

INNOVATION IN UNDERGRADUATE COMPUTER SCIENCE EDUCATION

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INTRODUCTION

As computing evolves, so does Computer Science as a discipline. This puts continual pressure on Computer Science educators to review, revise, and rewrite the courses and the curriculum. Educators have been rising up to the challenge, creating new courses, introducing innovative ideas and practices into existing courses, re-organizing the major and carve out minors. This panel will present some of the innovations that have been introduced into the undergraduate Computer Science curriculum.

Innovation is expensive. Change takes time, effort and commitment. This panel is designed to spark discussion among educators about innovation, help interested educators overcome the learning curve associated with curricular innovation and change, and help them adapt from successful practices. The panel will also provide an opportunity for educators in the audience to share their own curricular innovations.

HOMMA FARIAN & MATTHEW HAAS - DISTRIBUTED SYSTEMS

The Distributed Systems course at SUNY Geneseo is designed to provide a foundation in concurrent and High-Performance Computing environments. It includes exercises in parallel and distributed algorithm design, client/server communications, message passing, and networked operating system communications.

Each project in the course focuses on an important aspect of High-Performance Computing. The first project involves a straightforward algorithm, such as a matrix multiplier. Students first implement the solution sequentially, and analyze the limitations. They then split up the algorithm to perform parallel calculations, and analyze the difference in processing capability. The second project focuses on distributed computing methodologies, such as algorithms that can benefit from the scatter/gather method, and may involve more in-depth intercommunication amongst the processing nodes. We have used the classic "Traveling Salesperson" problem in the past. Another project is on client/server communication, and is designed to help students better understand message passing and the importance of communication. Finally, students build and configure their own cluster, which helps them learn about network latencies, disk I/O, memory-based transactions, etc. The students have access to a lab containing an existing cluster of 16 nodes for their projects.

FRANK LEE & YELENA KUSHLEYEVA – GAME DESIGN: EDUCATIONAL GAMES

The goals of this class were to allow students to:

1. Understand and appreciate the critical role of psychology of play and the principles of game design in designing and developing educational games; learn to work with materials from those fields by reading and reflecting on current research findings in game design, psychology of play, education, cognitive science, and human-computer interaction.
2. Recognize the essential role of interdisciplinary teams in designing educational games; learn to effectively function as a part of such teams by working in a group composed of students from Computer Science, Media Art and Design, Mathematics, Education, and Psychology.
3. Recognize the value of feedback received from educators with actual classroom experience for designing successful educational games; learn to solicit such feedback, and efficiently incorporate it into design process. This last aspect of the class actually carries a very deep impact on college students, as it generally teaches them how to work closely and effectively with experts from various domains while designing products for those domains.

To achieve these goals, we divided the course into two parts. In the first half, students learned the fundamentals of game design and the fundamentals of educational practice. This material was learned through lectures, readings, in-class activities, and small-scale design assignments. In the second half, students worked in multi-disciplinary teams to design their own educational math games for grades K-7. During this phase, students cycled through multiple revisions of their game designs. During each cycle of revision, K-7 teachers reviewed and commented on the educational value and classroom-use plausibility of student-proposed designs. This aspect of the course was very successful. The teachers were deeply engaged in the student projects, which in turn became a great source of motivation for our students. Our experience working with students and teachers led us to believe that development and free distribution of fun and engaging educational games has a potential for leading to a strong and beneficial partnership between universities and K-12 schools.

INGRID RUSSELL – MACHINE LEARNING IN ARTIFICIAL INTELLIGENCE

We have been developing an adaptable framework for teaching core AI topics using machine learning as the unifying theme. We have developed a suite of adaptable, hands-on laboratory projects that can be closely integrated into a one-semester AI course. These projects 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 in general, and software development in particular.

Each project involves the design and implementation of a learning system that enhances a commonly-deployed application. The projects have various emphases and can serve different goals within the general framework of teaching AI. While we envision using each as a semester-long project, the projects are easily adaptable and customizable, allowing faculty to tailor them as they deem necessary for their courses. At one extreme, students may implement an entire machine learning system that illustrates a core AI topic. At the other extreme, students may apply our solution code to understand the computational characteristics of the algorithms. In between is a range of choices, where instructors individually decide how much implementation is best for their students. We will present our model, an overview of the projects, and our experiences using them.

JACK BEIDLER – WEB PAGES TO WEB SITES TO WEB SERVICES

Teaching web development has come a long way. I began with the teaching of HTML and Javascript and the construction of web pages. It soon led to a broader focus on the role of the web server and the view of the web as a multi-tiered client server interactive environment. This in turn led to the delivery of virtual web pages with HTML and

Javascript encapsulated within reusable classes. As a result, more time could be spent in the course discussing the richness of the Web protocol and its potential that goes beyond its original intent.

Today the Web protocol is used not just for browser-server communication, more and more it is being used for computer to computer interaction via the Web Protocol. It is a relatively simple step from the use of classes to encapsulate and deliver correctly formed HTML-based communication between a browser and a server to the encapsulation and delivery of XML via classes through secure computer-to-computer communication. My presentation will be directed towards understanding the concepts underlying SOAP and WSDL standards and the development of a simple environment to provide Web protocol-based computer-to-computer experiences.

BHAGYAVATI – COMPUTER AND NETWORK SECURITY

An Information Assurance (IA) track in the graduate program resulted in a sprinkling of IA and security topics in undergraduate courses. From this beginning, a new course designed exclusively for undergraduates was developed. Titled "Introduction to Computer and Network Security," this course has been offered twice in the Computer Science department at Columbus State University. It has been taught as a blended classroom-Internet class and as an Internet-only class.

Topics covered in this course include traditional security techniques, vulnerabilities of these techniques, fault-tolerant software, email and web security, wireless and IM threats and the security implications of common programming mistakes. Assignment and project questions typically require independent research on the part of the student about network security topologies, security baselines, intrusion detection concepts and cryptography. Assignments include a mix of hands-on exercises and concept-questions as illustrated above. Examples of tools and technologies used for hands-on exercises are nmap, netstat, ping, traceroute, SuperScan, CIS security scanner, open-source Linux tools, hping2 and others.

In my presentation, I will discuss how to incorporate sufficient hands-on exercises so that students can grasp the applications of security tools. These exercises are often performed on single machines, therefore the tools need to be simple to use, yet yield reasonably accurate and detailed output to enable the students to understand the vulnerabilities and countermeasures in today's cyber-world. I will provide handouts to the audience containing actual assignment questions that have been effectively used to enhance the learning experience for our students.

BIOGRAPHIES

Ingrid Russell is Professor of Computer Science at the University of Hartford. Her research interests are artificial neural networks, pattern recognition, and computer science education. Her work has been supported by grants from the National Science Foundation, NASA and the Connecticut Space Grant Consortium. Recently, she chaired the Intelligent Systems focus group of the IEEE-CS ACM Task Force on Computing

Curricula 2001.

Frank J Lee is an Assistant Professor of Computer Science at Drexel University. His research interests include Human Computer Interaction, Cognitive Modeling, and Theories of Complex Skill Acquisition.

Yelena Kushleyeva is an NSF Graduate Research Fellow pursuing her Ph.D. in Computer Science at Drexel University.

Amruth Kumar is Professor of Computer Science at Ramapo College of New Jersey. His research interests include Intelligent Tutoring Systems and Computer Science education research. He is on the eastern and northeastern boards of the Consortium for Computing Sciences in Colleges.

Matthew Haas is the Assistant Director of the Distributed Computing Lab at SUNY Geneseo. He is also a Visiting Instructor of Computer Science at Corning Community College, working to establish collaboration between the two schools in the promotion and utilization of High-Performance Computing.

Homma Farian is a Lecturer of Computer Science at SUNY Geneseo. Her main areas of interest are CS Curriculum Development, and Distributed Systems.

Jack Beidler is Professor of Computer Science at University of Scranton, where he developed a Bachelor's program in Computer Science in 1970. He has more than 45 years of teaching experience and has published three text books. He is the founder of one of the first CCSC conferences. His current research interests are in computational complexity, data structures and algorithms, and applying the Web Protocol.

Bhagyavati is Assistant Professor of Computer Science at Columbus State University. Her research interests are in the areas of design, management and applications of wireless and mobile networks. She is involved with wireless grids, mobile databases, network security and wireless information assurance. She is also interested in teaching and learning methodologies, online learning communities and student engagement.

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