Christine Alvarado

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EDUCATION

MASSACHUSETTS INSTITUTE OF TECHNOLOGY, Cambridge, MA

2004 **PhD in Computer Science**
Thesis: *Multi-domain Sketch Understanding*, Randall Davis, advisor
Minor: Science, Technology and Society

2000 **SM in Electrical Engineering and Computer Science**
Thesis: *A Natural Sketching Environment: Bringing the Computer into Early Stages of Mechanical Design*

DARTMOUTH COLLEGE, Hanover, NH

1998 **AB in Computer Science** (*summa cum laude* with high honors in major)
Senior Honors Thesis: *Distributed Route Planning Using Partial Map Building*
Minor: Psychology

RESEARCH INTERESTS

The conjunction of artificial intelligence and human computer interaction. Particularly interested in the technical challenges of building intelligent interfaces, evaluating the effect and utility of those interfaces, and leveraging such interfaces to provide a platform on which to enrich computer science education by making it more accessible, especially to women and traditionally underrepresented minorities.

RESEARCH EXPERIENCE

HARVEY MUDD COLLEGE, Claremont, CA
Assistant Professor, Computer Science Department, 2005-Present

2005- **Smarter Educational Software through Sketch Recognition**
Recent work, done in collaboration with a colleague, aims to improve computer recognition of digital circuit designs in order to construct a sketch-based simulation tool that may be incorporated into Harvey Mudd's introductory digital design and computer architecture class, E85. Existing recognition technologies, including Tablet PC gesture recognition, place unacceptable constraints on users' drawing style or have not been shown to perform sufficiently robustly with end-users. The limited robustness of existing free-sketch recognition techniques is due, in part, to the lack of large corpora of real-world data. We have collected freely-drawn sketches from students in E85 and will use those sketches to extend existing techniques.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY, Cambridge, MA
Research Assistant, Artificial Intelligence Laboratory, 1998-2004

2003-4 **Understanding SkRUIs (Sketch Recognition User Interfaces)**
Applies recognition system developed for dissertation to explore the human-computer interaction issues that arise when incorporating sketch understanding into a complete tool. Developed a sketch recognition-based interface for creating diagrams in PowerPoint. This tool recognizes sketched diagrams and automatically imports them into PowerPoint. Explored issues such as when to display recognition feedback, how to support editing, and how to integrate pen-based sketching into a menu-based system. Developed guidelines for the construction of SkRUIs and discovered that many traditional user interface

iterative design techniques are inappropriate for the development of SkRUIs due to the unconstrained nature of a user's interaction with these interfaces.

2000-2004 **Multi-Domain Sketch Understanding**
Advisor: *Prof. Randall Davis*
Dissertation work presents an architecture and implemented system to perform robust sketch recognition in multiple domains. Addresses the problem that, although people use sketches to express and record their ideas in many domains, including mechanical engineering, software design, and information architecture, most Computer Aided Design programs cannot interpret free-hand sketches. The few existing sketch recognition systems either tightly constrain the user's drawing style or are fragile and difficult to construct. In previous work we found that domain knowledge can aid recognition. This thesis presents a sketch recognition architecture that combines shape and context information to improve recognition accuracy across a variety of domains. This architecture supports the development of robust recognition systems across multiple domains. It maintains a separation between low-level shape information and high-level domain-specific context information, but uses the two sources of information together to improve recognition accuracy. This approach improves recognition accuracy while maintaining efficiency through the combined use of a novel application of dynamically constructed Bayesian networks. This sketch recognition tool enables the construction of early-stage design tools in domains such as mechanical engineering, electrical engineering and software design.

2000-2004 **Interaction with Personal Electronic Information**
Advisors*: Prof. David R. Karger, Prof. Mark S. Ackerman*
With a co-worker, designed and conducted an in-depth observational study of 15 participants' interactions with their electronic information. Through a series of ten five-minute interviews and a single 45-minute interview, recorded people's interaction with their email, their files, and the Web in order to gain an understanding of what type of intelligent information management tool would be most beneficial to them. Through analysis of the data, discovered a significant but under-supported style of interaction in which people locate specific information by associating it with an information source and then navigate to that source. This discovery influenced the development of Haystack, a personal information management tool being developed at MIT.

2001 **Evaluation of Intelligent Systems**
Analyzed and compared the evaluation techniques reported for intelligent and user-controlled interfaces with a thorough survey of work presented at three recent prominent human computer interaction conferences. Discovered that intelligent interfaces were evaluated less often and less formally than user-controlled interfaces. Explored the relationship between errors produced by intelligent systems and their impact on the use of traditional evaluation techniques and suggested that in light of system error, traditional techniques are ill-suited to the evaluation of intelligent user interfaces.

1998-2000 **Sketch-Based Design Tool for Mechanical Engineering**
Advisor: *Prof. Randall Davis*
For master's thesis, developed a computer aided design tool specifically geared toward the early stages of mechanical engineering design. The system interprets a user's free-hand sketch as it is drawn, then allows simulation of the system using two-dimensional mechanical simulator. Introduced a method for translating a sketch into the designer's intended mechanical devices, despite ambiguities in the sketch. Working with Microsoft and 3rd party company to develop Microsoft Tablet PC power toy directly based on this work.

VIRTUAL INK CORP., Charlestown, MA
Summer Research Intern, 2000

2000 **Incorporation of Sketch Recognition in a Virtual Whiteboard System**
Developed sketch recognition system based on Master's work for use with the mimio® whiteboard data capture device.

DARTMOUTH COLLEGE, Hanover, NH
Undergraduate Research Assistant, 1997-1998

1997-8 **Distributed Robot Navigation**
Advisor: *Prof. Daniela Rus*
Developed a navigation system for a team of mobile robots consisting of a set of "blind" manipulation

robots and a single scout robot that relies on a series of sonar sensors for information about an unknown environment. Approach produced more optimal paths to the goal, as well as evading the concern of what actions to take should the entire system reach a dead end.

UNIVERSITY OF WASHINGTON, Seattle, WA
CRA-W Distributed Mentor Project Intern, Summer 1996

1996 **Visualization Tool for Flight Automation System**
Advisor: *Prof. Nancy Leveson*
Developed a system to visualize airline flight plans as part of a suite of tools developed to evaluate the safety of a proposed automated air traffic control system.

TEACHING EXPERIENCE

2005- HARVEY MUDD COLLEGE, Claremont, CA

Assistant Professor:

Computer Science Clinic: *Fair Isaac Corporation, Fall 2005—Spring 2006; Fall 2006—Spring 2007*

CS 5: Introduction to Computer Science: *Fall 2006*

CS 60: Principles of Computer Science: *Spring 2006, Fall 2006, Fall 2007*

CS 151: Artificial Intelligence: *Spring 2007*

CS 152: Computer Vision: *Fall 2005*

CS 182-1/CS 124: Non-Traditional User Interfaces: *Spring 2006, Fall 2007*

UNIVERSITY OF CALIFORNIA, SAN DIEGO, San Diego, CA

2005- **Instructor —** *COSMOS Program, Summer 2005; Summer2006; Summer 2007*

2005 **Laboratory Instructor**—*CSE 8A: Introductory Programming, Winter 2005*

UNIVERSITY OF SAN DIEGO, San Diego, CA

2004-5 **Post-doctoral Instructor:**

COMP300: Principles of Digital Hardware: *Spring 2005*

COMP360: Programming Languages: *Spring 2005*

COMP150: Introductory Programming: *Fall 2004*

COMP310: Operating Systems: *Fall 2004*

MASSACHUSETTS INSTITUTE OF TECHNOLOGY, Cambridge, MA

2002 **Instructor —** *Women's Technology Program, Summer 2002*

2001 **Teaching Assistant —** *6.001: Structure and Interpretation of Computer Programs, Spring 2001*

DARTMOUTH COLLEGE, Hanover, NH

1996 **Teaching Assistant** — *CS* 37*: Computer Architecture, Summer 1996*

GRANTS, AWARDS & HONORS

2007 Beckman Foundation Research Award

2006 Funding from HMC and IBM to take 20 undergraduates to Grace Hopper Conference, Oct 2006

2006 NSF Faculty Early Career Development (CAREER) Award (2006-2011)

2006 Baker Foundation Research Award

2005 University of California President's Postdoctoral Fellowship (*Declined*)

2003 Best Presentation, MIT Student Oxygen Workshop

1998 National Science Foundation Graduate Research Fellowship
Nominated, CRA Outstanding Undergraduate Award

1995-8 Rufus Choate Scholar, Dartmouth College

1996 CRA-W Distributed Mentor Project Award

1994 Honorable Mention, National Merit Scholar

Phi Beta Kappa National Honor Society
Golden Key Academic Honor Society

PUBLICATIONS AND PRESENTATIONS

REFEREED PUBLICATIONS

2007 Aaron Wolin, Devin Smith and Christine Alvarado, "A Pen-based Tool for Efficient Labeling of 2D Sketches." In *Proc. of Eurographics Workshop on Sketch-Based Interfaces and Modeling (SBIM)*. Riverside, CA. 2007.

Paul Wais, Aaron Wolin and Christine Alvarado, "Designing a Sketch Recognition Front-End: User Perception of Interface Elements". In *Proc. of Eurographics Workshop on Sketch-Based Interfaces and Modeling (SBIM)*. Riverside, CA. 2007.

Christine Alvarado and Michael Lazzareschi, "Properties of Real World Digital Logic Diagrams" In *Proceedings of 1st International Workshop on Pen-based Learning Technologies*. 2007.

Zach Dodds, Christine Alvarado, Geoff Kuenning, and Ran Libeskind-Hadas, "Breadth-first CS 1 for Scientists: Curriculum and Assessment", In *Proc. of the 12th Annual Conference on Innovation in Technology in Computer Science Education (ITiCSE 2007)*. 2007.

2005 Christine Alvarado and Randall Davis, "Dynamically Constructed Bayes Nets for Multi-Domain Sketch Understanding," *Proceedings of International Joint Conference on Artificial Intelligence (IJCAI)*, August 2005. (*also presented)*

2004 Christine Alvarado and Randall Davis, "SketchREAD: A Multi-Domain Sketch Recognition Engine," *Proceedings of ACM Symposium on User Interface Software and Technology (UIST).* October 2004. (*also presented*)

Christine Alvarado, "Sketch Recognition User Interfaces: Guidelines for Design and Development," *Proceedings of AAAI Fall Symposium on Pen-Based Interfaces.* October 2004. (*also presented*)

Michael Oltmans, Christine Alvarado, and Randall Davis, "ETCHA Sketches: Lessons Learned from Collecting Sketch Data," *Proceedings of AAAI Fall Symposium on Pen-based Interfaces.* October 2004.

Jamie Teevan, Christine Alvarado, Mark S. Ackerman, and David R. Karger, "The Perfect Search Engine Is Not Enough: An Observational Study of Orienteering Behavior in Directed Search," *Proceedings of ACM Conference on Human Factors in Computing Systems (CHI)*. March 2004.

2003 Christine Alvarado, "Dynamically Constructed Bayesian Networks for Sketch Understanding," *Proceedings of MIT Student Oxygen Workshop*. September 2003. (*also presented*)

2002 Christine Alvarado and Randall Davis, "A Framework for Multi-domain Sketch Recognition," *Proceedings of AAAI Spring Symposium on Sketch Understanding*. March 2002. (*also presented*)

2001 Christine Alvarado and Randall Davis, "Resolving Ambiguities to Create a Natural Sketch-Based Interface," *Proceedings of International Joint Conference on Artificial Intelligence (IJCAI)*. August 2001. (*also presented*)

Christine Alvarado and Randall Davis, "Preserving the Freedom of Paper in a Computer-Based Sketch Tool," *Proceedings of HCI International*. August 2001. (*also presented*)

ADDITIONAL PRESENTATIONS

2007 "Sketch Recognition for Digital Circuit Design in the Classroom." 2007 Invited Workshop on Pen-Centric Computing Research, Brown University, March 2007.

2004 "Multi-Domain Sketch Understanding." MIT PhD thesis defense. August 2004.

2003 "An Introduction to Recursion." Math and Computer Science Department, University of San Diego, December 2003.

"The Challenges of Sketch Recognition." Guest lecture, MIT Women's Technology Program. July 2003.

2002 "The Road to Intelligence is Paved with a Million-Million Expert Systems." MIT Dangerous Ideas Seminar. November 2002.

2001 "Surviving the Information Explosion." MIT Student Seminar. November 2001.

2000 "Building a Natural Computer-Based Sketch Tool." MIT Student Seminar. October 2000.

All publications available on-line at http://www.cs.hmc.edu/~alvarado/

SERVICE AND ACTIVITIES

HMC Service

WASC Steering Committee 2006-
Strategic planning committee 2006
CS5 redesign committee 2005-06
CS60 review committee 2006
Freshman advisor 2006-2007
Core coordinators committee, Spring 2006

Workshop Co-chair: Eurographics Workshop on Sketch-Based Interfaces and Modeling, 2007
Program Committee: Eurographics Workshop on Sketch-Based Interfaces and Modeling 2005-2007; MIT Student Oxygen Workshop 2003
Reviewer: UIST 2005-2007; Computers and Graphics 2006-2007; Eurographics 2005; CHI 2006; CSCW 2006

New Student Coordinator, MIT AI/LCS, 2002
Program Consultant, MIT Women's Technology Program, 2003
Founding Instructor, MIT Women's Technology Program, 2001
Organizer, MIT AI Lab Olympics, 2001
Organizer, MIT AI/LCS Graduate Student Lunch, 1999-2001
Organizer, MIT Fall BBQ, 1999

MIT Graduate Women of Course 6 (Electrical Engineering & Computer Science Dept.)
MIT Women's Ice Hockey Team (Co-captain 2000-1, Treasurer 2001-2)
MIT Triathlon Club
MIT Master's Swim Team, UCSD Master's Swim Team
Dartmouth NCAA-ranked Varsity Women's Crew Team, 1995-8

REFERENCES

References available on request.