PANEL ON INTERDISCIPLINARY APPROACHES TO REVITALIZING UNDERGRADUATE COMPUTING EDUCATION

presented at the 2008 Conference of the

Consortium for Computing Sciences in Colleges Northeastern Region (CCSCNE)

Staten Island, NY, April 12, 2008

Jesse M. Heines (*panelist and contact person*)
Dept. of Computer Science
Univ. of Massachusetts Lowell
Lowell, MA 01854
1-978-934-3634
heines@cs.uml.edu

Kenneth J. Goldman (*panelist*)
Dept. of Computer Science and Engineering
Washington Univ. in St. Louis
St. Louis, MO 63130
1-314-935-7542
kjg@cse.wustl.edu

Jim Jeffers (*panelist*)
Dept. of Art
Univ. of Massachusetts Lowell
Lowell, MA 01854
1- 978-934-3498
James_Jeffers@uml.edu

Edward A. Fox (*contributor*)
Dept. of Computer Science
Virginia Tech
Blacksburg, VA 24061
1-540-231-5113
fox@vt.edu

Robert Beck (*panelist*)
Computing Sciences
Villanova University
Villanova, PA 19085
1-610-519-7307
robert.beck@villanova.edu

SUMMARY

"Through the CISE Pathways to Revitalized Undergraduate Computing Education (CPATH) program, NSF's Directorate for Computer and Information Science and Engineering (CISE) is challenging its partners – colleges, universities and other stakeholders committed to advancing the field of computing and its impact – to *transform undergraduate computing education on a national scale*, to meet the challenges and opportunities of a world where computing is essential to U.S. leadership and economic competitiveness across all sectors of society." [4]

One approach to such revitalization is the introduction of interdisciplinary courses to expand the scope of computing education. This approach has its roots in programs such as Lynn Stein's "small footprint" core [2] and Georgia Tech's "threads" [3]. The basic idea is to have students from various disciplines work together on computing projects to expand their educational horizons and make computing courses more appealing.

This panel brings together educators who have developed and taught interdisciplinary courses with these goals in mind. The panelists will share their experiences and solicit new ideas from the audience. We expect a lively discussion on the pros and cons of this approach.

Categories and Subject Descriptors

J.5 Arts and Humanities, Fine Arts, Music, and Performing Arts.

Keywords

Computer science education, interdisciplinary programs.

PANELISTS' POSITION STATEMENTS

1. Jesse M. Heines

The Univ. of Massachusetts Lowell has received an NSF CPATH grant to connect computer science to the performing, fine, and design arts by developing a specialty track within the computer science curriculum called *Performamatics*. The focus of this work is to develop courses that combine CS with Art, Music, and Theater and a process for introducing such courses into traditional CS programs. The latter point is not a trivial one, as the

demands of an already packed curriculum and cultural inertia conspire to inhibit the introduction of new courses, particularly ones that do not explore newly developing CS areas.

However, we see the current trend to teach computing concepts in virtually all academic areas as a newly developing CS area itself. This trend is particularly common in today's art, music, and theater courses. In addition, computer applications in these areas are a major focus of students' interests, so we think it makes sense to try to tap into this interest to attract and retain CS majors.

Courses we are currently working on include:

- *Tangible Interaction Design*
  Bringing together CS and Art students around the theme of creating useful and educational artifacts that include embedded computing technology.
- *eAMP (Extended Art Media Performamatics)*
  Bringing together CS and Art students to create visual art that will be distributed rather than exhibited.
- *Music Performamatics*
  Bringing together CS and Music students to gain firsthand experience with the pros and cons of creating technology applications for classrooms with students who are growing up under the strong influence of media.
- *Theater Performamatics*
  Bringing together CS and Theater students to face real-world theater and entertainment challenges and create better ways to integrate computer technology and the performing arts.

We expect to be able to relate real findings from our experiences in developing these courses by the time this panel is convened.

2. Jim Jeffers

Art fields are increasingly relying on technology in general and computer technology in particular to realize fine and practical arts projects—from museum installations to video graphics and compositing in TV commercials. Our *Performamatics* approach creates a development team environment, where art and CS students work together to see more worldly projects to fruition.

In the *eAMP* (Extended Art Media Performamatics) area of *Performamatics*, art and design students work with CS students to develop programs which not only function as challenging CS exercises, but also do something artistic and aesthetic while performing their tasks. In the ideal, form and function push each other to create an exciting project, but the foremost result is an in-depth educational experience. *eAMP* focuses and challenges CS to address the vital and expanding realm of hand-held computing, from pocket PCs to cell phones. Small computers are getting more powerful and graphically sophisticated, and artists and designers are increasingly being asked to create for these devices, putting artists and computer scientists in the same room. Thus, *eAMP* is at the cutting edge for art and design as well as CS students, fostering an interdisciplinary match of exciting possibility and mutual benefit.

3. Kenneth J. Goldman

Educational research has shown that active and collaborative learning result in a deeper and more integrated understanding of concepts, as well as significant improvement in student retention in degree programs [1]. Collaborative learning builds important communication, teamwork, and leadership skills. In addition, active learning provides an opportunity to teach creative design through discussion and critiques.

Washington University's Dept. of Computer Science & Engineering (CSE) is transforming its undergraduate program by applying active learning—including inquiry-based, problem-based, and collaborative learning—in partnership with faculty in the College of Architecture. We are working to adapt teaching methods historically used in art and architecture design studios for use in computer science and engineering design studios. By capturing the passive learning content currently delivered as lectures and making it available online in a modular way, we will free up time to incorporate active and interdisciplinary learning sessions in the classroom and support interdisciplinary students in just-in-time learning of required background.

Many of the studio projects will be inspired by ongoing research. Examples of some interdisciplinary studio experiences we are planning include:

- Architecture and CSE students collaborating on the design of virtual spaces.
- Art and CSE students working together on creating virtual presence environments and interactive art installations.
- Civil engineering and CSE students collaborating on design and implementation of remotely operable laboratories, such as shake tables for seismic analysis of structures.
- Humanities students and CSE students working on new approaches and algorithms to support scholarly analysis of historical texts.
- Mechanical engineering, biomedical engineering, and CSE students working to build assistive devices.

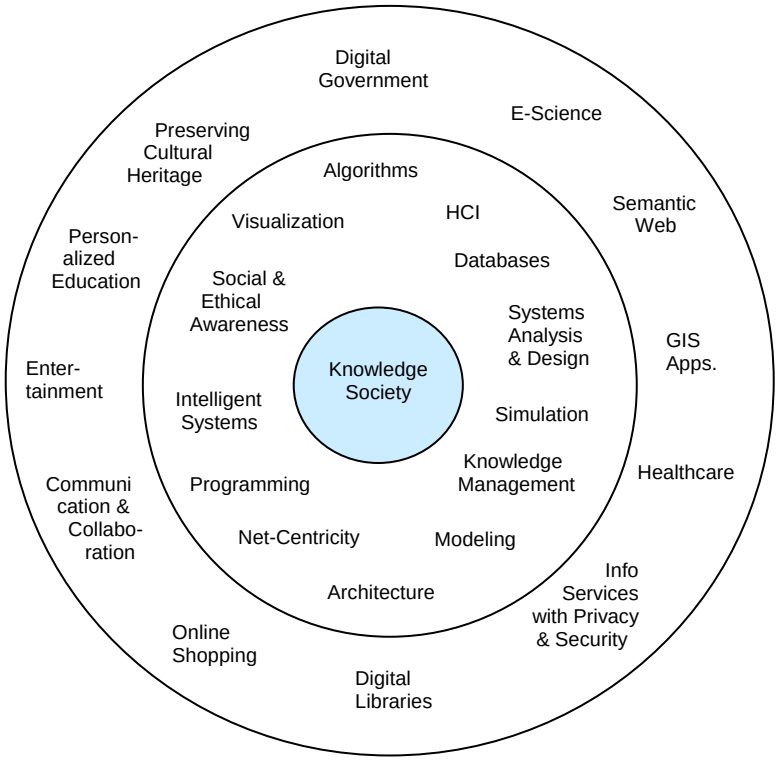
We hope that both the transformation process and the resulting program will serve as models for other institutions wishing to adopt interdisciplinary and active learning strategies. Tools and teaching practices we develop will be made available for others to adapt for use in their own institutions.

4. Edward A. Fox

NSF has awarded CPATH Collaborative Research Community Building grants for *Living In the KnowlEdge Society* (LIKES) to Virginia Tech (lead institution, with PI Fox and co-PIs Evia, Fan, Sheetz, and Zobel, from CS, English, Accounting & Information Systems, and Business Information Technology), North Carolina A&T (PI Carr, CS), Santa Clara Univ. (PI Chung, Information & Decision Sciences), and Villanova Univ. (PI Beck, CS). Our aim is to connect computing-related disciplines with many other fields (especially required "core" or liberal arts courses) to ensure that the nation's undergraduate students are prepared to live in the emerging Knowledge Society.

Through a series of four workshops (starting with late 2007 at Santa Clara and spring 2008 at North Carolina A&T), related online community discussions, and our own research, the LIKES community is discovering key computing-related issues in core disciplines and engaging leaders nationwide in brainstorming about their computing education needs. Deliverables include (1) new pedagogies in computing education, (2) integration of computing concepts into non-computing disciplines, (3) principles, guidelines, and techniques for integrating computing and non-computing curricula, and (4) formation of new communities for enhancing that integration.

This transforming of education in computing-related disciplines will foster a new generation of Knowledge Society builders. The figure shows how CS concepts (2nd circle) relate to Knowledge Society applications used by individuals and society (3rd circle).



REFERENCES CITED

[1] Bransford, J.D., Brown, A.L., & Cocking, R.R., eds. (2000). How people learn: Brain, mind, experience, and school. National Academy Press, Washington, DC.

[2] Downey, A.B., & Stein, L.A. (2006). *Designing a small-footprint curriculum in computer science.* Proc. of the 36th ASEE/IEEE Frontiers in Education Conf. San Diego, CA.

[3] Georgia Tech (2006). *Computer Science Threads*. 2006-2007 General Catalog. www.catalog.gatech.edu/colleges/coc/ugrad /comsci/threads.php accessed August 24, 2007.
[4] National Science Foundation (2006). *CISE Pathways to Revitalized Undergraduate Computing Education (CPATH)*. www.nsf.gov/funding/pgm_summ.jsp?pims_id=500025 accessed Aug. 24, 2007.