating Division), Parabool 160, Sliedrecht 3364 DH The Netherlands  
Voice: +31-184 496 999  
Fax: +31-184 421 065  
E-mail: janine@gcoeuropa.com  
www.icsc-naiso.org/conferences/itee2003/index.html

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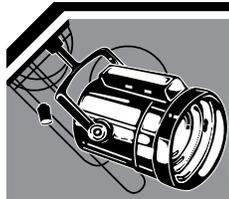
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Questions concerning the application process should be directed to the NRC at Tel: 202-334-2760; Fax: 202-334-2759; E-mail: [rap@nas.edu](mailto:rap@nas.edu) or Mail: National Research Council, 500 5<sup>th</sup> Street NW, GR 322A, Washington, DC 20001



## "Always Interesting" AI in the news

<http://www.aaai.org/aitopics/html/current.html>

**Where Lech Does Tech.** Desa Philadelphia. *Time*. July 1, 2002 ([www.time.com/time](http://www.time.com/time)). "Leading Poland to democracy brought Lech Walesa a Nobel Peace Prize and international acclaim, but he admits to a few regrets. One is that he was so busy throughout the 1980s and '90s that he 'did not have the time to follow developments in technology closely.' But he is catching up. The first corporate board Walesa, 58, has agreed to join is that of NuTech Solutions, a closely held company founded three years ago in Charlotte, N.C., by a pair of Polish immigrants. NuTech creates software that uses artificial intelligence (AI) to boost efficiency in its clients' manufacturing, distribution and customer service. ... [H]e joined NuTech primarily because he is passionate about the promise of its technologies, which he is studying avidly. 'The science and technology NuTech represents,' he says, 'are the future of all companies.'"

**Is There a Robot in your Future?** Siva Kasinathan ("a student this past year in the Manhattan [Kansas] Middle School system"). *The Manhattan Mercury*. June 21, 2002 ([www.themercury.com](http://www.themercury.com)). "Robot technology is helping humanity branch off into the future. It is the steppingstone for artificial intelligence, nanorobotics and cybernetics. Artificial intelligence, or AI, is a very new frontier that will allow robots to think. AI will permit robots to perform tasks such as exploring planets without human directions and keep themselves out of trouble."

**Robot on the Run.** Dave Higgins. *The Age*. June 20, 2002 ([www.theage.com.au](http://www.theage.com.au)). "Scientists running a pioneering experiment with 'living robots' which think for themselves today said they were amazed to find one escaping from the centre where it 'lives'. ... [Noel] Sharkey said: 'Since the experiment went live in March they have all learned a significant amount and are becoming more intelligent by the day but the fact that it had ability to navigate itself out of the building and along the concrete floor to the gates has surprised us all.'"

**Minority Report.** Roger Ebert. *Chicago Sun-Times*. June 21, 2002 ([www.suntimes.com](http://www.suntimes.com)). "The movie turns out to be eerily prescient, using the term 'pre-crime' to describe stopping crimes before they happen; how could Spielberg have known the government would be using the same term this summer?"

**Digital Warriors — Artificial Intelligence May Help Spot Future Terrorism Attacks.** Paul Eng. *ABC News*. May 22, 2002 ([abcnews.go.com](http://abcnews.go.com)). "Norman Geddes, president and CEO of Applied Systems Intelligence, a software maker in Roswell, Ga., thinks artificial intelligence can study terrorist behavior patterns and spot trouble. ... Geddes says a well-designed computer program can do what humans do, and maybe even do a better job at it. '[It's] the same as a good police officer,' he says. '[It] investigates leads, forms hypotheses, and narrows things down.' ... Artificial intelligence systems use complex math routines to discover patterns and predict possible outcomes."

**FBI's Most Wanted: New IT Priorities** (Commentary). Dan Farber. *ZDNet*. June 5, 2002 ([zdnet.com.com](http://zdnet.com.com)). "On NBC's 'Meet

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*This eclectic keepsake provides a sampling of what can be found (with links to the full articles) on the AI Topics web site. Please keep in mind that (1) the mere mention of anything here does not imply any endorsement whatsoever; (2) the excerpt might not reflect the overall tenor of the article; (3) although the articles were initially available online and without charge, few things that good last forever; and (4) the AI in the News collection— updated, hyperlinked, and archived — can be found by going to [www.aaai.org/aitopics/html/current.html](http://www.aaai.org/aitopics/html/current.html).*

—Jon Glick, Webmaster, AI Topics

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the Press' a few days ago, FBI Director Mueller said that 'it would be nice if we had the computers in the FBI that were tied into the CIA that you could go in and [search on] 'flight schools,' and any report relating to flight schools that had been generated anyplace in the FBI field offices would spit out." He went on to proclaim the need for AI that could offer more predictive technology."

**DOD Looks Closer at Promising Technologies.** Dawn S. Onley. *Government Computer News*. June 6, 2002 ([www.gcn.com](http://www.gcn.com)). "Nearly eight months after it released a request to industry for help developing technologies to combat terrorism, the Defense Department will now take the next step. ... The chosen ideas for

which the group sought white papers included: a system that, using an integrated database and data mining tools, could identify patterns and trends of terrorist groups and predict their behavior..."

**Robot Cameras "will predict crimes before they happen."** Andrew Johnson. *The Independent*. April 21, 2002 ([news.independent.co.uk](http://news.independent.co.uk)). "Scientists at Kingston University in London have developed software able to anticipate if someone is about to mug an old lady or plant a bomb at an airport. It works by examining images coming in from close circuit television cameras (CCTV) and comparing them to behaviour patterns that have already programmed into its memory. The software, called Cromatica, can then mathematically work out what is likely to happen next. And if it is likely to be a crime it can send a warning signal to a security guard or police officer. ... 'The idea is that the computer detects a potential event and shows it to the operator, who then decides what to do — so we are still a long way off from machines replacing humans,' Dr Velastin says."

**To Err Is Human.** George Johnson. *The New York Times*. July 14, 2002 ([www.nytimes.com](http://www.nytimes.com)). "Ordered to climb higher by the electronic voice of the cockpit's automatic collision detector, the pilot of the children's plane obeyed the befuddled ground controller instead. The airliner dove head-on into a DHL cargo jet — a tragedy that might have been averted if people put more faith in machines. ... The issue here is nothing so lofty as human versus artificial intelligence. What lay in the balance was a simple decision: up or down, 1 or 0. Believe the controller or believe the machine."

**Approximating Life.** Clive Thompson. *The New York Times Magazine*. July 7, 2002 ([www.nytimes.com](http://www.nytimes.com)). "Thousands of people flock to his Web site every day from all over the world to talk to his creation, a robot called Alice. It is the best artificial-intelligence program on the planet, a program so eerily human that some mistake it for a real person. As Wallace listens in, they confess intimate details about their lives, their dreams; they talk to Wallace's computer about God, their jobs, Britney Spears. ... [L]ast October, Alice won the Loebner competition for the second time in a row; this time one judge actually ranked Alice more realistic than a human."