National Science Foundation
CCLI Project Showcase

SigCSE 2008
Portland, Oregon

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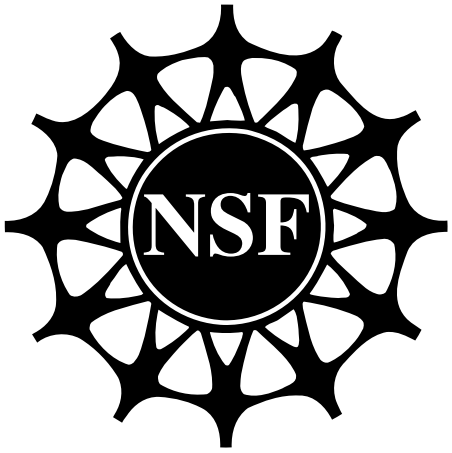
Booth 217, Exhibition Hall

Course, Curriculum and Laboratory Improvement Program



The NSF CCLI Showcase provides an opportunity for recipients of the National Science Foundation's Division of Undergraduate Education's Course, Curriculum & Laboratory Improvement Program (NSF DUE CCLI) to present their research to the broader computer science educational community.

There are four sessions: three in the morning (10:00 a.m. to 11:30 a.m.) on Thursday, Friday, and Saturday; and one in the afternoon (2:30 p.m. to 4:00 p.m.) on Friday.

http://www.cs.virginia.edu/~asb/nsfcclishowcase/

Program at a Glance

Thursday 10:00 a.m. – 11:30 a.m.

Project MLExAI: An Innovative Model for Teaching Core AI Concepts
- Ingrid Russell, University of Hartford
- Zdravko Markov, Central Connecticut State University

Cognitive Robotics with Tekkotsu: A Curriculum for Machines That See and Manipulate Their World
- David S. Touretzky, Carnegie Mellon University
- Ethan J. Tira-Thompson, Carnegie Mellon University
- Marsha C. Lovett, Carnegie Mellon University

Supporting Service-Learning Projects in Software Engineering Project Classes
- Chang Liu, Ohio University

Friday 10:00 a.m. – 11:30 a.m.

Integrating Privacy Ethics into the Undergraduate Database Curriculum
- Florence Appel, Saint Xavier University

Personalized Exploratorium for Database Courses
- Peter Brusilovsky, University of Pittsburgh
- Vladimir Zadorozhny, University of Pittsburgh
- Danielle H. Lee, University of Pittsburgh
- Sergey Sosnovsky, University of Pittsburgh
- Michael V. Yudelson, University of Pittsburgh
- Xin Zhou, University of Pittsburgh

The Affinity Research Group Model: Creating and Maintaining Effective Research Teams
- Ann Q. Gates, University of Texas at El Paso
- Steve Roach, University of Texas at El Paso

Problets: Practice Exercises for Computer Science I
- Amruth Kumar, Ramapo College of New Jersey

Program at a Glance

Friday 2:30 p.m. – 4:00 p.m.

Cooperative Learning Methods for Java-Based CS1 Courses

- Leland L. Beck, San Diego State University
- Alexander W. Chizhik, San Diego State University

Teaching by Collaborating: Toward a Pedagogy Adapted from the Open Source Culture

- John David N. Dionisio, Loyola Marymount University
- Ray Toal, Loyola Marymount University

Building and Using an Emulab

- W. David Laverell, Calvin College
- Timothy H. Brom, University of Kentucky

Saturday 10:00 a.m. – 11:30 a.m.

Cultural Challenges in Teaching Alice in Hawaii

- Judith L. Gersting, University of Hawaii at Hilo
- Keith Edwards, University of Hawaii at Hilo

WeBWorK in Computer Science

- Christelle Scharff, Pace University
- Andy Wildenberg, Cornell College
- Olly Gotel, Pace University
- Richard Kline, Pace University

Tablet PC's as Mind Tools for Enhancing Thinking and Learning Skills

- Cheryl Willis, University of Houston

Project MLExAI: An Innovative Model for Teaching Core AI Concepts

Thursday 10:00 a.m. – 11:30 a.m.

- Ingrid Russell, University of Hartford
- Zdravko Markov, Central Connecticut State University

The goal of this CCLI-Phase 2 project is to develop a framework for teaching core AI topics through a unifying theme of machine learning. It builds on the success of our smaller-scale NSF-funded project. A total of 26 adaptable, hands-on laboratory projects are being developed that can be closely integrated into a one-term AI course. Each project involves the development of a machine learning system in a specific application. The applications span a large area including network security, recommender systems, game playing, intelligent agents, computational chemistry, robotics, conversational systems, cryptography, web document classification, vision, data integration in databases, bioinformatics, pattern recognition, and data mining.

This is a multi-institutional effort that engages a community of twenty scholars from a broad range of universities working together on the development, implementation, and testing of curricular material, in a manner that fosters the integration of research and education. The project will enhance the student learning experience in the introductory Artificial Intelligence course by introducing machine learning elements into the AI course, implementing a set of unifying machine learning laboratory projects to tie together the core AI topics, and developing, applying, and testing an adaptable framework for the presentation of core AI topics which emphasizes the important relationship between AI and computer science.

Cognitive Robotics with Tekkotsu: A Curriculum for Machines That See and Manipulate Their World

Thursday 10:00 a.m. – 11:30 a.m.

- David S. Touretzky, Carnegie Mellon University
- Ethan J. Tira-Thompson, Carnegie Mellon University
- Marsha C. Lovett, Carnegie Mellon University

Many students are initially attracted to robotics by depictions of intelligent machines in science fiction. Characters such as R2D2 and C3P0 have perceptual abilities rivaling humans, and can skillfully navigate and manipulate objects. Though present-day technology, is not quite so advanced, astonishing progress has been made in recent years. Yet few of these advances are evident in undergraduate robotics courses.

This project is developing a curriculum for robot programming that focuses on high-level problems of perception, navigation, and manipulation, precluding students from getting bogged down in the minutiae of reading bump switches or turning motors on and off. We use a software framework called Tekkotsu developed at Carnegie Mellon that handles many details of robot control (see Tekkotsu.org). Tekkotsu includes a 'dual coding" vision system, forward and inverse kinematics solvers, a map builder, a particle filter for localization, a "lookout" for control of the camera, and a "pilot" for navigation. Originally developed for the Sony AIBO robot dog, Tekkotsu now supports a variety of platforms including the Qwerkbot, the iRobot Create, and new robots developed in-house. Tekkotsu is presently being extended to support a six degree-of-freedom arm.

The Cognitive Robotics elective at Carnegie Mellon is targeted at juniors and seniors, and is typically a student's first exposure to robotics. Just as beginning programmers use the ALICE system without having to study 3D rendering algorithms, beginning roboticists can use Tekkotsu's powerful tools to produce intelligent robot behavior without first mastering advanced artificial intelligence techniques

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Supporting Service-Learning Projects in Software Engineering Project Classes

Thursday 10:00 a.m. – 11:30 a.m.

- Chang Liu, Ohio University

Service-learning projects give students opportunities to work on real-world projects for real clients and expose them to unique issues and challenges not found in hypothetical academic projects. It is therefore helpful to introduce service-learning projects in Software Engineering project classes so that students can learn to apply Software Engineering tools and methodologies in real-world settings, and sharpen their communication and teamwork skills through the process. It is a challenge, however, to manage real-world projects, often based on substantial code base, in single-term courses. To address this problem, we developed and integrated a number of learning aids and teaching techniques to facilitate the adoption of real projects based on large, existing code base in single-term project courses. Our learning aids and teaching techniques include:

- Simulated team project process exercise in 3-D online virtual worlds
- Simulated team software specification exercise in 3-D online virtual worlds
- Adoption of Wiki as a tool to facilitate team communication
- Shared code segments from previous assignments among students

We have applied these learning aids and teaching techniques in a Software Engineering project class at Ohio University several times. Some of them were also applied in a Computer Science project class at University of Mary Washington. Preliminary results show that these learning aids and teaching techniques were effective in motivating students and enhancing their learning. They facilitated successful adoption of service-learning projects in our single-quarter classes.

Integrating Privacy Ethics into the Undergraduate Database Curriculum

Friday 10:00 a.m. – 11:30 a.m.

- Florence Appel, Saint Xavier University

This NSF-funded Educational Materials Development project is concerned with the creation of a set of privacy modules to be used by computer science educators in the introductory database theory and design course. The instructional material under development includes in-class discussion exercises, student assignments and examination questions that address the resolution of privacy issues that arise naturally at each stage in the database development process. The modules, which also contain teaching tips and resources, are intended to be introduced systematically throughout the introductory database curriculum, providing students with the experience of addressing privacy concerns throughout the design and deployment of a database. However, the individual modules are being created as stand-alone pieces, allowing an instructor to choose a subset of the entire collection.

The two-pronged project goal is to sensitize students to database privacy issues and to provide them with the means to implement privacy safeguards during the design process.

The integration of privacy ethics into the database curriculum is intended to introduce students to the larger social and moral context of database computing and enhance the study of database design. More generally, it is intended to encourage students to begin to view ethical decision-making and moral professional conduct as natural components of the knowledge, skill set and life of a computer professional. The expectation is that they will then be more likely to behave as ethical professionals when they enter the workforce.

Personalized Exploratorium for Database Courses

Friday 10:00 a.m. – 11:30 a.m.

- Peter Brusilovsky, University of Pittsburgh
- Vladimir Zadorozhny, University of Pittsburgh
- Danielle H. Lee, University of Pittsburgh
- Sergey Sosnovsky, University of Pittsburgh
- Michael V. Yudelson, University of Pittsburgh
- Xin Zhou, University of Pittsburgh

Structured Query Language (SQL) is the most widely used multipurpose database language. To assist students with mastering SQL, we developed an integrated Exploratorium for database courses. The Exploratorium has been designed to combine multiple types of advanced interactive content served by independent content servers. Currently, the Exploratorium integrates three types of interactive learning activities: annotated examples, self-assessment questions and SQL labs. Several adaptive hypermedia techniques are employed to provide personalized access to educational content. The architecture of the Exploratorium is open and the current version can be easily extended with additional activities and components. At SIGCSE we want to demonstrate the components of the Exploratorium, the personalization techniques, and the architecture, which allows integration of these components. We also want to share the results of the system evaluation in both graduate and undergraduate database classes.

The Affinity Research Group Model: Creating and Maintaining Effective Research Teams

Friday 10:00 a.m. – 11:30 a.m.

- Ann Q. Gates, University of Texas at El Paso
- Steve Roach, University of Texas at El Paso

Undergraduate research is a well-known approach to integrate knowledge and provide practice of the skills critical to business, industry, and government, in particular, refinement of cognitive and interpersonal skills, enhancement of personal growth, and inculcation of intellectual and management habits. While a common practice is to recruit and involve the most visibly successful students, this ignores a large number of promising students who can benefit from research experiences. To extend the research experience to a broader range of students, particularly students from under-represented groups, UTEP successfully developed and implemented the Affinity Research Group (ARG) model that provides students with opportunities to learn, use, and integrate the knowledge and skills that are required for research with those required for cooperative work. The model creates an integrated research environment in which a collective of diverse students and faculty contribute to the research effort. The three core components are: the definition of a group's core ideology; active fostering of student connectedness; and application of deliberate management practices that reinforce skills development and promote establishment of cooperative teams. Through the ARG model, faculty mentors create and sustain a cooperative environment that explicitly develops skills to make students successful in research, academe, and the workforce. As a result, students and faculty, in particular those from underrepresented groups, can reach higher levels of productivity and achievement. Through CCLI funding and IEEE-Computer Society Seed funding, the investigators have published an ARG handbook (www.computer.org/arg), and they deliver workshops on the model.

Problets: Practice Exercises for Computer Science I

Friday 10:00 a.m. – 11:30 a.m.

- Amruth Kumar, Ramapo College of New Jersey

Problets are web-based software tutors that help Computer Science I students learn programming concepts by solving problems. Problets present problems, grade the student's answer and provide instant feedback.

Problems: Problets present problems such as filling in missing code, debugging programs, predicting their output, predicting their state, and evaluating expressions. Problets present problems on only those concepts that the student does not know. This helps minimize the problems solved by students while maximizing their learning.

Feedback: Problets explain the step-by-step execution of the code underlying each problem. This has been shown to improve learning. This feature is unique to problets.

Usage: Problets can be used for closed lab exercises, after-class assignments, and in-class testing. They were used over 2600 times last year in the classes of over two dozen faculty. They are free for educational use.

Instructor support: Faculty sign up to use problets by email (no class lists needed). After their students use each tutor, faculty are provided an Excel report upon request. So, using problets takes minimal effort.

Topics: Currently, problets are available for arithmetic, relational and logical expressions, if-else statements, while and for loops, and C++ pointers. They are available in C, C++, Java and C#.

Effectiveness: Problets have been continually evaluated since 2000, and have been shown to help improve learning. They incorporate many features that have also been shown to facilitate learning.

For additional information, and to try out problets, please visit http://www.problets.org. If you are interested in using problets, please contact Amruth Kumar, amruth@ramapo.edu

Cooperative Learning Methods for Java-Based CS1 Courses

Friday 2:30 p.m. – 4:00 p.m.

- Leland L. Beck, San Diego State University
- Alexander W. Chizhik, San Diego State University

The primary goal of this project is to develop a more effective way of teaching the introductory computer programming course (CS1). We have designed a set of Java-based cooperative learning exercises for use in CS1, building on work performed in a previous CCLI proof-of-concept project. Most of our exercises involve a structured division of group responsibilities into roles, in order to focus students' attention on the most important concepts and processes being studied.

A series of educational experiments have shown statistically significant improvements in performance ($p < .01$) for students using the cooperative learning approach, as compared with students in a traditional lecture-based class. In these experiments, the benefits of cooperative learning clearly outweighed any possible losses due to reduced lecture time. These benefits were enjoyed by both male and female students, by majority and minority students, and by students from a variety of majors. There are indications that the educational benefits continue when students who had a cooperative learning experience in CS1 go on to CS2.

The next phase of the project will involve studying the effectiveness of our cooperative learning approach and materials at different institutions, and with different student populations. We have an extensive set of instructor's notes, and are eager to provide training and support for faculty members who are interested in using these materials. If you are interested in participating in this follow-up study, please contact us.

Teaching by Collaborating: Toward a Pedagogy Adapted from the Open Source Culture

Friday 2:30 p.m. – 4:00 p.m.

- John David N. Dionisio, Loyola Marymount University
- Ray Toal, Loyola Marymount University

Traditional computer science education often consists of short-lived, one-off programming exercises, students working alone with the instructor as an evaluator/overseer, and an ad hoc infrastructure for managing, submitting, and responding to student deliverables. The Recourse NSF CCLI project at Loyola Marymount University in Los Angeles, California is working toward a new model that is inspired by the open source culture: long-lived code that crosses courses and terms, increased collaboration among students and instructors, and a unified, curriculum-wide hardware and software infrastructure based on current software engineering best practices. Overall, the project strives to provide an educational experience that gives the student both (1) the engineering and people skills demanded by industry, and (2) sufficient fluency with computer science fundamentals to enable new research. Initial results suggest that this approach has produced students who can "hit the ground running" upon joining industry or research due to their prior immersion in tools and workflows as undergraduates, while also appreciating how collaborative work motivates increased clarity, ease of maintenance, and longevity of code and documentation.

Building and Using an Emulab

Friday 2:30 p.m. – 4:00 p.m.

- W. David Laverell, Calvin College
- Timothy H. Brom, University of Kentucky

An Emulab is a network testbed on which experiments can be carried out through a web interface. Emulabs are widely recognized as useful research environments. We have come to believe that Emulabs are also useful in education, specifically in teaching courses in operating systems and computer networks. Just as Emulabs make one think research before teaching, so they make one think of large research universities, not small liberal arts colleges. Part of our presentation answers the question whether equipment costs have fallen enough and Emulab software has evolved enough to bring about a situation in which Calvin College could build an Emulab. Calvin is a liberal arts college with approximately 4000 students and a support staff with considerable experience in networks and specific experience with Cisco products. The Calvin Emulab was certainly not built in a day, in fact, there were times when it appeared that we had taken on a challenge that we would not be able to make good on. We will describe the difficulties in some detail, and use our experience to argue that a school of Calvin's size and with a good support staff can indeed build its own Emulab. We will also give a live demonstration of how we have used the Calvin Emulab in our advanced computer networks course. We will also discuss ways to utilize Emulab technology if one cannot build their own local facility, particularly as Emulabs become federated and move toward integration with the GENI testbed.

Cultural Challenges in Teaching Alice in Hawaii

Saturday 10:00 a.m. – 11:30 a.m.

- Judith L. Gersting, University of Hawaii at Hilo
- Keith Edwards, University of Hawaii at Hilo

A new course developed at the University of Hawaii at Hilo with National Science Foundation support (DUE-0510157) uses the Alice programming language and environment. One of the major emphases in this course is to have students implement Hawai'ian myths and legends as Alice animations. The challenge was to merge qualitative concepts of Hawa'iian culture (social, historical and cultural information) with the quantitative field of computer science, and this is the main focus of our work.

Although many studies indicate that the narrative approach offered by Alice is a good way to ease students into the computer science major, our results along those lines have been mixed. However, as a way for students from many different cultural backgrounds to learn that they, too, can harness the power of the computer for meaningful storytelling, the course has been quite successful.

WeBWorK in Computer Science

Saturday 10:00 a.m. – 11:30 a.m.

- Christelle Scharff, Pace University
- Andy Wildenberg, Cornell College
- Olly Gotel, Pace University
- Richard Kline, Pace University

WeBWorK (external link: http://webwork.math.rochester.edu) is an open source web-based system used to deliver and grade homeworks and distribute their solutions. Developed at the University of Rochester, it is used by over sixty institutions to teach mathematics. WeBWorK offers traditional multiple-choice and short answer questions, but its novelty resides in that it can understand mathematical formulæ and support randomization and parameterization. Since 2004, we have been collaborating to adapt and extend WeBWorK for use in the computer science curriculum. A library of multiple-choice and short answer questions has been created for Java, Python, SML, C, and discrete mathematics. Moreover, a major part of our initiative has been to develop a WeBWorK extension based on JUnit called WeBWorK-JAG (Java Auto Grader) to automatically collect and grade Java program fragments, thereby extending the types of questions supported by WeBWorK to make it a better fit for practicing programming. Students use WeBWorK for Java homeworks in CS1 and CS2. In addition, we have initiated a novel and innovative pedagogical approach for teaching software quality assurance based upon having students contribute programming questions to WeBWorK. Students complete steps involving: (a) creation of questions for other students, (b) peer-review of formulation of questions, (c) construction of unit tests that check the correctness of the solution, (d) peer-review of the unit tests, and (d) testing of the question, all prior to deployment of the questions in the WeBWorK library. The WeBWorK in Computer Science project is described at: external link: http://csis.pace.edu/~scharff/webwork.

Tablet PC's as Mind Tools for Enhancing Thinking and Learning Skills

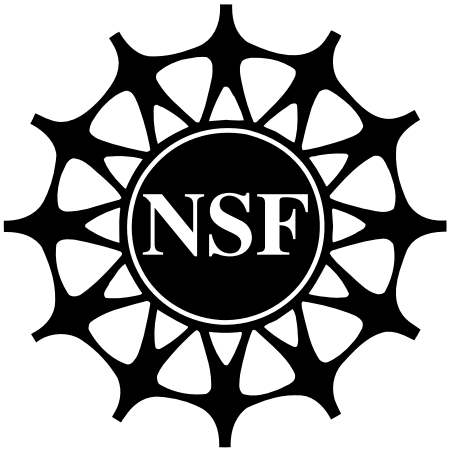
Saturday 10:00 a.m. – 11:30 a.m.

- Cheryl Willis, University of Houston

The College of Technology at the University of Houston is investigating the use of the Tablet PC as an instructional tool to facilitate the development of thinking and learning skills across the undergraduate Information Systems Technology program. Specific instructional activities lend themselves to critical thinking and problem-solving skill development. Mindmaps, a strategy introduced by Tony Buzan (1995), and other visual learning strategies, encourage learners to identify major concepts related to a topic, and then to create their own representation of how the concepts relate to one another. This project is extending previous work completed on the effectiveness of mind maps for improving critical thinking and problem solving skills by combining this visual learning technique with the use of Tablet PC's and pen-enabled mind mapping software.

The need exists to facilitate the development of learning and thinking skills throughout the undergraduate STEM curricula. UH is investigating the use of Tablet PCs as a mind tool that, when combined with the visual learning technique of mind mapping and mind mapping software tools, will improve learner outcomes in these critical areas. Since learning and thinking skills should be developed and reinforced in all courses, UH is creating a modular instructional design that can be adapted for use wherever the curriculum goals warrant it.

Project objectives include: (1) adapting and integrating the use of visual learning techniques to enhance the development of thinking and learning skills of students in the undergraduate IST program; (2) adapting and integrating the use of computer technology, specifically Tablet PCs, as a mind tool to enhance the development of thinking and learning skills of students in the undergraduate IST program; (3) increasing faculty use of Tablet PC's and visual learning techniques through faculty development activities; and (4) developing an assessment protocol for capturing and analyzing data regarding learner outcomes relating to critical thinking, collaboration, and problem solving.



The NSF CCLI showcase is a yearly event at the SIGCSE conference. If you are working on an NSF CCLI grant, or have recently completed one and would like to present at the showcase, please contact Aaron Bloomfield at aaron (at) virginia (dot) edu. The selection process will begin in the fall.

http://www.cs.virginia.edu/~asb/nsfcclishowcase/