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

Curriculum and program design for CS education. Designing curriculum and programs that make computer science education more accessible and engaging, especially to women and traditionally underrepresented minorities.

The conjunction of artificial intelligence and human computer interaction. Particularly interested in the technical challenges of building intelligent interfaces and evaluating the effect and utility of those interfaces.

POSITIONS HELD

July 1, 2011-	Harvey Mudd College, Associate Professor of Computer Science with tenure
2005-11	Harvey Mudd College, Assistant Professor of Computer Science
2009-	University of California, Riverside, Adjunct Assistant Professor of Computer Science and Engineering
2005-07	University of California, San Diego, Computer Science Instructor, COSMOS Summer Program
2005	University of California, San Diego, Computer Science and Engineering Laboratory Instructor
2004-05	University of San Diego, Postdoctoral Lecturer in Computer Science
1998-2004	Massachusetts Institute of Technology, Research Assistant in AI Lab/CSAIL
2002	Massachusetts Institute of Technology, Instructor, Women's Technology Program
2000	Virtual Ink Corp., Research Intern

TEACHING EXPERIENCE

HARVEY MUDD COLLEGE, Claremont, CA

Computer Science Clinic: *Fair Isaac Corporation, Fall 2005—Spring 2006; Fall 2006—Spring 2007; Bluebeam Software Inc.: Fall 2007—Spring 2008; Genius.com: Fall 2008—Spring 2009 ; Paramount Pictures: Fall 2010—Spring 2011*

CS 5: Introduction to Computer Science: *Fall 2006; Fall 2008 (lead instructor)*

CS 42: Principles and Practice of Computer Science: *Fall 2010*

CS 60: Principles of Computer Science: *Spring 2006; Fall 2006; Fall 2007; Fall 2009; Spring 2011*

CS 151: Artificial Intelligence: *Spring 2007; Spring 2008; Spring 2009*

CS 152: Computer Vision: *Fall 2005*

CS 182/CS 124: User Interface Design: *Spring 2006; Fall 2007; Spring 2009; Spring 2010; Spring 2011*

CS 182: Pen-Based Computing: *Spring 2008*

WRIT 001: Introduction to Academic Writing: *Fall 2010*

UNIVERSITY OF CALIFORNIA, RIVERSIDE, Riverside, CA

CS010: Introduction to Computer Science: *Winter 2011*

UNIVERSITY OF CALIFORNIA, SAN DIEGO, San Diego, CA

COSMOS Program*, Summer 2005; Summer2006; Summer 2007*

CSE 8A*:* Introductory Programming (Lab)*, Winter 2005*

UNIVERSITY OF SAN DIEGO, San Diego, CA

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

Women's Technology Program (Instructor), *Summer 2002*

6.001: Structure and Interpretation of Computer Programs (TA), *Spring 2001*

DARTMOUTH COLLEGE, Hanover, NH

CS 37: Computer Architecture (TA), *Summer 1996*

GRANTS, AWARDS & HONORS

2009   NSF Pathways to Revitalized Undergraduate Computing Education (CPATH) (2009-2012), $797,692 (PI)

2008   DARPA Deep Green (2008-2009), $101,516 (HMC PI)

2007   Beckman Foundation Research Award, $8,000 (PI)

2006   NSF Faculty Early Career Development (CAREER) Award (2006-2011), $403,000 (PI)

2006   Baker Foundation Research Award, $10,000 (PI)

2006-   Funding from HMC, IBM, and Boeing to take 20-45 undergraduates to Grace Hopper Conference (2006-2010), $10,000-$40,000 total per year

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

2003   Best Presentation, MIT Student Oxygen Workshop

1998   National Science Foundation Graduate Research Fellowship

MAJOR SCHOLARLY ACTIVITIES

HARVEY MUDD COLLEGE, Claremont, CA

2005- **Breadth-First CS1 for All**
We have developed a breadth-first CS1 course for majors and non-majors alike. This course presents a broad view of the discipline of computer science, leveraging relevant mathematics, science and engineering applications to teach core computer science concepts. This course does not presume that students will study more computer science, but prepares them for further study if they choose. We have found that this course significantly improves students' understanding of CS, its applications and its practice. We are currently working to expand this model beyond Harvey Mudd College.

2005- **Smarter Educational Software through Sketch Recognition**
This work aims to improve computer recognition of digital circuit designs in order to construct a sketch-based simulation tool. 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 Harvey Mudd College's digital design class and are using those sketches to extend existing techniques. We have developed a prototype tool, named LogiSketch, and have used it explore and improve both recognition algorithms and pen-based interface interaction design. We plan to pilot this tool in Harvey Mudd's introductory computer science course, CS5.

2009- **Senior Prom**
2011 In collaboration with colleagues, we developed a game for senior citizens, based on the popular game Dance Dance Revolution, called *Senior Prom*. This work involves an exploration into the needs and computer game capabilities of a unique population through user studies. The goal of our game is to help senior citizens maintain physical and mental health.

2008 **Vision-Based Algorithms for Recognizing Military Course of Action Diagrams**
In conjunction with researchers at Texas A&M University (TAMU), developed robust free-sketch algorithms for recognizing course of action diagrams. The challenge is to recognize hundreds of extremely similar symbols at high accuracy (>90%) without placing constraints on commanders who are engaged in military planning. Our vision-based algorithms were combined with TAMU's hierarchical recognizers to achieve this task. The results of our recognition were integrated with a complete military planning and simulation system.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY, Cambridge, MA

2000- **Multi-Domain Sketch Understanding**
2004 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- | **Interaction with Personal Electronic Information** |
| 2004 | 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 developed at MIT.

PUBLICATIONS AND PRESENTATIONS

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

REFEREED PUBLICATIONS

2010   Christine Alvarado and Zachary Dodds. "Women in CS: An Evaluation of Three Promising Practices." In *Proceedings of ACM Technical Symposium on Computer Science Education (SIGCSE).* March, 2010.

Martin Field, Sam Gordon, Eric Peterson, Raquel Robinson, Thomas Stahovich, Christine Alvarado. "The Effect of Task on Classification Accuracy: Using Gesture Recognition Techniques in Free-Sketch Recognition." *Computers and Graphics, Special Issue on Sketch-Based Interfaces and Modeling.* 34(5) October 2010.

Eric Peterson, Thomas Stahovich, Eric Doi, Christine Alvarado. "Grouping Strokes into Shapes in Hand-Drawn Diagrams." In *Proceedings of AAAI Conference on Artificial Intelligence (AAAI).* July 2010.

2009   Martin Field, Sam Gordon, Eric Peterson, Raquel Robinson, Tom Stahovich, Christine Alvarado. "The Effect of Task on Classification Accuracy: Using Gesture Recognition Techniques in Free-Sketch Recognition," In *Proceedings of Eurographics Workshop on Sketch-Based Interfaces and Modeling (SBIM).* August 2009.

2008   Zach Dodds, Ran Libeskind-Hadas, Christine Alvarado, Geoff Kuenning. "Evaluating a Breadth-First CS 1 for Scientists." In *Proceedings of ACM Technical Symposium on Computer Science Education (SIGCSE).* March 2008.

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

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

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

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

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.

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

2004   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.

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

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.

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

BOOKS AND BOOK CHAPTERS

2011   Christine Alvarado, Zach Dodds, Geoff Kuenning, Ran Libeskind-Hadas. *CS for Scientists and Engineers.* Draft under Review. https://www.cs.hmc.edu/twiki/pub/CS5/WebHome/cs5book.pdf

Christine Alvarado. "Multi-Domain Hierarchical Free-Sketch Recognition Using Graphical Models." In Jorge, Joaquim; Samavati, Faramarz (Eds.), *Sketch-based Interfaces and Modeling* (19-54). Springer. 2011.

INVITED PRESENTATIONS

2011   "Women in CS @ HMC: Three Promising Practices," Google TechTalk.

2009   "Recognizing Users' Sketches... Without Constraining Users' Drawing Styles," UC Riverside Colloquium.

2008   "CS1 for Scientists.**"** Greg Wilson, Christine Alvarado, Jennifer Campbell, Ruben Landau, Robert Sedgewick. Panel presentation at SIGCSE 2008.

"Sketch Recognition from the User's Perspective." UC Santa Barbara Media Arts and Technology lecture.

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

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

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

SERVICE

AP Computer Science: Principles Commission and Item Development Team
Member of the 10-person team developing the new *AP CS: Principles* course. The course has been piloted at 5 colleges/universities in 2010-2011. Since 2010, member of the 6-person team developing questions (items) for the AP exam associated with the course.

National Center for Women & Information Technology (NCWIT)
Since 2010, co-leader of the NCWIT Academic Alliance Recruitment and Engagement team. As part of this team, helped increase the membership of the NCWIT AA and the participation of its members.

Conference Chair and Program Committee Service
- Guest Editor, *Computers and Graphics Special Issue on Pen-Based Computing*, 2009
- Program Co-chair: Eurographics Workshop on Sketch-Based Interfaces and Modeling, 2008
- Workshop Co-chair: Eurographics Workshop on Sketch-Based Interfaces and Modeling, 2007
- Program Committee: Eurographics Workshop on Sketch-Based Interfaces and Modeling 2005- 11
- NSF Panelist: 2008 (1), 2007 (2), 2010 (1), 2011 (1)

Harvey Mudd College Service
- Western Association of Schools & Colleges (WASC) Steering Committee, 2006-present
- Faculty Executive Committee (elected committee), 2008-2010
- CS Diversity Committee Chair, 2009-present
- Women's faculty group, organizer 2007-2009
- Strategic planning committee 2006
- CS5 redesign committee 2005-2006
- CS60 review committee 2006
- Freshman advisor 2006-2007; 2008-2009
- Core coordinators committee, Spring 2006