

# NOBORU MATSUDA

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## EDUCATION

November 2004	<b>University of Pittsburgh</b> <i>PhD, Intelligent Systems</i> (Advisor: Kurt VanLehn)	Pittsburgh, PA
March 1988	<b>Tokyo Gakugei University</b> <i>MS, Mathematics Education</i>	Tokyo, Japan
March 1985	<b>Tokyo Gakugei University</b> <i>BS, Mathematics Education</i>	Tokyo, Japan

## PROFESSIONAL EXPERIENCE

6/2009 – Current	<b>Carnegie Mellon University</b> <i>Systems Scientist</i> Human-Computer Interaction Institute, School of Computer Science	<u>Pittsburgh, PA</u>
11/2004 – 5/2009	<b>Carnegie Mellon University</b> <i>Post Doctoral Fellow</i> Human-Computer Interaction Institute, School of Computer Science <i>SimStudent Project</i> at the Pittsburgh Science of Learning Center	<u>Pittsburgh, PA</u>
1/1999 – 10/2004	<b>University of Pittsburgh</b> <i>Graduate Student Researcher</i> Learning Research and Development Center <i>Advanced Geometry Intelligent Tutoring System Project</i> at the Center for Interdisciplinary Research on Constructive Learning Environments	<u>Pittsburgh, PA</u>

3/1998 – 12/1998 University of Pittsburgh Pittsburgh, PA

*Visiting Scholar*

Learning Research and Development Center

*Automated Geometry Theorem Prover Project*

4/1993 – 12/1998 University of Electro Communications Tokyo, Japan

*Assistant Professor*

Graduate School of Information Systems

4/1988 – 3/1993 Kanazawa Institute of Technology Kanazawa, Japan

*Assistant Professor*

Center for Computer Assisted Instruction

## RESEARCH INTERESTS

*Learning Sciences*: Cognitive theories of learning and teaching; Computational model of learning; Cognitive modeling for human and machine learning, teaching, and problem solving

*Applied Computer Science*: Educational Technology, Intelligent Tutoring Systems, Educational Data Mining

*Artificial Intelligence*: Automated theorem proving, knowledge representation, machine learning, and data mining

*Mathematics Education*: Teaching and learning strategies, problem solving, curriculum development

## PUBLICATIONS

### Peer-reviewed Journal Papers

1. Matsuda, N., Cohen, W. W., Sewall, J., Lacerda, G., & Koedinger, K. R. (2009; in preparation). SimStudent: Building an Intelligent Tutoring System by Tutoring a Synthetic Student. *International Journal of Artificial Intelligence in Education*.
2. Matsuda, N. & VanLehn, K. (2004). GRAMY: A geometry theorem prover capable of construction. *Journal of Automated Reasoning*, 32(1), 3-33.

3. Ochi, T., Matsuda, N., & Okamoto, T. (1998). An object oriented distributed working environment to integrate cooperative work and personal work. *Transactions of Information Processing Society of Japan*, 39(1), 123-130.
4. Yoshida, T., Matsuda, N., & Okamoto, T. (1997). The system for supporting to learn/diagnose Z notation. *Transaction of Japan Society for Information and Systems in Education*, 14(1), 3-12.
5. Okamoto, T., Matsuda, N., & Sasaki, H. (1996). Intelligent CAI for geometric theorem proving with dynamic manipulative interface. *Transactions of Information Processing Society of Japan*, 37(9), 1679-1687.
6. Okamoto, T., Matsuda, N., & Furiya, T. (1995). A Study of the relationship between programming abilities and academic achievement in junior high school mathematics. *Japan Journal of Educational Technology*, 19(2), 85-100.
7. Okamoto, T., Morihiro, K., Matsuda, N., & Takuma, S. (1994). Application of analogical reasoning and extraction of tutoring rules for concept-formation learning. *Electronics and Communications in Japan Part Iii-Fundamental Electronic Science*, 77(3), 75-86.
8. Okamoto, T., Matsuda, N., & Yasuda, K. (1994). Study of CAI with algorithm diagnosis system for novice C programmers. *Journal of Japan Society for CAI*, 11(2), 63-74.
9. Matsuda, N. & Okamoto, T. (1993). Student modeling for procedural problem solving. *IEICE Trans. of Inf. & Syst.*, E77-D(1), 49-56.
10. Matsuda, N., Nagashima, S., Okamoto, T., & Takuma, S. (1993). On the system of learning and diagnosis for fostering space concept. *Journal of Japan Society for CAI*, 10(3), 114-121.
11. Matsuda, N. & Okamoto, T. (1992). Student model and its recognition by hypothesis-based reasoning in ITS. *Journal of Electronics and Communications in Japan, Part III*, 75(8), 85-95.
12. Okamoto, T. & Matsuda, N. (1992). Overview on the studies of intelligent CAIs/ITSs in Japan. *Educational Technology Research*, 15(1-2), 1-8.
13. Matsuda, N. & Okamoto, T. (1992). Mental model of the process of composing geometric proofs using an intelligent tutoring system. *Japan Journal of Educational Technology*, 15(4), 167-182.
14. Okamoto, T., Matsuda, N., & Takuma, S. (1991). A knowledge based CAD to support students' learning elementary geometric concepts and diagnosing their misconceptions. *Japan Journal of Educational Technology*, 14(4), 147-157.
15. Matsuda, N. & Okamoto, T. (1990). An automatic generation of knowledge-base for an intelligent CAI on geometry theorem proving and a GUI to draw geometric figures.

*Transactions of IEICE* (the Institution of Electronics, Information, and Communication Engineering), *J73-D-II*(1), 88-99.

16. Okamoto, T. & Matsuda, N. (1989). Learning to recognize students' plan in geometry proof using intelligent CAI. *Transactions of Information Processing Society of Japan*, *30*(8), 1046-1057.
17. Okamoto, T. & Matsuda, N. (1988). An intelligent CAI for geometry proof. *Transactions of Information Processing Society of Japan*, *29*(3), 311-324.

### Refereed Papers in Conference Proceedings

18. Matsuda, N., Lee, A., Cohen, W. W., & Koedinger, K. R. (2009). A Computational Model of How Learner Errors Arise from Weak Prior Knowledge. In N. Taatgen & H. van Rijn (Eds.), *Proceedings of the Annual Conference of the Cognitive Science Society* (pp. 1288-1293). Austin, TX: Cognitive Science Society.
19. Matsuda, N., Cohen, W. W., Sewall, J., Lacerda, G., & Koedinger, K. R. (2008). Why Tutored Problem Solving may be better than Example Study: Theoretical Implications from a Simulated-Student Study. In B. P. Woolf, E. Aimeur, R. Nkambou & S. Lajoie (Eds.), *Proceedings of the International Conference on Intelligent Tutoring Systems* (pp. 111-121). Heidelberg, Berlin: Springer.
20. Matsuda, N., Cohen, W. W., & Koedinger, K. R. (2007). Evaluating a simulated student using real students data for training and testing. In C. Conati, K. McCoy & G. Paliouras (Eds.), *Proceedings of the international conference on User Modeling* (LNAI 4511) (pp. 107-116). Berlin, Heidelberg: Springer.
21. Matsuda, N., Cohen, W. W., & Koedinger, K. R. (2007). Predicting students performance with SimStudent that learns cognitive skills from observation. In R. Luckin, K. R. Koedinger & J. Greer (Eds.), *Proceedings of the International Conference on Artificial Intelligence in Education* (pp. 467-476). Amsterdam, Netherlands: IOS Press.
22. Matsuda, N., Cohen, W. W., & Koedinger, K. R. (2005). Building Cognitive Tutors with Programming by Demonstration. In S. Kramer & B. Pfahringer (Eds.), *Proceedings of the International Conference on Inductive Logic Programming* (Technical report: TUM-I0510) (pp. 41-46): Institut fur Informatik, Technische Universitat Munchen
23. Matsuda, N., Cohen, W. W., & Koedinger, K. R. (2005). Applying Programming by Demonstration in an Intelligent Authoring Tool for Cognitive Tutors. In *AAAI Workshop on*

*Human Comprehensible Machine Learning* (Technical Report WS-05-04) (pp. 1-8). Menlo Park, CA: AAAI association.

24. Matsuda, N., & VanLehn, K. (2005). Advanced Geometry Tutor: An intelligent tutor that teaches proof-writing with construction. In C.-K. Looi, G. McCalla, B. Bredeweg & J. Breuker (Eds.), *Proceedings of The 12th International Conference on Artificial Intelligence in Education* (pp. 443-450). Amsterdam: IOS Press.
25. Matsuda, N. & VanLehn, K. (2003). Modeling Hinting Strategies for Geometry Theorem Proving. In P. Brusilovsky, A. Corbett & F. de Rosis (Eds.), *Proceedings of the 9th International Conference on User Modeling* (pp.373-377), Berlin, Heidelberg: Springer.
26. Matsuda, N. & VanLehn, K. (2000). A Reification of a Strategy for Geometry Theorem Proving. In G. Gauthier, C. Frasson & K. VanLehn (Eds.), *Proceedings of the International Conference on Intelligent Tutoring Systems* (Lecture Notes in Computer Science, No.1839, p.660), Berlin, Heidelberg: Springer.
27. Matsuda, N. & VanLehn, K. (2000). Decision Theoretic Instructional Planner for Intelligent Tutoring Systems. In B. du Boulay (Ed.), *Workshop Proceedings on Modeling Human Teaching Tactics and Strategies* (ITS2000, pp.72-83).
28. Matsuda, N. (1998). Cognitive Contribution of Diagrammatic Reasoning Model towards Geometry ITS. In B. P. Goettl, H. M. Halff, C. L. Redfield, V. J. Shute (Eds.), *Workshop Proceedings on Cognitive Principles in Intelligent Tutoring Systems* (ITS98).
29. Matsuda, N. & Okamoto, T. (1998). Diagrammatic Reasoning for Geometry ITS to Teach Auxiliary Line Construction Problem. In B. P. Goettl, H. M. Halff, C. L. Redfield & V. J. Shute (Eds.), *Proceedings of the International Conference on Intelligent Tutoring Systems*, (Lecture Notes in Computer Science No.1452, pp.244-253), Heidelberg, Berlin: Springer.
30. Matsuda, N. & Okamoto, T. (1996). Parallel Computing Model for Problem Solver Towards ITSs. In C. Frasson, G. Gauthier & A. Lesgold (Eds.), *Proceedings of the International Conference on Intelligent Tutoring Systems* (Lecture Notes in Computer Science No.1086, pp.234-242), Heidelberg, Berlin: Springer.
31. Matsuda, N. & Okamoto, T. (1994). Student Modeling for an ITS to Study Problem Solving. In H Ueno & V. L. Stefanuk (Eds.), *Proceedings of Japan-CIS Symposium on Knowledge Based Software Engineering* (pp.94-99), Saitama, Japan: Isshinsha.
32. Matsuda, N. & Okamoto, T. (1992). Student Model Diagnosis for Adaptive Instruction in ITS. In C. Frasson, G. Gauthier & G.I. McCalla (Eds.), *Proceedings of the International Conference*

on *Intelligent Tutoring Systems* (Lecture Notes in Computer Science No.608, pp.467-474), Heidelberg, Berlin: Springer-Verlag.

### Book Chapters

33. Matsuda, N. (2006). How to get a Ph.D in America. In Akira Arimoto and Ikuo Kitagaki (Eds.) *University Authority*, (pp.132-137). Tokyo: Minervashobo Publishers Inc.
34. Matsuda, N. (2005). Instructional strategies. In Hozumi Tanaka (Ed.) *Encyclopedia of Artificial Intelligence*. Tokyo: Japan Society of Artificial Intelligence.
35. Matsuda, N. (2005). Natural language processing in educational systems. In Hozumi Tanaka (Ed.) *Encyclopedia of Artificial Intelligence*. Tokyo: Japan Society of Artificial Intelligence.
36. Matsuda, N. (1999). Cognitive model of geometry theorem proving with construction and its application to intelligent tutoring systems. In Yoshishige Sugiyama (Ed.) *Towards new practical theories in mathematics education*. Tokyo: Toyokan Publishers Inc.
37. Matsuda, N. (1993). Computer networking. In Okamoto, T. (Ed.) *Introduction to Information Education for Teachers: Cases in High-School Education*, (pp.180-197). Tokyo: Personal Media.
38. Matsuda, N. (1992). Foundations of Computers. In Okamoto, T. (Ed.) *Introduction to Information Education for Teachers: Cases in Middle-School Education*, (pp.88-119). Tokyo: Personal Media.
39. Matsuda, N. (1990). What is CAI? In Okamoto, T. (Ed.) *Introduction to C Programming*, (pp.201-236). Tokyo: Personal Media.
40. Matsuda, N. & Kazuhiko Hatano (1990). Knowledge communication. In Okamoto, T. and Riichiro Mizoguchi (Eds.) *Artificial Intelligence and Tutoring Systems*, (pp.447-456). Tokyo: Ohmu Inc. This is a Japanese translation of Etienne Wenger, *Artificial Intelligence and Tutoring Systems*, Los Altos, CA: Morgan Kaufmann (1987).
41. Matsuda, N. (1988). Drill, Practice, and Machine Learning. In Okamoto, T., Kanji Akahori, and Setsuo Yokoyama (Eds.) *Computer environments for children*, (pp.21-40). Tokyo: Personal Media. This is a Japanese translation of Cynthia Solomon, *Computer environments for children*, Cambridge, MA: MIT Press (1986).

## Dissertation

42. Matsuda, N. (2004). The impact of different proof strategies on learning geometry theorem proving. Unpublished Ph.D dissertation. University of Pittsburgh.

## Other Publications

43. Matsuda, N., William W. Cohen, Jonathan Sewall, and Kenneth R. Koedinger (2006). Applying Machine Learning to Cognitive Modeling for Cognitive Tutors, Technical report CMU-ML-06-105, School of Computer Science, Carnegie Mellon University.
44. Matsuda, N., William W. Cohen, Jonathan Sewall, and Kenneth R. Koedinger (2006). What characterizes a better demonstration for cognitive modeling by demonstration? Technical report CMU-ML-06-106, School of Computer Science, Carnegie Mellon University.

## Invited Talks

45. SimStudent for STEM Education: A synthetic student to explore theories of learning and build effective interventions (2009). School of Education, Public Policy and Civic Engagement, University of Massachusetts Dartmouth. Fairhaven, MA.
46. SimStudent: Teaching a smart machine to learn how people learn (2008). Human Computer Interaction Graduate Program, Iowa State University. Ames, IA.
47. Beyond Building Cognitive Tutors by Demonstration – When SimStudent helps building a bridge between technology and education (2007). School of Education, Stanford University. Palo Alto, CA.
48. Using Simulated Student to build Cognitive Tutors and beyond – Cognitive Modeling with Programming by Demonstration (2006). Department of Computer Science Colloquium, Northern Illinois University. DeKalb, IN.
49. Building Cognitive Model for Cognitive Tutors by Demonstration (2006). Seminar series on e-Learning, Kumamoto University. Kumamoto, Japan.
50. Building Robust Learning Theories for Robust Learning (2006). International Symposium on e-Learning, Osaka Prefecture University. Osaka, Japan.

## GRANTS

- 2009-08 **National Science Foundation, Research and Evaluation on Education in Science and Engineering (REESE)**  
*Learning by Teaching a Synthetic Student: Using SimStudent to Study the Effect of Tutor Learning. Principal Investigator* (co-PIs: Kenneth R. Koedinger, William W. Cohen, and Gabriel J. Stylianides). August 1, 2009 to July 31, 2012. Award No. 0910176. \$492,439
- 2009-06 **Department of Education, Institute of Education Sciences, Education Technology**  
*Learning by Teaching Synthetic Student: Using SimStudent to Study the Effect of Tutor Learning. Principal Investigator* (co-PIs: Kenneth R. Koedinger, William W. Cohen, and Gabriel J. Stylianides). June 1, 2009 to May 31, 2012. Award No. R305A090519. \$1,413,273
- 2008-09 **Pittsburgh Science of Learning Center (Pittsburgh, PA)**  
*Towards a Theory of Learning Errors: Application of a Synthetic Student to Model How Students Learn Errors. Principal Investigator* (co-PIs: William W. Cohen and Kenneth R. Koedinger; CMU). September 1, 2008 to August 31, 2009. \$72,335
- 2008-12 **Japan Ministry of Education, Culture, Sports, Science and Technology**  
*Computer Supported Learning System for learning Communication Skills for Students with High-functioning Autism. Co-principal Investigator (PI: Kiyoshi Tajitsu, Hokusei University, Hokkaido, Japan). Award No. 20330197. Approximately \$207,000*
- 2005-09 **National Science Foundation, Advanced Learning Technologies (ALT)**  
*Building Cognitive Tutors with Programming by Demonstration: When Simulated Students help Cognitive Modeling and Educational Studies. Co-Principal Investigator (PI: William W. Cohen, CMU. co-PI: Kenneth R. Koedinger, CMU). September 15, 2005 to August 31, 2009. Award No. REC-0537198. \$499,473*
- 2006-07 **Japan Ministry of Education, Culture, Sports, Science and Technology**  
*Developing a Computer Assisted Instruction System for teaching Communication Skills using Pictograms for Students with Autism. Co-principal investigator (PI: Ikuya Murata, Hokkaido University of Education). Approximately \$24,400*
- 1995 **Japan Ministry of Education, Culture, Sports, Science and Technology**  
*Intelligent Learning Environment for Exploratory Learning, Principal Investigator,*

- Approximately \$10,000
- 1994 **University of Electro-Communications** (Tokyo, Japan)  
*Advanced Problem Solving Model for Intelligent Tutoring Systems, Principal Investigator, Approximately \$9,000*
- 1993 **Japan Ministry of Education, Culture, Sports, Science and Technology**  
*Modeling Students Competence in Procedural Problem Solving, Principal Investigator, Approximately \$10,000*
- 1990 **Japan Ministry of Education, Culture, Sports, Science and Technology**  
*Plan Recognition for an Intelligent Tutoring System in Geometry Theorem Proving, Principal Investigator, Approximately \$10,000*

### AWARDS, CERTIFICATES, AND SCHOLARSHIPS

#### **Award**

- 1988 **Outstanding Young Researcher Research Award**  
*Japan Society of Educational Technology*

#### **Certificate**

- 1985 **Teaching Certificate** in Mathematics for all grade levels (1st through 12th grade)  
*Japan Ministry of Education, Culture, Sports, Science and Technology*

#### **Travel Scholarship**

- 1996 **Yoshida Science Foundation**  
*International Conference on Intelligent Tutoring Systems (ITS96), Montreal, Canada*
- 1994 **Okawa Foundation**  
*Japan-CIS Symposium on Knowledge Based Software Engineering '94 (JCKBSE94), Pereslavl-Zalesski, Russia*
- 1992 **Telecommunications Advancement Foundation**  
*International Conference on Intelligent Tutoring Systems (ITS92), Montreal, Canada*

## **ACADEMIC SERVICES**

### **Editorial Board**

1996 – 1999      Journal of Japanese Society of Information and Systems in Education

### **Reviewers for Journals**

Applied Artificial Intelligence

Journal of Technology, Instruction, Cognition, and Learning

Journal of Educational Technology

Journal of Intelligent Systems

IEICE Transactions on Information and Systems (Japanese, IEICE: Institution of Electronics, Information and Communication Engineering)

Journal of Information Processing Society of Japan (Japanese)

Transaction of Japanese Society for Information and Systems in Education (Japanese)

Japan Journal of Educational Technology (Japanese)

### **Reviewer for Grant Proposals**

NSF review panel, 2007

### **Reviewers for Peer-reviewed Conferences**

International Conference on Computers in Education, 2001, 2006-2008

International Florida Artificial Intelligence Research Society Conference, 2006, 2008, 2009

International Conference on Intelligent Tutoring Systems, 1998, 2000, 2006, 2008

International Conference on Artificial Intelligence in Education, 1995, 2005, 2007, 2009

### **Conference Program Committee**

International Conference on Intelligent Tutoring Systems, 2010

International Conference on Educational Data Mining, 2008-2010

International Florida Artificial Intelligence Research Society Conference, 2006-2010

International Conference on Computers in Education, 2006, 2007

International Conference on Artificial Intelligence in Education, 1997

Joint National Conference on Educational Technology in Japan, 1994, 1997



- 2008/10-2009/08 Andrew Lee, Tatyana Tsymbalenko, and Travis Mandel (NSF Research Experience for Undergraduate, co-supervised with William Cohen and Ken Koedinger)
- 2008/06-07 Sarah Epstein (Summer Intern at Pittsburgh Science of Learning Center, co-supervised with Ken Koedinger)
- 2006/08-2008/08 Gustavo Lacerda (Research Assistant, co-supervised with William Cohen and Ken Koedinger)
- 2006/06-08 Anthony Zana and Reid VanLehn (Summer interns for NSF Research Experience for Undergraduate, co-supervised with William Cohen and Ken Koedinger)

## REFERENCE

Dr. Kenneth R. Koedinger

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School of Computer Science, Carnegie Mellon University  
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Dr. William W. Cohen

Associate Research Professor in Department of Machine Learning  
School of Computer Science, Carnegie Mellon University  
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Dr. Kurt VanLehn

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