

Integrated Research Components (IRC's): Ensuring that all students can have a research experience

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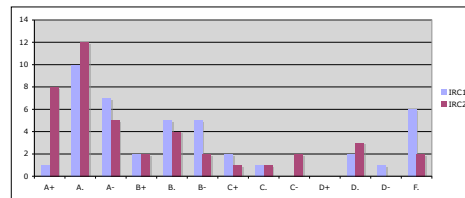
Background and Goals

Semester-long or year-long student projects are an important component in computer science curricula. Computing Curriculum 2001 (CC2001) [3] includes a capstone project in computer science for all students. The 2004 Model Curriculum for a Liberal Arts Degree in Computer Science [4] states as one of the objectives of the degree, "[S]tudents in the type of program described here should: ... [H]ave experience with at least one large, team-based project or research project."

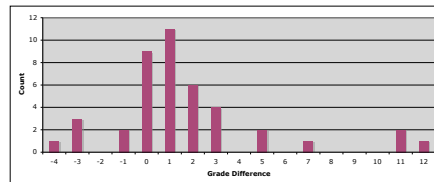
Such experiences, often called Capstone Experiences, Senior Projects, or Senior Theses, are incorporated into computer science degrees in several ways. Many are group software engineering projects, sometimes for an external client. Others are honors theses, publishable research projects performed only by the strongest students in the program. Other programs let students choose between team-based software projects and research projects [2, 6]. Another alternative, the Macalester model, mandates a research project for every student, so that "the excitement of research [is] an activity experienced by *everyone*" [5]. Even those students who do not find research to be exciting are well-served by a requirement that lets them discover this relatively early in their professional career.

Advantages of Two IRC's

- Time and incentive to learn from feedback from first IRC
- More chance of at least one positive research experience
- Less pressure to pass poor projects (or prevent graduation)
- The first IRC is early enough to encourage motivated students to seek out additional research experiences



IRC Grade Distributions: The distribution for second IRC's (red) shows a shift to the left and an increase in grades B- and above relative to the first IRC's (blue)



Individual Grade Changes: This graph shows change in grades (measured in grade steps) for 42 students who completed both IRC's. 64% earned a higher grade on the second IRC, 21% had no change, and 6% showed a drop between the two projects. The average grade difference was +1.69 grade steps.

IRC Specifics at Hiram College

- Every student does IRC's, connected to 2 different 300-level courses
- IRC 1 and IRC 2 are separate courses from the 300-level course
 - Students receive a separate grade for the IRC project
 - Students receive additional hours for the project
- Students choose their own projects within the boundaries of the course
 - Stronger students extend the state of the art. ("R"esearch)
 - Weaker students learn and use ideas that are new to them, while carrying out a significant implementation. ("r"esearch)
- Deliverables model a scientific research project
 - Formal proposal
 - Significant, original implementation
 - Paper, in a style suitable for submission to a research conference or journal
 - Oral presentation (at departmental semi-annual "research conference")
- Format makes effective use of faculty time
 - All IRC's in a semester have similar topics, and the faculty member is also preparing that course
 - Both faculty and students receive additional credit for IRC courses

Student Comments

"While on a summer internship [I went to [a presentation about] a program to simulate an organism's attack scheme on human cells that eventually cause the Chagas disease. I wasn't supposed to actually partake in the discussion, but I proposed a rough draft of a large scale simulation project using Arena, and told them about my project that I completed with you in my Simulation IRC. They really liked the idea ... Since I proposed the idea, they want me to program it for them, analyze the results, and present in front of the Biology Department and the Computer Science Department ... Hey, it's just like doing another IRC!" (2004 graduate, now in graduate school)

"My racing car work [from the Graphics IRC] showed that I could really handle gaming level graphics and really blew the interviewer out of the water. I was hired on the spot. He was surprised at how much I knew about other related work so I am glad you insisted on having us do a literature search." (2003 graduate, now working in the gaming industry)

Sample Projects

IRC Project	Course
<i>RoboTag: Using Autonomous Mobile Robots to Simulate a Childhood Game</i> , Brent Pliskow	AI
<i>Artificial Intelligence in Sports: A Study Upon American Football*</i> , Gregory Nilsen	AI
<i>An Expert System for Credit Evaluation and Explanation*</i> , Luke Hodgkinson	AI
<i>BLAST Organizm Cross-Comparison as a Toll for Genomic Sequencing*</i> , Adam Ewing	Bioinformatics
<i>Query Relaxation and Searching through CoBase</i> , Diana Kirby	Database
<i>Security and Usability of a Database Driven Web Application</i> , Jason Seith	Database
<i>The Simulation of Fire on OpenGL Using a Correlated Particle System</i> , Ankur Gupta	Graphics
<i>Modeling of Planetary Bodies from an Orbital Perspective</i> , Adam Busony	Graphics
<i>Modeling of a Deformable Hand in Real Time using Bezier Surfaces</i> , Jason Wray	Graphics
<i>Error Detection and Reliability in the Link Layer of a Network</i> , Jeffrey Zimmerman	Networks
<i>Ohio's Power Grid: An Independent Study</i> , Michael Wade	Simulation
<i>A Simulation of a Convenience Store</i> , Kohei Matsumoto	Simulation
<i>Recognizing American Sign Language Using Principal Component Analysis</i> , Art Geigel	Vision
<i>Locating Tracking and Interpreting EAN Bar Code Waveforms in a Two-Dimensional Video Stream*</i> , Jeffrey Adair	Vision

*Project was presented at an external conference

References

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