FY04 Innovations in Teaching with Technology Awards:
Teaching Data Structures Using Competitive Games Project Elaboration

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<th>Proposal Title:</th>
<th>Teaching Data Structures Using Competitive Games Project Elaboration</th>
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<tr>
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<td>Org Unit:</td>
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<td>Department(s):</td>
<td>Computer Science</td>
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<td>Funding Awarded:</td>
<td>$5,100</td>
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What do you intend to do?

*In what ways might this project improve education to students?*

Introducing a competitive programming project has two pedagogical benefits:

1. Increased student motivation and project participation
2. Decreased marking times

The major benefit of introducing a competition is that it encourages students to work harder to complete the assignment and practice their programming skills. Another benefit is that it increases student discussion and interaction. Interpersonal and programming skills are critical to students’ employment prospects. Testing of the initial prototype in Spring 2003 showed that students really enjoy the competitive aspect, and it was regarded by many as their best assignment *ever*. Many students demonstrated it to potential employers, and it can be used as a demonstration for recruiting.

The second major impact is that the competition system *automatically evaluates* student code. With funding cutbacks, it is important to leverage technology to increase the efficiency of education. The system increases marking efficiency by having the results of the competition determine the student’s grade. Often major programming projects are not offered because they are costly to develop and evaluate. This system minimizes instructor effort for such projects.

*Initially how many students will be impacted. List courses and number of students.*
The competition system will be used in introductory programming courses with large programming components. Currently, the systems works best for 22C:030 Computer Science III that enrolls about 100-120 students annually. However, recent curriculum changes may make it more suitable for 22C:020 Computer Science II (150 students/year), which in its new form will have a major project as its primary evaluation component. The competition system can also be used in 22C:135 Artificial Intelligence (~30 students) and introductory programming courses such as 22C:016 Computer Science I (300 students/year).

*In what ways might this project improve education and be replicated in other departments/units in the University?*

The use of automated grading techniques for assignments is an increasing trend. Recently, the Stanford database group has developed a system for automatically evaluating student database assignments. By developing the required infrastructure for Internet assignment deployment and grading, many courses can include automated assignments that allows students to build their knowledge without consuming teaching resources. Although the initial focus is on programming assignments, it is possible to extend the infrastructure to support other types of assignments in other departments.

*In what other ways is this project significant?*

The project fills an important need of instructors who require efficient methods for defining and evaluating assignments. There have been requests from several instructors at other universities for the system. By developing a general system, wide-scale deployment by instructors across campus and in other universities is possible. There are no similar tools anywhere because the idea of competitive programming is new, so the potential for a large, national impact is high.

The majority of the cost is for supporting an undergraduate student to work on the project during Spring and Summer 2004. The undergraduate will be paid $15/hour for 20 hours a week for 17 weeks. An undergraduate student has already been chosen who has previously worked with the PI on another project. This undergraduate also had the best project in the prototype testing during the CS III course and has expressed a keen interest of improving the competition system. $1,900 is for approximately one week support for the PI who will design the system and supervise the undergraduate student during its construction. The undergraduate will work during Summer 2004 to make the system ready for general deployment to other universities and colleges. The PI will supply all hardware and software needed for the project.
Rough estimate of costs

- $5,100 - 1 undergraduate student for Spring semester and 4 weeks during Summer 2004
- $1,900 - approximately 1 week salary support for PI

$7,000

Summary

Programming instructors require interesting assignments that students want to complete and that can be easily deployed and graded. This project will build a web-based system for supporting competitive programming assignments and evaluate its effectiveness on instruction. Competitive programming assignments increase student motivation, interest, and programming practice. The web-based system will contain a facility for automatic assignment marking that reduces the cost in deploying programming projects in courses with large enrollments.

References