

RECOGNIZING EXCELLENCE

Chancellor's Award for Excellence in STEM Education

STUDENT AWARD Proposal Cover Sheet (Student Version)

Applicant Information

Full Name: Koh Kyu Han
Last First M.I.

Faculty Adviser: Alexander Repenning

Proposal Title: Computing Computational Thinking

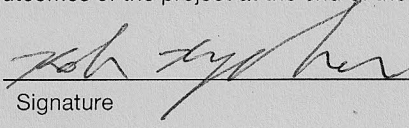
Contact Info: Computer Science UCB 430
Home Department Campus Box #
kohkh@colorado.edu 303-495-0357
Email Address Phone Number

Fellow Expectations

By submitting this application, I confirm that, if selected to receive a Chancellor's Award for Excellence in STEM Education, I will:

- Attend and be recognized at the annual Symposium on STEM Education (tentatively 9/23).
- Give a brief introduction (~10-15 min) to my project at DBER.
- Actively engage in the CU-Boulder STEM education community by attending Chancellor's Fellow events.
- Present my work to the STEM education community by:
 - Giving at least one DBER seminar
- OR**, if that is an impossibility:
 - I will give a talk that the CU-Boulder STEM education community is invited to attend
- Submit a one to three-page report detailing the outcomes of the project at the end of the funding period

I have read and understand this commitment:


Signature

Computing Computational Thinking: Towards the Automatic Recognition of Computational Thinking in Real Time

Submitted by Kyu Han Koh, Doctoral student, in Department of Computer Science

Faculty Advisor: Dr. Alexander Repenning, Professor in Department of Computer Science

Since the 1990's there have been multiple efforts to fix the broken pipeline at the K-12 level in computer science (CS) education [1-3], and most of those efforts have focused on the student motivational factor [4, 5]. The results of many studies in computer science education indicate that student motivation in computer science has been successfully increased by those efforts [4, 5], but most of them failed to rigorously assess student learning. I believe that this biased tendency of CS education research was caused by failing to have the right instrument to measure student learning of content at the semantic level. In other words, the right assessment instrument should be able to assess not only assess acquired students' knowledge but also guide students to the next level of learning. Student learning may be measured with existing tools such as grading rubrics, but it is extremely time consuming and has a limited functionality to provide necessary educational feedback from students' learning progressions.

In order to solve these challenges, I propose a method of automating the grading process. The method I propose, Computational Thinking Pattern Analysis (CTPA) (Figure 1) [6], is designed to measure student-learning skills and represent student content learning at the semantic level through phenomenological analysis in real-time. This concept uses a Latent Semantic Analysis (LSA) [7] inspired technique, multiple high dimensional cosine calculations to analyze semantic meanings of a given context with several pre-defined subjects/phenomena. Theoretically, this idea can be applied to several different domains such as natural language processing and visual end user programming. Therefore, this idea can be employed to build a learning assessment tool for computer science (CS) and/or computational thinking (CT) [14] education where visual programming is widely adopted.

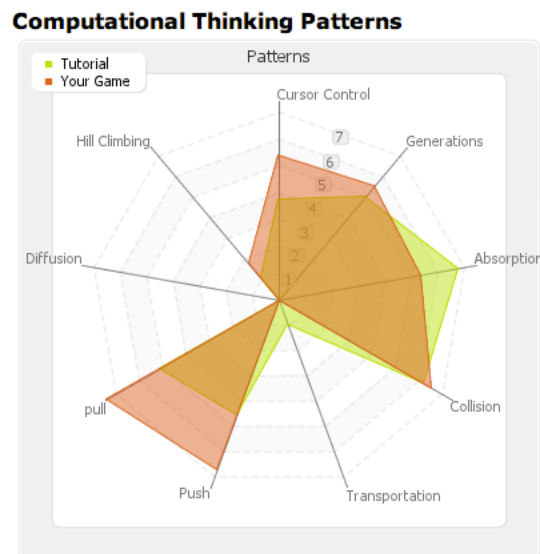


Figure 1. CTPA Graph Example. This graph is an actual student's example of a game of Frogger.

As part of my dissertation, I designed, developed, and studied the Scalable Game Design Arcade (Figure 2) [15], a cyberlearning infrastructure where middle school to grad school students share (play, download, leave comments, and rate each other on) their AgentSheets [3] projects including games and STEM simulations. The Scalable Game Design Arcade (SGDA) has collected more than 10,000 projects from 7,000 students over the past three years. All collected AgentSheets projects through SGDA are analyzed by CTPA.

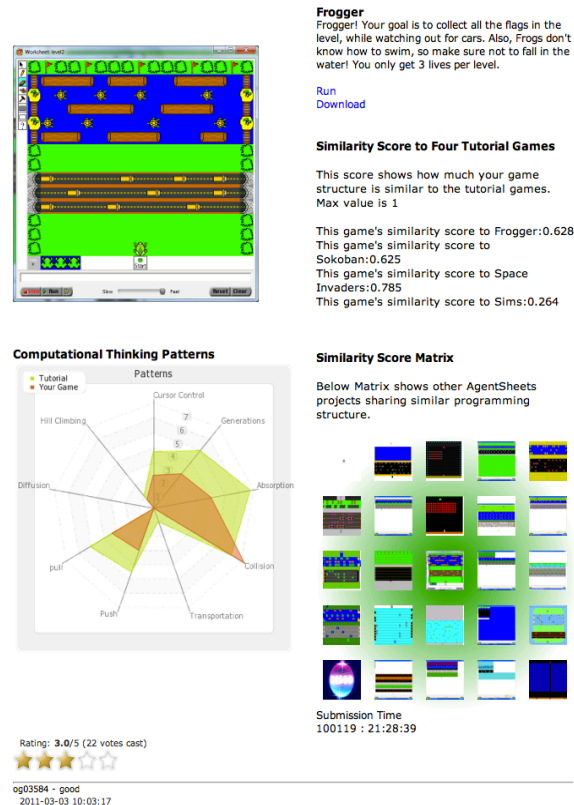


Figure 2. The Individual Page of SGDA. Individual page illustrates the screenshot of the game (upper left), Run and Download button (upper right), the game's similarity score compared to four tutorial games (middle right), a similarity score matrix showing similarly programmed games to the submitted game, and the CTPA graph (bottom right & left).

The analyzed results of CTPA have shown promise in providing educational assessments of learning trajectory [8], learning transfer [6], and programming divergence [9].

The main focus of this research aims at evaluating the CTPA to prove its usefulness as an educational instrument for STEM education. To evaluate CTPA's reliability (to verify its consistency of measuring outcomes) and CTPA's validity (to verify that CTPA actually measures what we attempt to assess) as a program analysis tool for educational purposes, I plan to employ the following research plan.

Research Plan

Since the early stage of CTPA development, the CTPA has been validated formally and informally with traditional Computer-Automated Scoring (CAS) system validation approaches and other educational validation approaches.

Yang et al. classified CAS system validation approaches into three different categories: [10].

- Approaches focusing on relationships among scores generated by different scorers
- Approaches focusing on relationship between test score and external measures
- Approaches focusing on scoring processes

And I plan to add one additional category to this CAS system validation approach:

- Approaches focusing on predictive validity

For a good validation approach for CTPA, the purpose of CTPA and the consequence of the interpretation of CTPA should be addressed. The original CTPA was not designed as a computer-automated scoring system, but it was close to a program analysis tool that could present students' problem solving skills and programming skills. It demonstrates what kinds of computational thinking (pattern) skills were used to implement AgentSheets [3] projects to indicate students' problem solving skills and how well the projects were implemented (similarly programmed to the given tutorials) to show students' programming skills. Nevertheless, the interpretation of CTPA has showed its possibility as a CAS system with the development of CTPA applications such as Learning Skill Scores calculation [8]. Also, it is possible to convert CTPA into a holistic score with CTPA applications. It means that the consequence of the interpretation of CTPA is able to translate CTPA analysis into a computer-generated score. Therefore, the consequence of the interpretation of CTPA is similar to the ones of other CAS systems. It is able to provide instructional and diagnostic feedback including self-assessment.

CTPA can be considered as not only a CAS system but also a program phenomenological analysis tool. So the CTPA should be validated from several different aspects with several different validation approaches.

Category 1: relationships among scores generated by different scorers

My approach will assess the correspondence between CAS-system-generated scores and scores assigned by human scorers.

With this kind of validation approach, there is a high possibility of variations due to intra-rater inconsistency and inter-rater differences. To solve this issue, more than 3 scorers/experts will participate in this category evaluation, and their rating will be classified into three different categories; pure programming ratings, pure design ratings, and overall ratings. Also, the correlation between CTPA-generated scores and expert-generated scores will be obtained by Pearson correlation and Spearman rank correlation, and their correlations values' significance will be assessed too.

Category 2: relationship between test score and external measures

In this category, my study is designed to evaluate the relationship between the CAS-system-generated scores and Computational Thinking Pattern Quiz [11]. The Computational Thinking Pattern Quiz is another computational thinking assessment tool to measure students' understanding of computational thinking (pattern) skills through phenomenological comparisons.

Computational Thinking Pattern (CTP) Quiz has a certain set of questions that involves video of real-life phenomena relating to patterns students programmed in their class implementation period. All CTP Quiz questions are open-ended questions, and students are able to answer freely why and how they match computational thinking patterns in the quiz videos and computational thinking patterns from the AgentSheets project they programmed. Basically this quiz works as a student interview that can judge students' understanding of computational thinking patterns. This CTP Quiz results will be evaluated by several computational thinking experts' agreements to check its internal consistency.

Additionally, I will assess the differential agreement between CTPA scores and ratings given by people with different levels of domain expertise including students, teachers, and researchers as Landauer et al. did for their CAS system [12]. They reported that their CAS-generated scores showed higher correspondence with ratings given by scorers with higher expertise than with those given by scorers with lower expertise [10, 12].

Category 3: Approaches focusing on scoring processes

Converting CTPA into a holistic score is not the only way to validate CTPA. CTPA can be validated with approaches focusing on scoring processes. For example, when a game of Frogger is graded, a grader will look the functionalities of Frogger; Frogger can be moved with key controls (cursor control), a tunnel creates cars or trucks (generation), etc. Thus, CTPA also should be able to check the functionalities of computational thinking patterns as a human scorer does. To do so, each canonical pattern of CTPA should be matched to the basic requirement of a human grader's or a student's perception. This process that refines canonical computational thinking patterns can be done with statistical approaches or human expert agreement. Currently, the canonical computational thinking pattern is defined by human expert agreement, but I plan to add a statistical approach, which captures an average model for each computational thinking pattern from a project submission database, as well.

Category 4: Approaches focusing on predictive validity

The last validity subject is predictive validity, which could be a possible clue to learning progressions interpretation. I will determine predictive validity by calculating R-squared value comparing student (CTPA-computed) skills before the final project and student (CTPA-computed) skills of the final project. If they are highly related, then we can say that students who gain more experienced through pre-final project assignments are expected to show better skills in the final project too.

Intellectual Merit: Semantic assessment in CS/CT education would be able to provide better individual feedback and faster learning assessment to students and teachers by measuring student skills and challenges and analyzing learning contents at the semantic level. This kind of feedback can be used to determine when and how teachers can expand students' learning capability in accordance with the theories of the Zone of Proximal Development and Flow [13]. A validated CTPA will contribute to the study of learning theory, professional development, and educational data mining by providing empirical data in order to refine the current conceptual framework of educational systems.

Broader Impact: This research suggests a method that can assess students' learning skills, provide effective learning guidelines, and compute students' learning outcomes. This type of method, which cannot be found widely, can be used to create cyberlearning systems that help large numbers of teachers and students to learn computational thinking. This research is currently being applied to build a cyberlearning infrastructure, which is used for the Educational Game Design class, which has been held in computer science department since the spring of 2010 and will be held in ATLAS from the fall of 2013.

A timeline for completion of the Project

May 2013 – Data aggregation. In the first month, I plan to put together the data sets necessary to answer some research questions described in my dissertation description document. Much of the data has already been collected, but it needs to be collated in an appropriate format for answering each question. This phase is also exploratory, which will help tweak the framework in my dissertation synopsis to better represent the patterns found in the data.

May - June 2013 – Survey and experiment deployment for validity evaluation. Also in the first month, I plan to deploy the necessary design interventions that will help get the necessary data that I do not have already. Most of these experiments are already designed and just need to be tweaked.

Category 1 validation – From 3rd week of May to 4th week of May.

Category 2 validation – From 3rd week of May to 2nd week of June.

June 2013 – Category 3 validation/Software quality assurance – Based on the result of validity evaluation, I plan to update the current algorithm and technique of CTPA to reduce false positive/negative of CTPA and increase the validity of CTPA.

July - August 2013 – Data analysis. I plan to create the necessary visualizations and statistical analyses to examine some research questions outlined in my dissertation synopsis.

Learning Trajectory – From 1st week of July to 4th week of July.

Social Programming Divergence – From 1st week of August to 4th week of August.

Category 4 validation – 4th week of August.

August - September 2013 – Results. I plan to put together the findings in a structured form, and integrate all the findings into a cohesive document accessible to a broad audience.

November 2013 – Draft – a first draft of the project report.

March 2014 – Final version.

References

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- [2] Peppler, K. & Kafai, Y. B., Collaboration, Computation, and Creativity: Media Arts Practices in Urban Youth Culture. In C. Hmelo- Silver & A. O'Donnell (Eds.), In Proc. Computer Supported Collaborative Learning, New Brunswick, NJ, USA, 2007
- [3] Repenning, A., Excuse me, I need better AI! Employing Collaborative Diffusion to make Game AI Child's Play. In Proc. ACM SIGGRAPH Video Game Symposium, Boston, MA, USA, ACM Press, 2006.
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- [6] Koh, K. H., Basawapatna, A., Bennett, V., Repenning, A. 2010. "Towards the Automatic Recognition of Computational Thinking". In Proceedings of IEEE International Symposium on Visual Languages and Human-Centric Computing 2010, Leganés-Madrid, Spain, September 21-25, 2010
- [7] T. K. Landauer., D. Laham., B. Rehder., M. E. Schreiner., P. Langley., *How well can passage meaning be derived without using word order? A comparison of Latent Semantic Analysis and humans*, In Proc. the 19th annual meeting of the Cognitive Science Society Mahwah, NJ: Erlbaum (1997) , p. 412--417.
- [8] Bennett, V., Koh, K. H., Repenning, A. Can Learning Acquisition be Computed?, IEEE International Symposium on Visual Languages and Human-Centric Computing 2011, Pittsburgh, PA, USA, September 18-22, 2011
- [9] Bennett, V., Koh, K. H., Repenning, A., "Computing Creativity: Divergence in Computational Thinking", ACM Special Interest Group on Computer Science Education Conference, (SIGCSE 2013), March 6-9, 2013, Denver, Colorado, USA
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- [11] Basawapatna, A., Koh, K. H., Repenning, A., Webb, D., Marshall, K., Recognizing Computational Thinking Patterns, SIGCSE 2011: Reaching Out The 42nd ACM Technical Symposium on Computer Science Education March 9-12, 2011, Dallas, Texas, USA
- [12] Landauer, T. K., Laham, D., & Foltz, P. W. (2001, February). The intelligent essay assessor: Putting knowledge to the test. Paper presented at the Association of Test Publishers Computer-Based Testing: Emerging Technologies and Opportunities for Diverse Applications conference, Tucson, AZ.
- [13] Repenning, A., Programming goes back to school, Communications of the ACM (May 2012), 55, 5, pp. 38-40, ACM Press, New York, NY, USA.

- [14] Wing, J.M. "Computational Thinking." *Communications of the ACM*, 49:3, 33-35, 2006.
- [15] Koh, K. H., Bennett, V., Repenning, A., Inspiring Collaborative Benefits: An Interaction between a Virtual and a Physical Group Learning Infrastructure, *Western Canadian Conference on Computing Education (WCCCE 2010)*, Okanagan, B.C., Canada May 7-8, 2010

EDUCATION

- Ph D. Student, Computer Science and Cognitive Science, University of Colorado, Boulder, August 2007 – present
 - Graduate Certification in Cognitive Science, Institute of Cognitive Science, University of Colorado, Boulder, April 2011
 - Advisor: Dr. Alexander Repenning
- M.S., Computer Science, Auburn University, Auburn, AL, May 2007
 - Advisor: Dr. Cheryl D. Seals
 - Thesis:
PINEHILL: A NOVEL APPROACH TO COMPUTER AIDED LANGUAGE LEARNING
- B.E., Computer Science, Soongsil University, Seoul, South Korea, February 2004

PUBLICATIONS

Peer-Reviewed Conference Papers

- Bennett, V., **Koh, K. H.**, Repenning, A., Computing Creativity: Divergence in Computational Thinking, ACM Special Interest Group on Computer Science Education Conference, (SIGCSE 2013), March 6-9, 2013, Denver, Colorado, USA
- **Koh, K. H.**, Repenning, A., Nickerson, H., Endo, Y., Motter, P., Will it Stick? Exploring the Sustainability of Computational Thinking Education Through Game Design, ACM Special Interest Group on Computer Science Education Conference, (SIGCSE 2013), March 6-9, 2013, Denver, Colorado, USA
- Webb, D. C., Repenning, A., & **Koh, K. H.**, Toward an Emergent Theory of Broadening Participation in Computer Science Education, ACM Special Interest Group on Computer Science Education Conference, (SIGCSE 2012), February 29 - March 3, 2012, Raleigh, North Carolina, USA.
- Bennett, V., **Koh, K. H.**, Repenning, A., CS Education Re-Kindles Creativity in Public Schools , ITiCSE '11: Annual Conference on Innovation and Technology in Computer Science Education, Darmstadt, Germany, June 27-29, 2011
- Ioannidou, A., Bennett, V., Repenning, A., **Koh, K. H.**, Basawapatna, A., Computational Thinking Patterns. Paper presented at the 2011 Annual Meeting of the American Educational Research Association (AERA) in the symposium “Merging

Human Creativity and the Power of Technology: Computational Thinking in the K-12 Classroom”, New Orleans, April 8-12, 2011

- Basawapatna, A., **Koh, K. H.**, Repenning, A., Webb, D., Marshall, K., Recognizing Computational Thinking Patterns, SIGCSE 2011: Reaching Out The 42nd ACM Technical Symposium on Computer Science Education March 9-12, 2011, Dallas, Texas, USA
- **Koh, K. H.**, Bennett, V., Repenning, A., Inspiring Collaborative Benefits: An Interaction between a Virtual and a Physical Group Learning Infrastructure, Western Canadian Conference on Computing Education (WCCCE 2010), Okanagan, B.C., Canada May 7-8, 2010
- **Koh, K. H.**, Basawapatna, A., Bennett, V., Repenning, A., Towards the Automatic Recognition of Computational Thinking, IEEE International Symposium on Visual Languages and Human-Centric Computing 2010, Leganés-Madrid, Spain, September 21-25, 2010
- Basawapatna, A., **Koh, K. H.**, Repenning, A., Using Scalable Game Design To Teach Computer Science From Middle School to Graduate School, ITiCSE '10: Annual Conference on Innovation and Technology in Computer Science Education, Ankara, Turkey, June 26-30, 2010
- -Repenning, A., Basawapatna, A., and **Koh, K. H.** 2009. Making university education more like middle school computer club: facilitating the flow of inspiration. In Proceedings of the 14th Western Canadian Conference on Computing Education (Burnaby, British Columbia, Canada, May 01 - 02, 2009)
- **Koh, K. H.**, Gopaldaswamy, S., Srirangarajan, A., Jin, J., Seals, C. D. Usability of AgentSheets for Creating Educational Simulation, ISCA 19th International Conference on Computer Applications in Industry and Engineering Conference (CAINE'06), Las Vegas, Nevada, USA. November 2006, pp218-223.

Peer-Reviewed Conference Posters

- Bennett, V., **Koh, K. H.**, Repenning, A. Can Learning Acquisition be Computed?, IEEE International Symposium on Visual Languages and Human-Centric Computing 2011, Pittsburgh, PA, USA, September 18-22, 2011

- **Koh, K. H.**, Bennett, V., Repenning, A., Computing Indicators of Creativity, ACM Creativity & Cognition 2011, The High Museum of Art · Atlanta, Georgia, USA, November 3-6, 2011

Doctoral Consortium

- **Koh, K. H.** Computing Computational Thinking, IEEE International Symposium on Visual Languages and Human-Centric Computing 2011, Pittsburgh, PA, USA, September 18-22, 2011

Student Research Competition

- **Koh, K. H.** Real-Time Automated Computational Thinking Assessment Tool, ACM Special Interest Group on Computer Science Education Conference, (SIGCSE 2013), March 6-9, 2013, Denver, Colorado, USA. (semi-finalist)
- **Koh, K. H.** Computing Computational Thinking, ACM Special Interest Group on Computer Science Education Conference, (SIGCSE 2012), February 29 - March 3, 2012, Raleigh, North Carolina, USA. (semi-finalist)

INVITED TALKS

- Towards the Automatic Recognition of Computational Thinking for Adaptive Visual Language Learning, Auburn University, Auburn, AL, November 3, 2011
- Csíkszentmihályi meets Vygotsky: Early thoughts on adaptive learning balancing creativity with scaffolding, Life Long Learning and Design Lab, University of Colorado, Boulder, CO, November 3, 2010
- Scalable Game Design, iDREAMS Project, Korea University, Seoul, South Korea, July 27, 2010
- Exploring output filter mechanism to provide convenient and trustworthy service for Google 3D warehouse users, Life Long Learning and Design Lab, University of Colorado, Boulder, CO, March 19, 2008

STUDENT SYMPOSIUMS

- Computing Computational Thinking in real-time, Graduate Student Colloquium, Computer Science Department, University of Colorado, Boulder, CO, Feb 26, 2013
- Computational Thinking Pattern Analysis for Adaptive Visual Language Learning in Scalable Game Design Arcade, ICS Fiesta and Poster Session, Institute of Cognitive Science, University of Colorado, Boulder, CO, April 29, 2011

AWARDS

- Research Award, Institute of Cognitive Science, 2013, University of Colorado at Boulder
- Research Award, Institute of Cognitive Science, 2011, University of Colorado at Boulder
- University Fellowship, 2007/2008, University of Colorado at Boulder
- STARS Student Leadership, 2007, Auburn University
- Academic Excellence Scholarship, 2001/2003, Soongsil University

EXPERIENCE

Research Experience

- Graduate Research Assistant: CT4TC (Computational Thinking for Teaching Computing) funded by NSF
University of Colorado, Boulder, CO 1/2012 – present
Cyberinfrastructure Designer. Design, build, and maintain ScalableGameDesign Arcade and Wiki for web support.
- Graduate Research Assistant: iDREAMS Project funded by NSF
University of Colorado, Boulder, CO 1/2009 – 12/2011
Cyberinfrastructure Designer. Design, build, and maintain ScalableGameDesign Arcade and Wiki for web support.
- STARS Student Leadership : STARS Alliance Project funded by NSF
Auburn University, Auburn, AL, 1/2007 – 8/2007
Used Language : Alice 3D, Squeak
This project is committed with 3rd to 5th elementary school students in Auburn,

Alabama. We taught them how to create their own computer simulations with end user programming languages such as Alice 3D and Squeak. Through this project, we have tested the usability of those end user programming tools and observed how children cope with the limitations of those tools.

Teaching Experience

- Graduate Teaching Assistant: CSCI 1300 Computer Science 1
University of Colorado, Boulder, CO 1/2008 – 5/2008
Taught and Graded programs in Python, C++. Lab monitor and aided students in learning programming concepts.
- Instructor : Comp 1000 Personal Computer Applications
Auburn University, Auburn, AL 1/2007 – 5/2007
Lab Instructor: Introduction to personal computers and software applications including word processing, spreadsheets, databases, and presentation graphics; generation and retrieval of information with the Internet; integration of data among applications.
- Graduate Teaching Assistant: Comp1210 Fundamentals of Computing
Auburn University, Auburn, AL 8/2006 – 12/2006
Taught and Graded programs in Java. Lab monitor and aided students in learning programming concepts.

Employment Experience

- Computer Graphic Designer
Jeju Environmental Institute, Jeju, South Korea, 5/1999 – 5/2004
Landscape designing with Photoshop, Illustrator, and AutoCAD.

COMMUNITY SERVICES

- STARS (Students & Technology Academia Research & Service) Student Leadership
Auburn University Alliance, Auburn, AL, 1/2007 – 7/2007
The mission of the STARS (Students & Technology in Academia, Research & Service) Alliance is to increase the participation of women, under-represented

minorities, and persons with disabilities in computing disciplines through multi-faceted interventions focused on the influx and progression of students from middle school through graduate school in programs that lead to computing careers.

- President of Japanese Student Organization
Auburn University, Auburn, AL, 8/2006 – 5/2007
Organize and direct Japanese language class for students in Auburn University.
Participate university activities as an international student organization.

COMPUTER SKILLS

- Software: Visual Programming Environments (AgentSheets, Alice, Squeak, Scratch), Rational Rose, Visual C, Microsoft Access/Visual Basic, DreamWeaver, Photoshop, Illustrator
- Hardware: NT, SUN Workstations. IBM, IBM compatibles, and Macintosh PCs
- Languages: C/C++, JAVA, Python, HTML, SQL, PHP, XML, Javascript

LANGUAGE PROFICIENCY

- English
- Korean (Native Language)
- Japanese (Excellent, Second Language)
- Chinese (Semi-fluent Speaker)
- German (Basic level)

RECOGNIZING EXCELLENCE

Chancellor's Award for Excellence in STEM Education

STUDENT AWARD Proposal Cover Sheet (Adviser Version)

Applicant Information

Full Name: Repenning Alexander
Last First M.I.

Student Advisee: Kyu Han Koh

Proposal Title: Computing Computational Thinking

Contact Info: Computer Science UCB 430
Home Department Campus Box #

ralex@cs.colorado.edu (303) 492-1349
Email Address Phone Number

Adviser Expectations

By submitting this application, I confirm that, if my advisee is selected to receive a Chancellor's Award for Excellence in STEM Education, I will:

- Attain a 25% GRA salary match from my own funding sources or from my department
- Attend the annual Symposium on STEM Education (tentatively 9/23)
- Actively engage in the CU-Boulder STEM education community by attending the weekly DBER Seminar Series when possible

I have read and understand this commitment:



Signature



University of Colorado
Boulder

Alexander Repenning, Ph.D.
Computer Science Department
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Monday, April 1, 2013

To the Chancellor's Graduate Awards for Excellence in STEM Education Selection Committee:

I am delighted to recommend one of my Ph.D. students, Kyu Han Koh, for the Chancellor's Graduate Awards in STEM Education. I believe that Kyuhan is working on a very critical piece of the STEM Cyberlearning puzzle piece which is crucial for developing a 21st Century workforce. His work on analyzing computational thinking in game design and STEM simulation creation applications is truly revolutionary. He has not only built critical analysis systems but has collected over 12,000 games produced by over 10,000 students. In other words he has acquired an extraordinarily large research base to explore important educational issues.

Kyu Han has been conducting his dissertation research under my guidance for the last five years. In this time, Kyu Han has showed great research progress. He published fifteen research articles, eleven conference papers and four posters, and he was invited to guest lecture at four universities. Moreover, Kyu Han successfully passed his proposal defense in front of a highly interdisciplinary committee including faculty from Computer Science, the School of Education, as well as from Molecular, Cellular, and Developmental Biology. Kyu Han's goal is to validate an important theory of broadening participation in computer science education. He not only works with University of Colorado faculty but also collaborates with researchers at SRI International, who serve as external evaluators for large National Science Foundation projects in which Kyu Han is participating. I'll oversee his project and his collaboration with SRI researchers and faculty from the School of Education and the department of Computer Science to ensure the successful completion of his research.

The expected outcomes of his research will be beneficial to the CU classes. For example, his research could contribute to the Educational Game Design class, which has been held in computer science department and will be held in ATLAS. His research can be used for educational assessment such as grading, tracking student-learning progress, and assessing student-learning divergence.

Kyu Han already implemented all the necessary research system and system evaluation tools. Much of the data – data collected from over 10,000 students – necessary for the study proposed has already been collected. To complete his dissertation, Kyu Han needs to complete several evaluation/validation experiments for his research tool. Initially, Kyu Han proposed to finish those validation experiments by May 2013, but he rescheduled to complete those experiments by October of this fall semester. This updated schedule gives him four more months to work on his dissertation.

Having watched Kyu Han's progress over the last 5 years, I have full confidence in his ability to make high impact contributions to the fields of computer science education and learning sciences.

Kuhan will report progress to me personally on a weekly basis. I will be tracking his success towards the goal of computing computational thinking.

The results of Kuhan's work are highly relevant to the department as well as to outreach activities. At the department level the ability of assessing computational thinking patterns is important as means to judge computational skills that students have acquired. His tools are already in use in the popular educational game design course taken by graduate and undergraduate students. At the outreach level Kyuhan's research is employed to explore transfer between game design and STEM science simulation modeling tasks.

25% matching funds can be provided.

Thank you for your consideration.

Sincerely,

A handwritten signature in cursive script that reads "Alexander Repenning". The signature is written in black ink and is positioned above the typed name.

Dr. Alexander Repenning

Research Professor

Alexander Repenning

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Repenning has been an active contributor to research in end-user programmable agents and multimodal interfaces since 1989. He explores new end-user development paradigms and new media helping casual computer users to investigate and communicate complex ideas interactively.

Education

1993	Ph.D. , Computer Science	Computer Science, University of Colorado at Boulder
1993	Cognitive Science Certificate	Institute of Cognitive Science, University of Colorado
1990	M.S., Computer Science	Computer Science, University of Colorado at Boulder
1985	B.S., Computer Engineering	Engineering College Brugg-Windisch, Switzerland

Appointments

Fall 2011 - present	University of Colorado, Computer Science Department: Full Research Professor
Oct. 2006-2007	University of Lugano, Computer Science Department: Associate Professor Visiting Professor.
March 2004 -	University of Colorado, Computer Science Department: Associate Research Professor
March 1996 - March 2004	University of Colorado, Computer Science Department: Assistant Research Professor, Institute of Cognitive Science: Faculty Fellow

Research: Explore new end-user programming paradigms enabling a wide range of users to comprehend and communicate complex ideas through interactive simulations. Build advanced compiler technology to automatically turn end-user programmed interactive simulations into Java applets and JavaBeans components. Devise new component-based software engineering approaches enabling distributed teams of developers, content experts, producers and users to effectively build educational software. Develop a new framework called The Pragmatic Web to enable information challenged Web users to access and interact with information through multimodal, speech enabled, end-user programmable agents.

Teaching: Teach user interface design, object-oriented design, visual programming language issues and compiler design in project-based course. Teach agent-centered AI course through game design projects. Engage students in component-based design and programming making students build interactive middle school math applications published on the MathForum and on the Public Broadcast System (PBS).

Nov. 2002 – present	CTO of AgentSheets Inc. , part-time.
Feb. 1998 - Nov. 2002	President and Interim CEO of AgentSheets Inc.

Founded AgentSheets Inc. with the goal to create sustainable simulation authoring tools and services for lifelong learning. Research Web-based reuse of agents, projects and course material

to lower threshold for teachers to use simulation technology in curriculum (NSF supported). Start collaboration with organizations in Germany (Fraunhofer Institute) and Japan (PFU limited) to use AgentSheets in international projects.

Jan. 1994 –
Feb. 1996

University of Colorado at Boulder: Research Associate

Taught graduate/undergraduate courses on learning and design. Organized Computer Science Summer Intern Camp 1994 and 1995. Collaborated with the MIT Media Lab by supervising senior project students at CU creating the LEGOsheets environment used to visually program the programmable LEGO brick developed by MIT. Worked with Apple towards turning Agentsheets into a commercial educational application. Supervised research creating interactive World Wide Web applications. Worked with Boulder teachers and students.

June 1992 –
Aug. 1992

Hewlett-Packard, Switzerland: User Interface Designer

Evaluated user interface of HP expert system shell. Performed user studies with users, designers and project leaders. Created user test suite for future product usability evaluations.

June 1991 –
Aug. 1991

Xerox PARC: Intern

Built a content-based hypertext system called BUCH for SPARC stations to gracefully retrieve textual information in extremely large, complex, and ill-structured information spaces. Produced and published video of BUCH.

Nov. 1985 –
June 1988

Asea Brown Boveri Research Center, AI Group, Switzerland: Researcher

Designed and implemented the OPUS object-oriented programming language including programming environment, user interface builder, and widget library. Built portable graphical user interface for Windows, DOS, Macintosh, and VAX. Developed knowledge representation, rule-based programming language and spreadsheet-like user interface for expert system shell. Developed an Object-Oriented Prolog interpreter. Responsible for internships.

Aug 1977- May
1982

Asea Brown Boveri: Electronics Designer

Designed and produced analog and digital equipment, computer chips and electromechanical devices including: FM transmitters, high energy power supplies, gas and steam turbine power plant controllers, stereo HIFI amplifiers, disk controllers, programmable PROM burners, high performance A/D+D/A boards, and personal computers. Produced small series of personal computers.

Awards & Honors

- 2013 **University of Colorado Computer Science for High School (CS4HS) Project featured by Google.** The Google CS4HS Program showcased the University of Colorado CS4HS project broadcasting a live interview with students, teacher, researchers and administrators.
- 2013 **Scalable Game Design project showcased by the National Science Foundation.** NSF has invited Repenning to showcase the Scalable Game Design project at the 44rd ACM Technical Symposium on Computer Science Education (SIGCSE 2013): Teaching, Learning, and Collaborating conference.
- 2012 **Scalable Game Design project showcased by the National Science Foundation.** NSF has invited Repenning to showcase the Scalable Game Design project at the 43rd ACM Technical Symposium on Computer Science Education (SIGCSE 2012): Teaching, Learning, and Collaborating conference, and the CE21 Computing Education for the 21st Century PI and Community Meeting.
- 2011 **NSF success story for Congressional Publication.** Two of Repenning's NSF research projects, AgentSheets and Inflatable Icons, related to educational technology were nominated as NSF success

stories from the Directorate of Engineering to be included in Congressional Publications. AgentSheets was presented as one of only 3 projects to the director of the National Science Foundation as a success story how NSF support has helped build an infrastructure for formal and informal learning for K-20 students through the development of play environments that promote STEM, especially computational thinking and engineering design, learning in formal and informal environments.

- 2010 **Telluride Tech Festival Honoree.** Repenning was honored at the 2010 Telluride Tech Festival for contributions to computer science. Past honorees include Sir Tim Berners-Lee (creator of the World Wide Web), Vinton Cerf (father of the Internet), and Alan Kay (Turing Award recipient and inventor of modern object-oriented programming).
- 2010 **Congressional Hearing.** Repenning's Collective Simulation, the Mr. Vetro human physiology education research, was included in the Congressional Justification for 2011 budget for the National Institutes of Health (NIH) presented by the National Center for Research Resources (NCRR).
- 2009 **Entrepreneurship Recognition, University of Colorado, Technology Transfer Office and the Boulder Innovation Center.** Recognition by CU Interim Provost and Executive Vice Chancellor for Academic Affairs Dr. Stein Sture.
- 2008 **Electronic Arts Scholar.** Recognition for game related research attracting women and under-represented populations to study Computer Science. Sponsored participation of Electronic Arts, ACM, and Microsoft Research supported GDCSE'08 conference aboard the Celebrity Century Cruise Ship.
- 2007 **University of Colorado Science Discovery Development Board member.** Board includes Nobel Laureates, Deans and Department chairs.
- 2005 **Advisor to the Organization for Economic Co-operation and Development (OECD):** presented a simulation framework for the Programme for the International Assessment for Adult Competencies (PIAAC), Sept 12-13, German Institute for Adult Education, Bonn, Germany.
- 2002 **Advisor to the International Media Research Foundation,** an organization sponsored by the Japanese Ministry of Education and the Ministry of International Trade and Industry, June 27 - July 4, Workshop, presentation and exhibit, Tokyo, Japan.
- 2001, 2002 **Advisor to the European Commission:** launching a new End-User Development research initiative. Presentation of AgentSheets at the IST conference, Düsseldorf, Germany 2001, EUD Network of Excellence, Pisa, Italy, 2002.
- 2001 **Invited by Japanese Government** to World Expo 2001, Asia #1 Information Technology trade show. Tokyo.
- 2001 **Advisor to National Academy of Sciences** at "Improving Learning through Information Technology" symposium. Showcase AgentSheets as exemplary technology. Washington.
- 2001 **Best of the Best Innovators:** Invited, sponsored exhibition of research by Association for Computing Machinery at ACM 1, San Jose.
- 1996 **Most Innovative Application of the World Wide Web.** WebQuest, an AgentSheets based application, is awarded Gold medal by Isabelle de Kerviler, Mayor of Paris. WebQuest paper is awarded best paper of WWW5 by Robert Cailliau, CERN. Paris.
- 1993 **Recognition of Outstanding Contributions,** Apple Computer Inc., Repenning, introduced by Apple's VP presented AgentSheets in front of thousands of developers at Apple's World Wide Developer Conference ATG Extravaganza. San Jose.
- 1988 **Brown Boveri Research Center Scholarship** (\$20,000, 2 years)
- 1985 **Contraves Award** (best thesis of Engineering College Brugg-Windisch)

Grants

National Institutes of Health (NIH), Office of Research Infrastructure Programs, SBIR Phase I, R43 OD012081, CyberMOD: A Gentle-Slope Cyberlearning Infrastructure to Support STEM Education, \$150,000, Sept. 1, 2012-Feb. 2013, Alexander Repenning (Principal Investigator).

Google Inc., CS4HS, Computer Science for High Schools, \$10,000, Use of AgentSheets as Computational Thinking Tools, Alexander Repenning (Principal Investigator), 2012.

National Science Foundation, Computing Education for 21st Century (CE 21), Type II: CT4TC - Computational Thinking for Teaching Computing: Validating a Theory of Broadening Participation, \$1,500,000, Alexander Repenning (Principal Investigator), Kris Gutierrez (Co- Principal Investigator), David Webb (Co- Principal Investigator), Jan 1, 2012 – Dec. 31, 2014. *Original proposal (\$7M) was recommended for funding but the CE21 program got defunded. This is still the largest CE21 Type I/Type II project and the only CE21 Type II proposal funded by NSF.*

National Science Foundation, SBIR, 1158792, SBIR Phase IIB: Scalable Game Design: Broadening Computer Science Participation with Low-Threshold, High-Ceiling Design Environments, \$54,375, Alexander Repenning (Principal Investigator).

National Science Foundation, Technology Enhancement for Commercial Partnerships, SBIR Phase II TECP: Scalable Game Design: Broadening Computer Science Participation with Low-Threshold, High-Ceiling Design Environments, \$93,028.00, A collaboration between AgentSheets and Google Inc. to bring 3D Inflatable Icons to the Web and integrate it to Google Sketchup, Alexander Repenning (Principal Investigator). March 1, 2011 – August 31, 2011.

National Science Foundation, Innovative Technology Experiences for Students and Teachers (ITEST), Reforming IT Education through Game Design: Integrating Technology-Hub, Inner City, Rural and Remote Regions, \$1,499,425, Alexander Repenning (Principal Investigator), Jeffery Kidder (Co- Principal Investigator), David Webb (Co- Principal Investigator), Jan 1, 2009 – Dec. 31, 2011.

National Science Foundation, SBIR & REESE, REU, Research Experience for Undergraduates, \$16,000, 3D Game and Simulation Web players, Alexander Repenning (Principal Investigator), July 1 – December 31, 2010.

National Science Foundation, Division of Industrial Innovation and Partnerships, SBIR Phase I: CyberCollage: A Collective Programming Environment for the Social Exploration of Computational Thinking through Games, \$149,950, Alexander Repenning (Principal Investigator), July 1 – December 31, 2010.

Google Inc., CS4HS, Computer Science for High Schools, \$20,000, Use of AgentSheets as Computational Thinking Tools, Clayton Lewis (Principal Investigator), Alexander Repenning (CO-PI), Anthea Roen (CO-PI), 2010.

National Science Foundation, SBIR & REESE, SBIR Phase II: Scalable Game Design: Broadening Computer Science Participation with Low-Threshold, High-Ceiling Design Environments, IIP 0848962 , \$465,612, Alexander Repenning (Principal Investigator), March 1, 2009 – February 28, 2011.

National Science Foundation, Scalable Game Design: Broadening Computer Science Participation with Low-Threshold, High-Ceiling Design Environments, IIP 0712571, \$100,000, Alexander Repenning (Principal Investigator), 2007.

National Institutes of Health, “SBIR Phase II: A Collective Simulation Framework for Health Science Education”, \$749,000, March 5, 2007 – March 1, 2009, Alexander Repenning (Principal Investigator), collaborators: University of Colorado, Harvard Graduate School of Education, and the Drexel University College of Medicine.

European Community (75%) & Greek Ministry of Education (25%), “AgentSheets: Educational tool for developing interactive simulations and activities for Greek schools”. This project includes the dissemination of a localized authoring tool and simulation content to 1200 Greek schools. €180,000, 2006-2007.

National Institutes of Health, “SBIR Phase I: A Collective Simulation Framework for Health Science Education”, \$77,539, September 30, 2005 – March 28, 2006, Alexander Repenning (Principal Investigator).

National Science Foundation, “CI-TEAM: Preparing for Cybercollaboration Between Scientists and Software

Developers”, January 1, 2006 - December 31, 2007, \$249880, Christopher DiGiano (Principal Investigator), Alexander Repenning (Co-Principal Investigator).

National Science Foundation, “Mobility Agents for Persons with Cognitive Disabilities”, March 1, 2004 – February 28, 2006, \$500,000, Alexander Repenning (Principal Investigator).

National Science Foundation, EIA, “ITR/PE: Training and Resources for Assembling Interactive Learning Systems”, September 15, 2002 - August 31, 2006, \$3,200,000, Christopher DiGiano (Principal Investigator, SRI International), Eugene A. Klotz (Co-Principal Investigator, Drexel University), Shelley V. Goldman (Co-Principal Investigator, Stanford University), Jeremy Roschelle (Co-Principal Investigator, SRI International), Alexander Repenning (Co-Principal Investigator).

National Science Foundation, DMI, “SBIR Phase I: Mobility Agents for Persons with Cognitive Disabilities”, January 1, 2003 - June 30, 2003, \$100,000, Alexander Repenning (Principal Investigator).

National Science Foundation, DMI, “SBIR Phase I: C5: An Educational Simulation Architecture For Wireless Handhelds”, January 1, 2003 - June 30, 2003, \$100,000, Alexander Repenning (Principal Investigator).

National Science Foundation, REC, “Educational Software Components of Tomorrow: A Testbed for Suitable Development of Reusable, Interoperable Object for Middle School Mathematics Reform”, October 1, 1998 - September 30, 2001, \$1,995,982.00, Roy D. Pea (Principal Investigator), James J. Kaput (Co-Principal Investigator), Jeremy Roschelle (Co-Principal Investigator), Christopher DiGiano (Co-Principal Investigator). Subaward: SRI International to University of Colorado, Alexander Repenning (Principal Investigator), \$351,594.00.

National Science Foundation, DMI, “SBIR Phase II: Agent-Based Simulation and Modeling over the Web”, September 1, 1999 - August 31, 2001, \$400,000.00, Alexander Repenning (Principal Investigator).

National Science Foundation, DMI, “SBIR Phase I: Agent-based Simulation and Modeling Over the World Wide Web”, January 1, 1998 - June 30, 1998, \$100,000.00, Alexander Repenning (Principal Investigator).

National Science Foundation, REC, “Lifelong Learning - Bringing Learning Activities to Life”, September 15, 1996 - August 31, 2000, \$1,955,996.00, Gerhard Fischer (Principal Investigator), Alexander Repenning (Co-Principal Investigator), Hal Eden (Co-Principal Investigator), Michael A. Eisenberg (Co-Principal Investigator).

National Science Foundation, REC, “Learning by Design: Environments to Support Reinventing and Reengineering Education as a Lifelong Process”, September 15, 1995 - August 31, 1997, \$398,482.00, Gerhard Fischer (Principal Investigator), Alexander Repenning (Co-Principal Investigator), Hal Eden (Co-Principal Investigator), Michael A. Eisenberg (Co-Principal Investigator).

National Science Foundation and ARPA, Technical Reinvestment Program, “Authoring tools for Tomorrow”, February 15, 1993 – August 31, 1994, \$220,000.00, James Spohrer (Principal Investigator), Gerhard Fischer (Co-Principal Investigator), Alexander Repenning (Co-Principal Investigator).

National Science Foundation, Undergraduate Research REU Supplement, “Learning by Design”, 1997-1998, \$20,000.00, Gerhard Fischer (Principal Investigator), Alexander Repenning (Co-Principal Investigator), Hal Eden (Co-Principal Investigator), Michael A. Eisenberg (Co-Principal Investigator).

University of Colorado, Engineering Excellence Fund, “Simulations for K-12 Outreach”, Spring 1996, \$6028.16, Alexander Repenning (Principal Investigator).

National Science Foundation, REC, “Mastering High-Functionality Systems by Supporting Learning on Demand”, September 1, 1992 - February 28, 1995, \$1,167,168.00, Gerhard Fischer (Principal Investigator), Michael A. Eisenberg (Co-Principal Investigator), Alexander Repenning (Co-Director).

Publications

Refereed Journals

Repenning, A., Programming Goes Back to School, *Communications of the ACM* (May 2012), 55, 5, pp. 38-40, ACM Press, New York, NY, USA. *Invited, rated popular and (online version only) including embedded video.*

Repenning, A., Ioannidou, A., Computational Thinking for Game Design, Special Issue on Computational Thinking, The Voice of K-12 Computer Science Education and its Educators (Voice), (May 2011), Computer Science Teacher Association (CSTA), 4-5.

Ioannidou, A., Repenning, A., Webb, D., Keyser, D., Luhn, L. and Daetwyler, C. Mr. Vetro: A Collective Simulation for teaching health science. *International Journal of Computer-Supported Collaborative Learning, ijCSCL*, 5 (Feb. 2010), International Society of the Learning Sciences (ISLS), 141-166.

Repenning, A., Ioannidou, A., Dättwyler, C., Luhn, L. and Repenning, N. Mr. Vetro: Assessing a Collective Simulation Framework. *Journal of Interactive Learning Research, JILR*, 21 (4 2010), Association for the Advancement of Computing in Education, Chesapeake, VA, 515-537.

Repenning, A., Ioannidou, A., & Webb, D. AgentCubes: Incremental 3D End-User Development. *Journal of Visual Languages and Computing, Special Issue on Best Papers from VL/HCC2008*, 20 (4 2009), Elsevier, 236-251.

Repenning, A. Inflatable Icons: Diffusion-based Interactive Extrusion of 2D Images into 3D Models. *The Journal of Graphical Tools*, 10 (1 2005), A K Peters, Natick, MA, 1-15.

Repenning, A. and Ioannidou, A. Agent-Based End-User Development. *Communications of the ACM*, 47 (9 2004), ACM, New York, NY, 43-46. *Invited: Special issue on End-User Programming.*

Ioannidou, A., Repenning, A., Lewis, C., Cherry, G. and Rader, C. Making Constructionism Work in the Classroom. *International Journal of Computers for Mathematical Learning*, 8 (1 2003), Springer, 63-108.

Repenning, A., Ioannidou, A., Payton, M., Ye, W. and Roschelle, J. Using Components for Rapid Distributed Software-Development. *IEEE Software*, 18 (2 2001), IEEE Computer Society, Los Alamitos, CA, 38-45.

Repenning, A. and Ioannidou, A. Engaging Learners through Simulation-Based Design. *Zeitschrift für Hochschuldidaktik, Studienverlag Innsbruck-Wien-München*, 24 (H.1 2001), 47-58. *Invited: Special issue on Computers in medical Education*

Repenning, A. and Perrone, C. Programming by Analogous Examples. *Communications of the ACM*, 43 (3 2000), ACM, New York, NY, 90-97.

Repenning, A., Ioannidou, A., & Zola, J. AgentSheets: End-User Programmable Simulation. *Journal of Artificial Societies and Social Simulation*, 3 (3 2000), SimSoc Consortium. *(online journal with no page numbers)*

Repenning, A., Ioannidou, A., & Phillips, J. Building a Simulation of the Spread of a Virus. *Learning Technology Review, Apple Computer*, (Winter 2000), 56-72.

Roschelle, J., DiGiano, C., Koutlis, M., Repenning, A., Phillips, J., Jackiw, N., & Suthers, D. Developing Educational Software Components. *IEEE Computer*, 32 (9 1999), IEEE Computer Society, Los Alamitos, CA, 50-58.

Repenning, A. AgentSheets: End-User Programmable Simulations as Interactive Media. *Logo Exchange*, 18 (1 1999), 19-22.

Ioannidou, A., & Repenning, A. End-User Programmable Simulations. *Dr. Dobb's* (August 1999), 40-48.

Repenning, A., Ioannidou, A., & Ambach, J. Learn to Communicate and Communicate to Learn. *Journal of Interactive Media in Education*, 98 (7 1998). *(online journal with no page numbers)*

Eden, H., Eisenberg, M., Fischer, G., & Repenning, A. Domain-Oriented Design Environments: Making Learning a Part of Life. *Communications of the ACM*, 39 (4 1996), ACM, New York, NY, 40-42.

Ambach, J., Perrone, C., & Repenning, A. Remote Exploratoriums: Combining Networking and Design Environments. *Computers in Education (Special Issue on the Internet in Education)*, 24 (3 1995), 163-176.

Repenning, A., & Sumner, T. Agentsheets: A Medium for Creating Domain-Oriented Visual Languages. *IEEE Computer*, 28 (3 1995), IEEE Computer Society, Los Alamitos, CA, 17-25. (*Oct. 2010: cited by 178*)

Repenning, A. Programming Substrates to Create Interactive Learning Environments. *Journal of Interactive Learning Environments, Special Issue on End-User Environments*, 4 (1 1994), 45-74.

Refereed Conference Proceedings

Koh, K. H., Repenning, A., Nickerson, H., et al. Will it Stick? Exploring the Sustainability of Computational Thinking Education Through Game Design. In *Proceedings of the ACM Special Interest Group on Computer Science Education Conference, (SIGCSE 2013)*, (Denver, Colorado, USA, March 6-9, 2013 (to appear)). ACM Press, New York, NY.

Bennett, V., Koh, K. H. and Repenning, A. Computing Creativity: Divergence in Computational Thinking. In *Proceedings of the ACM Special Interest Group on Computer Science Education Conference, (SIGCSE 2013)* (Denver, Colorado, USA March 6-9, 2013 (to appear)). ACM Press, New York, NY.

Basawapatna, A. and Repenning, A. The Simulation Creation Toolkit: An Initial Exploration Into Making Programming Accessible While Preserving Computational Thinking. In *Proceedings of the ACM Special Interest Group on Computer Science Education Conference, (SIGCSE 2013)* (Denver, Colorado, USA, March 6-9, 2013 (to appear)). ACM Press, New York, NY,

Webb, D. C., Repenning, A., and Koh, K. H., 2012. Toward an Emergent Theory of Broadening Participation in Computer Science Education. In *Proceedings of the 43rd ACM technical symposium on Computer Science Education (SIGCSE '12)*. ACM, New York, NY, USA, 173-178.

Repenning, A., Smith, C., Owen, B., et al. AgentCubes: Enabling 3D Creativity by Addressing Cognitive and Affective Programming Challenges. In *Proceedings of the World Conference on Educational Media and Technology, EdMedia 2012* (Denver, Colorado, USA, June 26-29, 2012) 2762-2771.

Ahmadi, N., Jazayeri, M. and Repenning, A. Engineering an Open-Web Educational Game Design Environment. In *Proceedings of the The 19th Asia-Pacific Software Engineering Conference (APSEC'12)* (Hong Kong, December 4-7, 2012). ACM.

Ahmadi, N., Jazayeri, M. and Repenning, A. Performance Evaluation Of User-Created Open-Web Games. In *Proceedings of the 27th Annual ACM Symposium on Applied Computing* (Trento, Italy, 2012). ACM, 730-732.

Koh, K. H., Bennett, V., Repenning, A., Computing Indicators of Creativity, *ACM Creativity & Cognition 2011*, The High Museum of Art, Atlanta, Georgia, USA, November 3-6, 2011.

Bennett, V., Koh, K. H., Repenning, A. Can Learning Acquisition be Computed?, in *Proceedings of the IEEE Symposium on Visual Languages and Human-Centric Computing, VL/HCC '11*, (Pittsburgh, PA, USA Sept. 18-22, 2011), IEEE Computer Society, Los Alamitos, CA. 243-244.

Bennett, V., Koh, K. H., Repenning, A., CS Education Re-Kindles Creativity in Public Schools, *ITiCSE '11: Annual Conference on Innovation and Technology in Computer Science Education*, Darmstadt, Germany, June 27-29, 2011. 183-187.

Repenning, A., Making Programming more Conversational, in *Proceedings of the IEEE Symposium on Visual Languages and Human-Centric Computing, VL/HCC '11*, (Pittsburgh, PA, USA Sept. 18-22, 2011), IEEE Computer Society, Los Alamitos, CA. 191-194.

Ashok Basawapatna, Kyu Han Koh, Alexander Repenning, David C. Webb, and Krista Sekeres Marshall. 2011. Recognizing computational thinking patterns. In Proceedings of the 42nd ACM technical symposium on Computer science education (SIGCSE '11). ACM, New York, NY, USA, 245-250.

Koh, K. H., Basawapatna, A., Bennett, V. and Repenning, A. 2010. Towards the Automatic Recognition of Computational Thinking for Adaptive Visual Language Learning. In Proceedings of the Conference on Visual Languages and Human Centric Computing, VL/HCC 2010 (Madrid, Spain, Sept. 21-25, 2010). IEEE Computer Society, Los Alamitos, CA, 59-66. (*acceptance rate: 29.5%*)

Koh, K. H., Bennett, V., and Repenning, A. 2010. Inspiring Collaborative Benefits: An Interaction Between a Virtual and A Physical Group Learning Infrastructure. In Proceedings of the 15th Western Canadian Conference on Computing Education (Kelowna, British Columbia, Canada, May 07 - 08, 2010). WCCCE '10. ACM, New York, NY, 1-5.

Repenning, A., Webb, D., Ioannidou, A., 2010. Scalable Game Design and the Development of a Checklist for Getting Computational Thinking into Public Schools, In Proceedings of the 41st ACM technical symposium on Computer science education, SIGCSE 2010, (Milwaukee, Wisconsin, USA, March 10 - 13, 2010), ACM, New York, NY, 265-269. (*acceptance rate: 34%*)

Basawapatna A., Koh, K.H., Repenning, A. 2010. Using Scalable Game Design to Teach Computer Science From Middle School to Graduate School. In Proceedings of ITiCSE '10 (Bilkent, Ankara, Turkey, June 26-30, 2010), ACM, New York, NY, 224-228. (*acceptance rate: 51%*)

Basawapatna, A., Repenning, A. 2010. Cyberspace Meets Brick and Mortar: An Investigation into How Students Engage in Peer to Peer Feedback Using Both Cyberlearning and Physical Infrastructures. In Proceedings of ITiCSE '10 (Bilkent, Ankara, Turkey, June 26-30, 2010), ACM, New York, NY, 184-188. (*acceptance rate: 51%*)

Basawapatna, A., Repenning, A. 2010. Visualizing Student Game Design Project Similarities. In Proceedings of Diagrams '10, Lecture Notes in Computer Science, (Portland, Oregon, August 9-11, 2010), Springer Berlin, Heidelberg, 285-287. (*acceptance rate: 34%*)

Alexander Repenning, Andri Ioannidou, David C. Webb, Diane Keyser, Heather MacGillivray, Krista Sekeres Marshall, and Calvin Pohawpatchoko, 2010, Teaching Computational Thinking through Scalable Game Design, Presented at the 2010 American Educational Research Association Annual Meeting (AERA 2010), Denver, Colorado, April 30 - May 4, 2010. (*online only: no page numbers, acceptance rate: 53%*)

Basawapatna, A. Repenning, A. Cyberspace Meets Brick and Mortar: Finding the Sweet Spot between Cyberlearning and Traditional Instruction. Poster Presentation at SIGCSE '10. (Milwaukee, Wisconsin, USA, March 10 - 13, 2010), ACM, New York, NY. (*not published in proceedings, paper acceptance rate: 30%*)

N. Ahmadi, M. Jazayeri, F. Lelli, and A. Repenning. Towards the Web of Applications: Incorporating End User Programming into the Web 2.0 Communities. In *Proceedings of the 2nd international Workshop on Social Software Engineering and Applications* (Amsterdam, The Netherlands, August 24 - 24, 2009). SoSEA '09. ACM, New York, NY, 9-14. (*acceptance rate: 83%*)

Ioannidou, A., Repenning, A. and Webb, D. Using Scalable Game Design to Promote 3D Fluency: Assessing the AgentCubes Incremental 3D End-User Development Framework. In Proceedings of the 2008 IEEE Symposium on Visual Languages and Human-Centric Computing, VL/HCC '08 (Herrsching am Ammersee, Germany, Sept. 15-19 2008), IEEE Computer Society, Los Alamitos, CA, 47-54. (*acceptance rate: 45%*)

Ahmadi, N., Repenning, A. and Ioannidou, A. 2008. Collaborative End-User Development on Handheld Devices. In Proceedings of the 2008 IEEE Symposium on Visual Languages and Human-Centric Computing, VL/HCC '08 (Herrsching am Ammersee, Germany, Sept. 15-19 2008), IEEE Computer Society, Los Alamitos, CA, 237-241. (*acceptance rate: 45%*)

Repenning, A. and Ioannidou, A. Mr Vetro: a Collective Simulation Application for Physiology Education. 12th Annual Meeting of the International Association of Medical Science Educators, IAMSE 2008, (Salt Lake City, Utah, July 25-29, 2008) (*abstract and presentation only, acceptance rate unknown*)

Repenning, A. and Ioannidou, A. End-User Visualizations. In Proceedings of the 2008 International Conference on Advanced Visual Interfaces, AVI 2008, (Napoli, Italy, May 28-30, 2008), ACM, New York, NY, 492-493. (*acceptance rate: 22%*)

Repenning, A. and Ioannidou, A. Agent Warp Engine: Formula Based Shape Warping for Networked Applications. In Proceedings of the 2008 International Conference on Advanced Visual Interfaces, AVI 2008, (Napoli, Italy, May 28-30, 2008), ACM, New York, NY, 279-286. (*acceptance rate: 27%*)

Repenning, A. and Ioannidou, A. Broadening Participation Through Scalable Game Design. In Proceedings of the 39th SIGCSE Technical Symposium on Computer Science Education, SIGCSE '08 (Portland, OR, USA, March 12 - 15, 2008), ACM, New York, NY, 305-309 (*acceptance rate: 31%*)

Repenning, A. and Ioannidou, A. X-expressions in XMLisp: S-Expressions and Extensible Markup Language Unite. In Proceedings of the 2007 international Lisp Conference (Cambridge, United Kingdom, April 01 - 04, 2007). ILC '07. ACM, New York, NY, 1-11.

Repenning, A. and Ioannidou, A., Collective Simulations: Teaching Physiology Through Technology-Enhanced Role-Play, Fifth Interdisciplinary Conference Communication, Medicine & Ethics (COMET 2007), (Lugano, Switzerland, 2007). (*abstract and presentation only*)

Repenning, A. Excuse me, I need better AI!: employing collaborative diffusion to make game AI child's play. In Proceedings of the 2006 ACM SIGGRAPH Symposium on Videogames (Boston, Massachusetts, July 30 - 31, 2006). Sandbox '06. ACM, New York, NY, 169-178 (*acceptance rate: 18%*)

Repenning, A., Collaborative Diffusion: Programming Antiojects. In Proceedings of the OOPSLA 2006 Onwards, ACM SIGPLAN International Conference on Object-Oriented Programming Systems, Languages, and Applications, (Portland, Oregon, 2006), ACM, New York, NY, 574-585. (*acceptance rate: 20%*)

Repenning, A. and Ioannidou, A., AgentCubes: Raising the Ceiling of End-User Development in Education through Incremental 3D. In Proceedings of the IEEE Symposium on Visual Languages and Human-Centric Computing 2006, VL/HCC'06, (Brighton, United Kingdom, Sept. 4-8, 2006), IEEE Computer Society, Los Alamitos, CA, 27-34. (*acceptance rate: 25%*)

Repenning, A. and Ioannidou, A., Mobility Agents: Guiding and Tracking Public Transportation Users. In Proceedings of The 8th International Working Conference on Advanced Visual Interfaces, AVI 2006, (Venezia, Italy, May 23-26, 2006), ACM, New York, NY, 127-134. (*nominated for best paper, acceptance rate: 40%*)

DiGiano, C., Kireyev, K., Repenning, A. (2006) "Evolving Tools Organically With Computational Wikis", Poster at ACM CSCW 2006 Conference, ACM, New York, NY. (*paper acceptance rate: 20%*)

Repenning, A. and A. Ioannidou Mr. Vetro: A Collective Simulation Framework. In Proceedings of the ED-Media 2005, World Conference on Educational Multimedia, Hypermedia & Telecommunications, (Montreal, Canada, June 2005) Association for the Advancement of Computing in Education, 1612-1619. (*paper acceptance rate: 20%, paper received highest reviewer scores, invitation to journal paper*)

Repenning, A., & Sullivan, J. The Pragmatic Web: Agent-Based Multimodal Web Interaction with no Browser in Sight. In Proceedings of the Ninth International Conference on Human-Computer Interaction, INTERACT '03, (Zürich, Switzerland, Sept 1-5, 2003), IOS Press, 212-219. (*acceptance rate: 33%*)

Repenning, A. (2003). The Pragmatic Web: Customizable Web Applications. CHI 2003 Conference on Human Factors in Computing Systems, Workshop on End-User Development, (Fort Lauderdale, Florida, April 5-10, 2003). (*workshop paper, acceptance rate: ~60%*)

Repenning, A. AgentSheets: an Interactive Simulation Environment with End-User Programmable Agents. In Proceedings of the Interaction 2000 Conference, (Tokyo, Japan, Feb. 29- Mar 1, 2000), 1-8. (*keynote address paper*)

Roschelle, J. DiGiano, C., Chung, M., Repenning, A., Tager, S., & Treinen, M. Reusability and interoperability of tools for mathematics learning: Lessons from the ESCOT project. In Proceedings of Intelligent Systems &

Applications at University of Wollongong, (Wollongong, NSW, Australia, 2000), ICSC Academic Press, Wetaskiwin, AB, Canada, 664-669.

Repenning, A., Ioannidou, A., & Phillips, J. Collaborative Use & Design of Interactive Simulations. In Proceedings of the Computer Supported Collaborative Learning Conference, CSCL'99, (Palo Alto, California, Dec. 12-15 1999), Routledge, USA, 475-487. (*acceptance rate: 50%*)

Cherry, G., Ioannidou, A., Rader, C., Brand, C., & Repenning, A. Simulations for Lifelong Learning. In Proceedings of the National Educational Computing Conference, NECC '99, (Atlantic City, NJ, 1999), 42-52.

Ioannidou, A., Repenning, A., & Zola, J. (1998). Posterboards or Java Applets? In Proceedings of the Third International Conference on the Learning Sciences, ICLS-98, (Georgia Tech, Atlanta, GA, Dec. 16-19, 1998), Association for the Advancement of Computing in Education, 152-159.

Perrone, C., & Repenning, A. Graphical Rewrite Rule Analogies: Avoiding the Inherit or Copy & Paste Reuse Dilemma. In Proceedings of the 1998 IEEE Symposium of Visual Languages, VL98, (Nova Scotia, Canada, Sept. 1-4, 1998), IEEE Computer Society, Los Alamitos, CA, 40-46. (*VL acceptance rate typically: 30-40%*)

Rader, C., Cherry, G., Brand, C., Repenning, A., & Lewis, C. Designing Mixed Textual and Iconic Programming Languages for Novice Users. In Proceedings of the 1998 IEEE Symposium of Visual Languages, VL98, (Nova Scotia, Canada, Sept. 1-4, 1998), IEEE Computer Society, Los Alamitos, CA, 187-194. (*VL acceptance rate typically: 30-40%*)

Spohrer, J. C., Repenning, A., & Dev, P. Educational Object Economy: Authoring Tools for Simulations and On-Line Communities. In Virtual Worlds and Simulation Conference, Simulation Series, VWSIM '98, (San Diego, CA, Jan. 11-14, 1998), 115-116. (*acceptance rate: 30%*)

Repenning, A., Ioannidou, A., Rausch, M., & Phillips, J. Using Agents as a Currency of Exchange between End-Users. In Proceedings of the WebNET 98 World Conference of the WWW, Internet, and Intranet, (Orlando, Florida, USA, Nov. 7-12, 1998), 762-767. (*acceptance rate: ~50%*)

Repenning, A. Social Behavior Processing: Stepping-Stones between the Use and Design of Behaviors. Presented at Workshop on Software Behavior Description, (St. Thomas, USA, Virgin Islands 1998). (*workshop paper, no printed proceedings*)

Ambler, A., L., Green, T., Kumura, D. T., Repenning, A., & Smedley, T. 1997 Visual Programming Challenge Summary. In Proceedings of the 1997 IEEE Symposium of Visual Languages, (Capri, Italy, Sept. 23-26 1997). IEEE Computer Society, Los Alamitos, CA, 11-18.

Repenning, A., & Ambach, J. The Agentsheets Behavior Exchange: Supporting Social Behavior Processing. In Extended Abstracts of Proceedings of the CHI 97, Conference on Human Factors in Computing Systems, (Atlanta, Georgia, March 22-27, 1997), 26-27. (*CHI overall acceptance rate: 24%*)

Repenning, A., & Ioannidou, A. Behavior Processors: Layers between End-Users and Java Virtual Machines. In Proceedings of the 1997 IEEE Symposium of Visual Languages, (Capri, Italy, Sept. 23-26 1997), IEEE Computer Society, Los Alamitos, CA, 402-409.

Ambach, J., & Repenning, A. Puppeteers and Directors: Supporting Artistic Design by Combining Direct-Manipulation and Delegation. In Proceeding of the Second International Symposium on Creativity and Cognition, (Loughborough, U.K, April 29-30, 1996), 67-76.

Repenning, A., & Ambach, J. Tactile Programming: A Unified Manipulation Paradigm Supporting Program Comprehension, Composition and Sharing. In Proceedings of the 1996 IEEE Symposium of Visual Languages, (Boulder, Colorado, Sept. 3-6, 1996), IEEE Computer Society, Los Alamitos, CA, 102-109.

Perrone, C., Clark, D., & Repenning, A. WebQuest: Substantiating Education in Edutainment through Interactive Learning Games. In Proceedings of the WWW5 Conference, (Paris, France, May 6-10, 1996), 1307-1319. (*acceptance rate: 25%, this paper won best paper award and gold medal by mayor of Paris*)

Smith, J., Perrone, C., & Repenning, A. Agentsheets Common Ground: A Collaborative Learning Tool. Presentation at ECOOP '96. (Linz, Austria, July 1996).

Gindling, J., Ioannidou, A., Loh, J., Løkkebø, O., & Repenning, A. LEGOsheets: A Rule-Based Programming, Simulation and Manipulation Environment for the LEGO Programmable Brick. In Proceeding the 1995 IEEE Symposium of Visual Languages, VL'95, (Darmstadt, Germany, Sept 5-9, 1995), IEEE Computer Society, Los Alamitos, CA, 172-179.

Repenning, A. Bending the Rules: Steps toward Semantically Enriched Graphical Rewrite Rules. In Proceeding the 1995 IEEE Symposium of Visual Languages, VL'95, (Darmstadt, Germany, Sept 5-9, 1995), IEEE Computer Society, Los Alamitos, CA, 226-233.

Schneider, K., & Repenning, A. Deceived by Ease of Use: Using Paradigmatic Applications to Build Visual Design. In Proceedings of 1st Conference on Designing Interactive Systems: Processes, Practices, Methods, & Techniques, DIS'95, (Ann Arbor, MI, August 23-25, 1995) ACM, New York, NY, USA, 177-188. (*acceptance rate: 25%*)

Stahl, G., Sumner, T., & Repenning, A. Internet Repositories for Collaborative Learning: Supporting both Students and Teachers. In Proceedings of the 1995 Computer Support for Collaborative Learning, CSCL '95, (Bloomington, Indiana, 1995), 321-328.

Repenning, A. (1994). Bending Icons: Syntactic and Semantic Transformation of Icons. In Proceedings of the 1994 IEEE Symposium on Visual Languages, VL'94 (St. Louis, MO., Oct. 4-7, 1994), IEEE Computer Society, Los Alamitos, CA, 296-303.

Repenning, A., & Sumner, T. Programming as Problem Solving: A Participatory Theater Approach. In Proceedings of the 1994 Workshop on Advanced Visual Interfaces, AVI '94, (Bari, Italy, 1994), ACM New York, NY, USA, 182-191.

Repenning, A. Agentsheets: A Tool for Building Domain-Oriented Visual Programming Environments. In Proceedings of the INTERACT '93 and CHI '93 conference on Human factors in computing systems, INTERCHI '93, (Amsterdam, the Netherlands, April 24-29, 1993), ACM New York, NY, USA, 142-143. (*acceptance rate: 19%, cited by 81, Google Scholar, 2010*)

Repenning, A. Domain-Tailored Spatial Metaphors. INTERACT '93 and CHI '93 conference on Human factors in computing systems, INTERCHI '93, Workshop on Spatial Metaphors, (Amsterdam, the Netherlands, April 24-29, 1993), ACM New York, NY, USA.

Repenning, A., & Citrin, W. Agentsheets: Applying Grid-Based Spatial Reasoning to Human-Computer Interaction. In Proceedings of the 1993 IEEE Symposium on Visual Languages, VL'93, (Bergen, Norway, Aug. 24-27, 1993), IEEE Computer Society, Los Alamitos, CA, 77-82.

Repenning, A., & Sumner, T. Using Agentsheets to Create a Voice Dialog Design Environment. In Proceedings of the 1992 ACM/SIGAPP Symposium on Applied Computing, (Kansas City, MO., 1992), ACM New York, NY, USA, 1199-1207.

Repenning, A. Creating User Interfaces with Agentsheets. In Proceedings of the 1991 SIGAPP Symposium on Applied Computing, (Kansas City, MO., April 3-5, 1991), 190-196.

Book Chapters

Lewis, C. and Repenning, A. Creating Educational Gamelets. In DiGiano, C., Goldman, S. and Chorost, M. eds. Educating Learning Technology Designers: Guiding and Inspiring Creators of Innovative Educational Tools, Routledge, 2008, 200-229. 362 pages.

Repenning, A., & Ioannidou, A. What makes End-User Development Tick? 13 Design Guidelines. In F. Paternò & V. Wolf (Eds.), End-User Development, Human-Computer Interaction Series, Vol. 9. Dordrecht: Kluwer, 2006, 51-86, 492 pages.

Repenning, A., & Perrone, C. Programming by Analogous Examples. In H. Lieberman (Ed.), *Your Wish Is My Command: Programming by Example*, 2001, Morgan Kaufmann Publishers, 90-97, 390 pages.

Refereed Symposia

Repenning, A. (chair), Lee, I. (discussant), Ioannidou, A., Bennet, V., Koh, K., Basawapatna, A., Webb, D., Macgilivray, H., Denner, J., Werner, L., Marshall, K., Merging Human Creativity and the Power of Technology: Computational Thinking in the K-12 Classroom, American Educational Research Association, (New Orleans, Louisiana, April 8 - 12, 2011).

Malyn-Smith, J. (chair), Lee I. (discussant), Denner J., Shannon, C., Panoff, R., Werner, L., Siobhan, B., Computational Thinking - Progress in Defining, Supporting and Measuring Computational Thinking in Projects Funded by NSF's Division of Research on Learning. American Educational Research Association, (New Orleans, Louisiana, April 8 - 12, 2011).

Unrefereed Conference Proceedings

Repenning, A. & Lewis, C., (2005). Playing a Game: The Ecology of Designing, Building and Testing Games as Educational Activities. Ed-Media World Conference on Educational Multimedia, Hypermedia & Telecommunications, Montreal, Canada.

Repenning, A. (2001). The Role of Simulation in Creativity. In International Symposium on Social Creativity and Meta-Design, Aspen, Colorado.

Repenning, A. (1999, May 27-30, 1999). Consumers \Leftrightarrow Producers versus Use \Leftrightarrow Design. In PFU L3D Workshop 1999, Breckenridge, CO.

Technical Reports, Videos

Repenning, A., & Ambach, J. (1996). Visual AgenTalk: Anatomy of a Low Threshold, High Ceiling End User Programming Environment (Technical Report CU-CS-802-96): Department of Computer Science, University of Colorado.

Repenning, A. (1994). Agentsheets: The Manual (Technical Report CU-CS-699-94): University of Colorado at Boulder.

Repenning, A. (1993). 1993 World Wide Developers Conference, ATG Extravaganza: Agentsheets [live presentation to 5000 people + Video]. Cupertino, CA: Apple Computer Inc.

Repenning, A. (1993). Agentsheets: A Tool for Building Domain-Oriented Dynamic, Visual Environments. Unpublished Dissertation, Department of Computer Science, University of Colorado at Boulder.

Repenning, A. (1991). The OPUS User Manual (Technical Report CU-CS-556-91): Department of Computer Science, University of Colorado at Boulder, Boulder, Colorado.

Repenning, A., & Pedersen, J. (1991). BUCH: A Textual Retrieval Interface [Video]. Palo Alto: Xerox PARC.

Repenning, A. (1987). Repräsentation von graphischen Objekten (Research Report CRB 87-84 C): Asea Brown Boveri Research Center, Artificial Intelligence group, Dätwill 5405, Switzerland.

Patents

Diffusion-based Interactive Extrusion of Two-Dimensional Images into Three-Dimensional Models, United States Patent and Trademark Office, Protected by U.S. Patent No. 8,116,591, granted February 14, 2012.

Diffusion-based Interactive Extrusion of Two-Dimensional Images into Three-Dimensional Models, United States Patent and Trademark Office, Protected by U.S. Patent No. 7,995,863, granted August 9, 2011.

Diffusion-based Interactive Extrusion of Two-Dimensional Images into Three-Dimensional Models, United States Patent and Trademark Office, 2004, Protected by U.S. Patent No. 7,630,580, granted December 8, 2009.

“Verfahren zur Ausführung von zwei in verschiedenen Programmiersprachen geschriebenen Programmen.”
Application for Letters Patent in Germany: Sept. 22, 1986, Identification P 36 32 139.7; Assignment of U.S. Rights to Invention: Oct. 9, 1986.

Committees

Program Committee: IEEE Symposium on Visual Languages and Human-Centric Computing, 2013, San Jose, CA, USA.

Program Committee: Fourth International Symposium on End-User Development, (IS-EUD), Copenhagen, Denmark, 2013.

Program Committee: IEEE Symposium on Visual Languages and Human-Centric Computing, 2012.

Program Committee: Third International Symposium on End-User Development, (IS-EUD), Torre Canne, Italy, 2011.

Program Committee: IEEE Symposium on Visual Languages and Human-Centric Computing, 2010.

Program Committee: The 9th International Conference on Interaction Design and Children, Barcelona, Spain, 2009.

Program Committee: IEEE Symposium on Visual Languages and Human-Centric Computing, 2009.

Program Committee: The 8th International Conference on Interaction Design and Children, Como, Italy, 2009.

Program Committee: IEEE Symposium on Visual Languages and Human-Centric Computing, 2008.

Program Committee: Second Symposium on EUD (EUD 2009) in March 2009 in Siegen, Germany.

Program Committee: OOPSLA 2007.

Program Committee: SIGGRAPH Sandbox 2007.

Program Committee: Pragmatic Web Conference 2006, Stuttgart, Germany.

Program Committee: International Conference on Computational Science and Education 2006, Engaging People in Cyberinfrastructure and Role of Computational Technology in Research & Education, Rochester, New York

Program Committee: INTERACT 2003, International Conference on Human-Computer Interaction, Zürich, Switzerland.

Program Committee: VL 2000 IEEE Workshop on Visual Languages

NSF Initiative planning on Complex Systems in Education, 1999

Program Committee: Visual End-User '99, Workshop on End-User Programming

Program Committee: VL '98 IEEE Workshop on Visual Languages

Program Committee: VL '97 IEEE Workshop on Visual Languages

Program Committee: VL '96 IEEE Workshop on Visual Languages

Program Committee: Human Centric Computing 2003, New Zealand

Workshop Organization

Peer Reviewed Workshops

Instructor, Teach Your Students Game Design in One Week, International Society for Technology in Education Conference (ISTE 2012), 190 registered participants, June 24-27, San Diego, California, USA.

Instructor, Teach Your Students Game Design in One Week, International Society for Technology in Education Conference (ISTE 2011), 92 registered participants, June 26-29, Philadelphia, Pennsylvania, USA. (reviews: 5.9/6.0)

Instructor, with Mark Shouldice, Teaching Game Design, Technology in Education (TIE Colorado 2011) Conference, June 19-21, Copper Mountain, Colorado, USA.

Instructor, with Lewis, C., Workshop: Gamelet Design for Education. In Annual Games, Learning & Society Conference (GLS 2006), (Madison, Wisconsin, 2006).

Co-Chair, symposium: Challenges in Developing Authentic, Multi-University, Cross-Disciplinary, Design-Based Courses, ED-Media, 2005, Montreal, Canada.

Instructor, tutorial: Game Design for Education, IDC 2005, 4th International Conference for Interaction Design and Children, Boulder, Colorado.

Co-Chair: End-User Development, CHI 2003, Fort Lauderdale.

Instructor: Agent-Based Simulations, SC2002, Super Computing, Baltimore.

Chair: Symposium on End-User Programming, Stresa, Italy, 2001.

Chair: Child's Play '96, Workshop on End-User Programming and Education, Boulder, CO, 1996.

Co-Chair: Visual Language Challenge '97, Isle of Capri, Italy, 1997.

Co-Chair: Child's Play '95, Workshop on End-User Programming and Education, Boulder, CO, 1995.

Invited Workshops

Teacher training workshop, Schweizer Tag für den Informatikunterricht, Kantonsschule Limmattal, Urdorf, Switzerland, Jan 11, 2013.

Teacher training workshop, ETH Zürich, Ausbildungs-und Beratungszentrum für Informatikunterricht (ABZ), Zürich, Switzerland, November 28, 2012.

Teach Your Students Game Design in One Week, Middle Tennessee State University, Murfreesboro, TN, Nov. 4, 2011.

Game Design with AgentSheets, Stanford University, Department of Education, April 15, 2003.

Game Programming, Full day workshop for Japanese kids age 8-12 to build games, sponsored by the Japanese International Media Research Foundation, NTT InterCommunication Center, Tokyo, June 29, 2002.

How to make your own interactive web game, MIT Media lab, Mindfest, Boston, MA, 1999.

Introduction to Simulation Design, Engineering School Open House, University of Colorado, Boulder, CO, 1999 and 2001.

Art Exhibits

Art.Bit Collection, Tokyo Opera City Tower, Connecting Programming with Art, Tokyo, Japan, curator: Kouichirou Eto, June 21 - August 11, 2002.

Fine Art Front Porch Fall Series, University of Colorado, “Programmable LEGO and Fine Art”, Boulder, CO, October, 10, 1996.

Reviewer for

National Grant Organizations

- NSF Innovative Technology Experiences for Students and Teachers (ITEST)
- NSF Information Technology Research (ITR)
- NSF Human Computer Interaction & Universal Access (HCI & UA)
- NSF Interactive Systems (IS)
- NSF Small Business Innovation Research (SBIR)
- NSF CAREER Program
- NSF Partnerships for Innovation (PFI)
- NIH National Institute on Drug Abuse

International Grant Organizations

- Israel Science Foundation
- Hong Kong Research Grants Council
- Natural Sciences and Engineering Research Council of Canada
- NWO, the Netherlands Organization for Scientific Research

Private Grant Organizations

The John D. and Catherine T. MacArthur Foundation

Journals

- Communications of the ACM
- Human-Computer Interaction
- International Journal of Human-Computer Studies
- Journal of Interactive Learning Environments
- ACM Transactions on Computer-Human Interaction
- IBM Systems Journal
- Simulation Modelling Practice and Theory
- IEEE Computational Science & Engineering
- International Journal of Visual Languages
- Journal for Research in Mathematics Education
- Journal of Organizational and End User Computing
- Information & Software Technology

Conferences

- Computer Human Interaction (CHI '09), Boston, USA, April 2009
- Computer Human Interaction (CHI '08), Florence, Italy, April 2008
- Information Systems (ECIS'06). Göteborg, Sweden, June 2006
- User Interface Software and Technology, UIST
- IEEE Visual Languages
- International Conference on Human-Computer Interaction
- International Conference On User Modeling

Book Publishers

- Manning Publications Co.

Invited Presentations

Keynote: “Programming is Hard & Boring” Addressing Cognitive and Affective Challenges in Computer Science Education, Schweizer Informatik-Olympiade (Swiss Computer Science Olympics) 2013, Swiss Federal Institute of Technology Zürich (ETH), Jan 12, 2013, Zürich, Switzerland. *Last years keynote was given by Turing award Winner Donald E. Knuth.*

Keynote: “Programming is Hard & Boring” Addressing Cognitive and Affective Challenges in Computer Science Education, The Consortium for Computing Sciences in Colleges: Rocky Mountain Conference (CCSC), Oct. 12, Denver, Colorado. 2012.

Colloquium, Social Computational Thinking Tools: Reinventing Computation Education in Public Schools, Middle Tennessee State University, Computer Science Department, Nov. 4, 2011, Murfreesboro, TN, USA.

Keynote: Social Computational Thinking Tools: Reinventing Computation Education in Public Schools, The Brazilian HCI Conference (IHC 2011) and 5th Latin American HCI Conference (CLIHC 2011), Oct. 26, 2011, Porto de Galinhas, Pernambuco, Brazil.

Colloquium, Social Computational Thinking Tools: Reinventing Computation Education in Public Schools, Universidade Federal de Pernambuco (UFPE), Computer Science Department, Oct. 24, 2011, Recife, Pernambuco, Brazil. *UFPE is rated 6/7 (very high) in the Brazilian University rating system.*

Colloquium, Social Computational Thinking Tools: Reinventing Computation Education in Public Schools, Pontifícia Universidade Católica do Rio de Janeiro (PUC RIO), Computer Science Department, Oct. 20, 2011, Rio de Janeiro, Brazil. *PUC RIO is rated 7/7 (top) in the Brazilian University rating system.*

Presentation with Susan Johnson, “Using Visualization Tools to Teach Programming”, 94th Annual Summer Conference, Colorado Association of Career and Technical Education, July 21, 2011, Loveland Colorado, USA.

Presidential Session, Social Computational Thinking Tools, Design Research Exploring Transformative Frameworks for Learning and Education, American Educational Research Association Annual Meeting, April 10, 2011, New Orleans, LA, USA.

Presentation, Scalable Game Design, STEM Science Technology Engineering & Math (STEM) Education Coalition, Oct. 4, 2010, CSU Denver Downtown Campus, Denver, CO, USA.

Honoree Presentation, Repenning is honored for contributions to computer science at the 2010 Telluride Tech Festival, Oct. 2, Telluride, CO, USA. *(Past honorees include Sir Tim Berners-Lee (creator of the World Wide Web), Vinton Cerf (father of the Internet), and Alan Kay (Turing Award recipient and inventor of modern object-oriented programming)).*

Presenter, SIGDE Forum: The Digital Generation, the Digital Divide, the Mobile Divide, the Literacy Divide, ISTE 2010, June 28, 2010. Denver, CO, USA.

Keynote: “Learning by Making Games”, A Blue Print for STEM, June 27, 2010, Denver School of Science and Technology, a pre-ISTE conference, Denver, CO, USA.

Invited Lecture: School of Mines, “Writing Motivational Project Proposals”, November 6, 2009, Golden, CO, USA.

National Science Foundation brown bag, Computational Thinking Talk series, “Computational Thinking Tools for Scalable Game Design”, July 1, 2009, Arlington, WV, USA.

University of Bern, “Computational Thinking Tools for Scalable Game Design”, June 22, 2009, Bern, Switzerland.

Panel: University of Denver, Bridges to the Future event, “Scalable Game Design”, March 31, 2009, Denver, CO, USA.

Keynote: ECOOP/ELW 2007, “Antiobjects: Mapping Game AI to Massively Parallel Architectures using Collaborative Diffusion”, July 30, 2007, Berlin, Germany.

Keynote: ICT in Education 2007, “Beyond Individualized Instruction”, May 7, 2007, Island of Syros, Greece.

Talk: ICT in Education 2007, “IT Fluency through Game-Based Design”, May 8, 2007, Island of Syros, Greece.

Talk: ETH Zürich, “Antiobjects: Mapping Game AI to Massively Parallel Architectures using Collaborative Diffusion”, April 30, 2007, Zürich, Switzerland.

Colloquium: Carnegie Mellon University, “Antiobjects: Mapping Game AI to Massively Parallel Architectures using Collaborative Diffusion”, April 27, 2007, Pittsburgh, USA.

Colloquium: University of Memphis, “Antiobjects: Mapping Game AI to Massively Parallel Architectures using Collaborative Diffusion”, April 20, 2007, Memphis, USA.

Demonstration: Schloss Dagstuhl, “Incremental 3D End-User Development”, Feb. 20, 2007, Germany

Colloquium: University of Geneva, “Video Games meet Ubiquitous Computing: The Collective Simulation of a Human Being”, Dec. 7, 2006, Geneva, Switzerland.

Colloquium: EPFL Lausanne, “Video Games meet Ubiquitous Computing: The Collective Simulation of a Human Being”, Dec. 13, 2006, Lausanne, Switzerland.

Colloquium: Oregon State University, “Antiobjects”, Oct. 23, 2006, Corvallis, Oregon, USA.

IDSIA (Istituto Dalle Molle di Studi sull'Intelligenza Artificiale), “Excuse me, I need better AI!”, Oct. 12, 2006, Manno, Switzerland.

Colloquium: University of Lugano, Early Steps Towards Cyberinfrastructure enhanced End-User Development, May 11, 2006, Lugano, Switzerland.

University of Lugano, End-User Programmable Agents: of Programmable Services, Toys and Games, Dec. 16, 2005, Lugano, Switzerland.

Deutsches Institut für Erwachsenenbildung, Simulations for the International Assessment of Adult Competencies (PIAAC), Sept 12-13, 2005, Bonn, Germany.

6th Annual International Symposium On Advanced Radio Technologies , “Wireless Technologies to Support People with Cognitive Disabilities on Public Transportation Systems”, March 2-4, 2004, Boulder, CO.

Technology, Neuroscience and the Future of Cognitive Disability, “Commercialization and the SBIR Model”, October 9-10, 2003, Denver, CO.

Media X Gaming to Learn conference, audience included: education researchers, professional game designers, and funding officers (NSF, Hewlett foundation, MacArthur foundation), September 18-19, 2003, Stanford University, Palo Alto, CA.

Keynote presentation to funding officers of the European Research Commission and the Germany Science Foundation: International Symposium on End User Development, Schloss Birlinghoven, Sankt Augustin (Bonn), Germany, October 7-8, 2003.

European Network of Excellence on End-User Development, End-User Development– Who needs it? Pisa, Italy, September 20, 2002.

NTT InterCommunication Center, “Programming meets Art”, Tokyo, June 30, 2002.

Institute for the Advancement of Emerging Technologies in Education, The Constructivist Software Struggle – Constructivist Software in a Dog-Eat-Dog Market, panel with Seymour Papert , Dave Benoit, Ann H. McCormick, and Alexander Repenning, Charleston, WV , May, 2002.

University of Tokyo, AI group, "Thought Amplification", Tokyo, Japan, June 28, 2002.

Toshiba R&D Center, "Multimodal Speech Interfaces meet the Web," Kawasaki, Japan, Jan 25, 2002.

Google, Machine Learning Group, "Agent-based Voice Portals to the Web", Mountain View, CA, November 30, 2001.

NASA Ames, Research Institute for Advanced Computer Science Colloquium, "The End-User Programmable Web", Moffett Field, CA, November 29, 2001.

National Academy of Sciences, "Using Simulations in K-12 Education", Washington, DC, January, 24, 2001.

National Educational Computing Conference (NECC), "Producing Interactive Problems of the Week: Component-Based Integration Teams", Chicago, IL, June 26, 2001.

European Commission, ITS 2001, "The Pragmatic Web", Düsseldorf, Germany, December 4, 2001.

International Symposium On Social Creativity and Meta-Design, "The Role of Simulation in Creativity", Aspen, CO, May 8, 2001.

National Science Foundation, Workshop to Integrate Computer-based Modeling and Scientific Visualization into K-12 Teacher Education Programs, NCSA ACCESS center, Ballston, VA, October 25-26, 2000.

Keynote address, Interaction 2000, Asia largest HCI conference, "AgentSheets: an Interactive Simulation Environment with End-User Programmable Agents," Tokyo, February 29, 2000.

Nara Advanced Institute of Science and Technology, Nara, Japan, March 4, 2000.

NTT Communications Science Laboratory, Kyoto, Japan, March 3, 2000.

Panasonic/Fujitsu (PFU) Research Center, Tokyo, March 1, 2000.

Advanced Telecommunications Research Institute (ATR), Kyoto, March 2, 2000.

Software Research Associates (SRA), Tokyo, February 28, 2000.

Sony CSL Lab, Tokyo, February 28, 2000.

Apple Computer Inc. @ Macworld 2000, "The use of simulation tools in science," San Francisco, CA, January, 2000.

MIT Media Lab, Panel with Andi DiSessa and Brian Silverman on "Kids and Programming," Boston, MA, 1999.

PFU L3D Workshop, "Consumers <=> Producers versus Use <=> Design," 1999, Breckenridge, CO, 1999.

University of Duisburg, "Agent-Based Interactive Simulations", Duisburg, Germany, April 14, 1999.

Fraunhofer Institute, "Agent-Based Interactive Simulations", Darmstadt, Germany, April 13, 1999.

University of Colorado, Mervyn Young Memorial Lecture Series, "Agents in Simulations and Games", Boulder, CO, October 15, 1998.

Carnegie Mellon University, Human Computer Interaction Institute Colloquium, "End-User Programmable Agents", Pittsburgh, PA, April 7, 8, 1998.

Keynote address, Psychology of Programming, "Programming For The Rest Of Us: Lessons Learned From Programmers Who Do Not Want To Be Programmers," Milton Keynes, England, January 10, 1998.

The 1998 Conference on Virtual Worlds and Simulation, "Ristretto: Creating Agent-Based simulations in Java", San Diego, California, January 11, 1998.

Apple Computer, Workshop on Knowledge for Development for Representatives from the White House, "Educational Media in the next Millenium", Cupertino, California, Nov. 12, 1997.

Georgia Tech Workshop On Educational Component Software, "From Agents to Components", Atlanta, GA, June 25, 1997.

Workshop On Model Building As Part of Science Learning, "Educational Simulation Design", Boulder, CO, June 26, 1997.

Sun Microsystems, Educational Components in Java Teacher Workshop, "Designing Interactive Simulations", Menlo Park, California, June 24, 1997.

LEGO Headquarters, "End-User Programmable Tools & Toys", Billund, Denmark, Oct 9, 1997.

Swiss Federal Institute for Environmental Science and Technology, EAWAG, "The Use of Agents in Environmental Simulations", Dübendorf, Switzerland, Oct. 22, 1997.

Marvin Minsky's MIT Media Lab Spring Colloquium Series, "Tactile Programming: A Unified Manipulation Paradigm Supporting Program Comprehension, Composition and Sharing", Boston, MA, April 24, 1996.

GMD Darmstadt, Presentation of Agentsheets and LEGOsheets, Darmstadt, Germany, Sept. 4, 1995.

GMD Bonn, Presentation of Agentsheets and LEGOsheets, Bonn, Germany, Sept. 1, 1995.

University of Bremen, Presentation of Agentsheets and LEGOsheets, Bremen, Germany, Sept. 13, 1995.

Alan Kay's Apple Hill Workshop on Computers and Education, "Agentsheets as Constructionist Environment", Apple Hill, NH, August 28, 1995.

MIT Media Lab, "Agentsheets: A Substrate to create Domain-Oriented Programming and Simulation Environments", Boston, MA, April 21, 1994.

Apple Computer Inc., Advanced Technology Group.: "Building Agent-Based Applications", Apple World Wide Developers Conference, Advanced Technologies Extravaganza, (audience ~4000 people), San Jose, CA, 1993. Apple presented demonstrations of Agentsheets at conferences in Frankfurt, Germany, June 14, and Deauville, France, June 21, 1993.

Reviewed Talks and Posters

Poster: Scalable Game Design: Effectively Teach Computer Education in Middle Schools, National Educational Computing Conference, NECC 2009, June 30, 2009, Washington, DC, USA.

Talk (1 hour): Scalable Game Design: Effectively Teach Computer Education in Middle Schools, National Educational Computing Conference, NECC 2009, July 1, 2009, Washington, DC, USA.

Open Source Projects

Created and maintained a number of Open Source projects under the LGPL license for simulation authoring tools including XMLisp, The Open Agent Engine, speech recognition wrappers, GamePad interfaces and various Lisp programming tools including anticipatory symbol completion. Many of these tools have been ported to other hardware and software platforms.

Google Code project: <http://code.google.com/p/xmlisp/>

Synergistic Activities

Development of research tools: Developed the AgentSheets simulation-authoring tool. Tool allows end-users to build complex agent-based simulations and publish them as Java applets or JavaBean software components. An international user community includes students and teachers in K-12 & university, government research organizations (e.g., NASA), and private sector. Simulations have been built for a variety of subjects including physics, mathematics, sociology, electricity, chemistry, mechanics, environmental design, politics, and economics. With partial NSF/SBIR support AgentSheets has been turned into a commercial product. AgentSheets is currently localized into non-English languages including Japanese.

Innovations in teaching: In collaboration with SRI International, the Mathforum/WebCT, and the University of Massachusetts interactive (AgentSheets-based) middle school math activities are produced and published in support of the Connected Math curriculum. Explore the use of software component technology to build effective educational materials. Research the process of component-based rapid distributed software development.

Development of databases to support research and education: Founding member of the Educational Object Economy <http://www.eoe.org>. Collaborated with Apple Computer, Houghton Mifflin Company, PWS, Stanford University, University of Massachusetts at Amherst, and Carnegie Mellon University to build Java authoring tools and seed EOE repository. EOE is largest database of educational Java applets on the Web.

Contributions to the science of learning: Chaired and co-chaired several workshops on end-user programming, simulation authoring in education, and assessment issues in constructivist learning. Initiated outreach activities for computer science students (undergraduates and graduates) to work on educational technology, work in local middle and high schools, present their work at international conferences and to collaborate with educational technology companies including the LEGO toy company and Apple.

Service on national boards and committees. Participate in a variety of planning meetings on national research programs including the National Academy of Sciences, Definition of A National Initiative Using Technology In K-16 Education, and Building the Educational Grid for Pre-Service Training. Programming committee member and reviewer for education and end-user programming oriented journals/conferences. Reviewer for national (e.g., NSF) as well as international (e.g., Hong Kong Research Grants Council) research funding organizations.

Collaborators & Other Affiliations

Collaborators. NSF Grant: Jeremy Rochelle, Chris DiGiano, Roy Pea - SRI International - James Kaput - University of Massachusetts. Book: Henry Lieberman - MIT Media Lab.

Graduate Advisor. Clayton Lewis, University of Colorado.

Teaching Achievements

Software Atelier II at the University of Lugano was ranked 2/15 of all Spring 2007 Informatics courses.

Repenning's general approach to teaching is to involve undergraduate as well as graduate students in authentic projects and research opportunities connecting them with real world problems. Students are encouraged to participate in outreach activities providing content, tools and services to communities. Examples:

A senior project team designed a visual programming language for the MIT programmable brick called LegoSheets in collaboration with researchers at the MIT Media lab. Undergraduate students learned:

- how to collaborate with researchers locally (at University of Colorado) and at a distance (MIT Media Lab).
- to design complex software by using user-centered design. Students worked with middle schools students at local school to design language, build prototypes, test and revise software. Students volunteered to spend significant amounts of time in the Computer Club advising kids on using computers, building robots and constructing programmable cars.

- to give presentations and write research papers. The team got a paper (regular not student category) accepted at the Visual Languages '95 symposium in Darmstadt, Germany. Students got awarded prize allowing them to travel to Germany and present paper. Presentation was well received and led to an annual, partially NSF supported, event at the Symposium called the Lego Visual Programming Challenge.

A group of undergraduate and graduate students worked with high school students to build simulations in social studies. High school students built and published dozens of complete simulations of events in American history including The Montgomery Bus Boycott, The Flint Strike, and The Californian Grape Boycott. One of the high school teams was awarded with a trip to Atlanta to present their work at a conference on technology in education. The simulations published on the Web became subject of a small media debate in Germany resulting in several articles in German newspapers discussing the progressive use of interactive media in education in the USA.

Graduate students collaborated with teachers, developers and publishers to build course material. Students attended workshops designing interactive middle school math content for the MathForum. They learned about the complete software development cycle including component-based design, distributed development, prototyping, versioning, and bug testing. Content produced was published on the MathForum and on Public Broadcast System (PBS) Web pages.

Students working on these projects received recognition in industry and research. Several groups got invited to present their work in Silicon Valley, and at research conferences. Two undergraduates graduated as best students in the engineering program, and three students received best engineering project price.

Courses Taught: Artificial Intelligence, Object-Oriented Design & Analysis, Information Technology for Education, Senior Projects, Game Programming, Game Design; University of Lugano: Computer Graphics, Simulation & Scientific Visualization, Software Atelier II

Teaching Outreach: University of Colorado High School Honors Institute, representing Computer Science department: game design workshops; University of Colorado Science Discovery Center: course on scientific simulation building; University of Colorado SMART Program, Summer Multicultural Access to Research Training: advised summer students; Centennial Middle School, Boulder, Colorado: computer science course on game design; CU Upward Bound Program: a 6 week course in game design for residential summer students from native Indian reservations.

Thesis Advisor: Martin Rausch, Braden Craig, Jonathan Phillips, Andri Ioannidou, Wenming Ye, and Oliver Leukel, Jennifer Turney. Kavita Agrawal, Catherina Poggi, Politecnico di Milano & USI Communication.

Letters of Recommendation

Available upon request

Languages

English, German, and Swiss German: fluent

Italian: able to participate in casual conversation

Hobbies

Mountain biking