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CPATH | CISE Pathways to Revitalized Undergraduate Computing Education

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Campus Wide Computation Initiative -
A New Model for Computing Education

The goal of this project is to develop a model for a campus wide computation initiative that will transform undergraduate computing education in the institution and academic environment. The activities that make up this model will engage in computation students and faculty who are outside the typical computing community.

The transformation is achieved through the involvement of (1) faculty leaders inside the computing community in teaching and research collaborations with faculty and students from outside the computing community, and (2) faculty and industrial partners who develop programs that highlight the increasingly important role of computation in their respective industries.

The integration of technology into secondary mathematics often begins and ends with the graphing calculator. This is problematic on a number of levels from eroding arithmetic skills to education lobbying by hardware manufacturers, but most deleterious is that the calculator functions (often literally) as a "black box" which produces answers to problems while hiding the process. The aim of my RET project is to keep the benefit of advanced computational and visualization tools but mitigate the "black box" effect by giving them a role in the creation of such tools.

The idea is to integrate a mathematics software environment into the curriculum in the hopes that once commonalities among several problems are recognized, students can be assigned to write functions or subroutines that scale the techniques to handle more complex problems.

Benefits include the functionality of said routines but more importantly require that one really understands how the mathematics is applied at all levels, which is to say, the mathematics itself. Furthermore, students are forced to think about their own processes and realize that they engage in computational thinking all the time but they may not always recognize it.

Successes

The greatest successes came from students and usually accompanied a cry of "That's so cool!" Many students in my Introduction to Statistics course utilized Sage in their final projects, though did not go far beyond computing CDF (cumulative distribution function) values not covered in tables at the back of their textbook. A few really ran with it, however, as did one pair who ran multiple simulations to compare computer and human performance as random number generators.

Challenges

Challenges are myriad, however. The downside of open software, particularly when developed by mathematicians, is terse documentation (when there is any documentation at all). With very few resources at our disposal (the computer lab is but a hodgepodge of spare parts) and little chance of booming budgets on the horizon, access is the chief difficulty. A significant percentage of students have no Internet access at home and many who do lack the savvy necessary to install a major software package. Many interact using the demonstration site http://sagenb.org/ well maintained by the development team, but easily overtaxed.

Reflection

Overall, the RET experience has led me to think in new ways about how students learn if for no other reason than it has forced me to examine my own learning in an area I am far from expert. Though much can be improved in its implementation, as the program matures, I anticipate our students will have another rich area to approach mathematics. That and my engineering colleagues should laugh less at my coding skills.