



The University of Georgia

AI Newsletter

Institute for Artificial Intelligence
The University of Georgia
Athens, GA 30602-7415 U.S.A.

Spring 2010

Research Spotlight: Can a Computer Understand a Cathedral?

Where do art history, engineering, logic, and linguistics meet? Try a Gothic cathedral. UGA faculty members Stefaan van Liefferinge (Art History) and Don Potter and Michael Covington (IAI) and AI graduate student Ben Brodie (pictured) are exploring the connection.

The key idea is that cathedrals are composed of definite parts, with definite relations, and historians have a precise language to describe them. This is just the kind of thing computers should be good at keeping track of. So the researchers are building an ontology – a precise logical model of parts and attributes – for Gothic vaulting units. It will later be expanded to cover the whole cathedral and, eventually, other forms of architecture.



With the ontology in hand, they will move toward natural language understanding. The goal is to have the computer take a written description of a cathedral, and do just what an expert reader would do – start with a “generic” mental image of a cathedral and adapt it to fit the one being described. The same technique, of course, will be applicable to precise verbal descriptions in many other areas, including engineering and medicine.

This work is presently supported by a UGA Faculty Research Grant. Proposals have been submitted to other funding sources.

News: Hoogenboom, Ebell join AI Faculty

Dr. Gerrit Hoogenboom of the Department of Biological and Agricultural Engineering and Dr. Mark Ebell of UGA’s College of Public Health are new Faculty Fellows of the Institute for Artificial Intelligence. Stationed at UGA’s Griffin Experiment Station, Dr. Hoogenboom builds advanced computer models of crop yields and factors that affect it. Dr. Ebell’s research areas include evidence-based medicine and point-of-care decision support.

Letter from the Director

Welcome to the spring newsletter! We hope you enjoy receiving the IAI Newsletter and keeping up to date on all the cool activities we have going on these days. Feel free to send us your comments and suggestions about the newsletter any time; we are always glad to hear from you. We recently finished the spring semester where we had a good group of undergraduate Cognitive Science students graduate, and two successful end-of-semester MSAI thesis defenses, by Ananta Palani (graduate 155) and Muthukumaran Chandrasekaran (graduate 156). The next step for the Cognitive Science graduates includes a variety of destinations from taking some time off to relax and hang out with the parents (a strange but common activity these days but something that was unheard of in my day :) to attending medical school. As for Artificial Intelligence Master's students Ananta and Muthu, both are planning to further their graduate education by pursuing a Ph.D. degree. Muthu will be heading to the UGA Computer Science Ph.D. program while Ananta is preparing to start his advanced studies in Photonics at Cambridge University in England.



Even though we have had some hard economic times and have had to deal with several budget reductions, things do seem to be getting better. For example, earlier in the academic year the Institute was able to replace all of the really old student laboratory computers with new Dell PC's through the College's three-year equipment upgrade program. Plus, we have been successful with a couple of year-end residual funds proposals submitted to the Dean's office (the Dean routinely invites departments, institutes, and centers to submit proposals for special projects). For example, we were awarded funds to acquire an EEG brain wave sensor array and accompanying software package so students can experiment with such things as mental control of remote objects (e.g., moving a cursor around on the computer screen with your thoughts) to doing research into the area of deception detection. The Institute has also been able to help out many of the AI faculty with smaller but needed financial (mostly travel) or equipment support (e.g., laptops and such).

Again, enjoy the newsletter, and have a safe summer.

– Don Potter
Director
Institute for Artificial Intelligence

Alumni News: Cambridge Congratulations

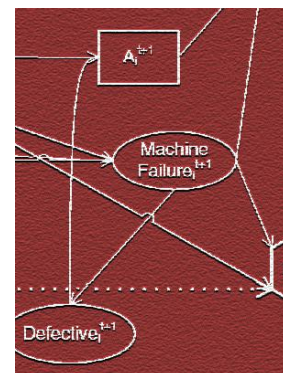
MSAI alumna **Lorina Naci** has just completed her Ph.D. at Britain's prestigious Cambridge University and will be working for the Medical Research Council in the same city. New MSAI graduate **Ananta Palani** will enter Cambridge this fall to pursue a Ph.D. in photonics engineering. The second-oldest educational institution in the English-speaking world, Cambridge University has just celebrated its 800th anniversary.



Research Spotlight: Disentangling Multiple Agent Decisions

Some distinctions make no difference. That is the key idea behind Muthukumaran Chandrasekaran's recently completed thesis on Interactive Dynamic Influence Diagrams (I-DIDs). These diagrams represent a sequential decision problem for uncertain settings where multiple agents interact with each other and with their environment.

The problem to be solved is that, as the agents model each other, each agent has to keep track of too many possibilities of what the other agents may be thinking. The solution is to disregard models that produce about the same distribution of expected behaviors as models already under consideration, even if their internal workings are different.



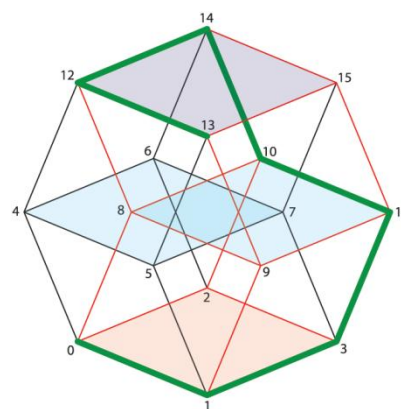
For a copy of this thesis, e-mail shbrooks@uga.edu.

Research Spotlight: Genetic Algorithms Hunt Snakes

A snake-in-the-box is a path along the edges of an N-dimensional hypercube, which never comes back to a point that is separated by only one dimension from a point already on it. A coil is a closed snake (one that ends at its origin). Snakes are used in binary coding, and more generally, the snake problem is a good testbed for applying AI to a hard mathematical problem.

The trouble is that too little is known about the natural history of snakes, so to speak. Existing genetic algorithm (GA) approaches represent snakes as series of points, but little is known about where snakes are likely to be found.

That's where Ananta Palani enters the picture. In his just-completed MSAI thesis, he surveys all known longest-snake paths in dimensions 1 to 7, to collect information about their characteristics. The result is a set of criteria that will facilitate the search in the future.



For a copy of this thesis, e-mail shbrooks@uga.edu.

Recent Publications and Presentations

W. D. Potter, E. Drucker, P. Bettinger, F. Maier, D. Luper, M. Martin, M. Watkinson, G. Handy, and C. Hayes, "Diagnosis, Configuration, Planning, and Pathfinding: Experiments in Nature-Inspired Optimization", in *Natural Intelligence for Scheduling, Planning and Packing Problems*, edited by R. Chiong, Springer-Verlag, Studies in Computational Intelligence (SCI) Series, 2009.

Michael A. Covington and Joe D. McFall, Cutting the Gordian knot: the moving-average type-token ratio (MATTR), *Journal of Quantitative Linguistics* 17: 2, 94-100 (2010).

Prashant Doshi, Xia Qu, Adam Goodie and Diana Young, "Modeling Recursive Reasoning in Humans Using Empirically Informed Interactive POMDPs", Ninth International Autonomous Agents and Multiagent Systems Conference (AAMAS), Toronto, Canada, 2010.

Muthukumaran C., Prashant Doshi and Yifeng Zeng, "Approximate Solutions of Interactive Dynamic Influence Diagrams using ϵ -Behavioral Equivalence", Eleventh International Symposium on Artificial Intelligence and Mathematics (ISAIM), Ft. Lauderdale, FL, January 6-8, 2010 (<http://gauss.ececs.uc.edu/Workshops/isaim2010/proceedings.html>).

Shank, D. B., G. Hoogenboom, and R. W. McClendon. 2008. Dew point temperature prediction using artificial neural networks. *Journal of Applied Meteorology and Climatology* 47(6):1757-1769.

Shank, D. B., R.W. McClendon, J. O. Paz, and G. Hoogenboom. 2008. Ensemble artificial neural networks for prediction of dewpoint temperature. *Applied Artificial Intelligence* 22(6):523-542.

Ashish, D., G. Hoogenboom, and R. W. McClendon. 2009. Land-use classification of multispectral aerial images using artificial neural networks. *International Journal of Remote Sensing* 30(8):1989-2004.

Smith, B. A., G. Hoogenboom, and R. W. McClendon. 2009. Artificial neural networks for automated year-round temperature prediction. *Computers and Electronics in Agriculture* 68(1):52-61.

Chevalier, R. F., G. Hoogenboom, R. W. McClendon, and J. A. Paz. 2010. Support vector regression with reduced training sets for air temperature prediction: a comparison with artificial neural networks. *Neural Computing and Applications* (in press).

Li, R., P. Bettinger, and K. Boston. 2010. Informed development of meta heuristics for spatial forest planning problems. *The Open Operational Research Journal*. 4: 1-11.

Bettinger, P. 2010. An overview of methods for incorporating wildfires into forest planning models. *International Journal of Mathematical and Computational Forestry & Natural-Resource Sciences*. 2(1): 43-52.

How to Sponsor Research

As an industrial partner or associate of the IAI, there are four ways you can be involved in our research:

Collaboration, especially student projects. It doesn't necessarily cost anything to work with us. We are always looking for good research topics, especially for master's theses.

Sponsored research. You can contract with us through the University of Georgia Research Foundation (UGARF) to do research for your company. *We are always looking for research sponsors.*

Donations. If you don't need confidentiality or a specific deliverable, you can simply make a gift to the IAI designated to support a particular research program. Donations are made through the Arch Foundation and are fully tax-deductible; contact us to make arrangements, or click on the "Support" button on www.ai.uga.edu.

Consulting. You can hire faculty members or advanced graduate students to work for you part-time as independent contractors. The University encourages this, within reasonable limits. It's a good way to do a small project with a high level of confidentiality, but the consultant works privately, and you don't get access to University facilities. Consulting projects often grow into sponsored research.

We also invite all industrial partners and associates to **come and visit us** and speak with groups of students. This is your "inside track" to recruiting.



The University of Georgia®

The AI Newsletter is published twice a year. For more information about the Institute's activities, e-mail shbrooks@uga.edu or look at www.ai.uga.edu. Thanks for your interest!