Course proposal: Introduction to Computer Simulation and Visualization
Academic level: Freshman/Sophomore
Target market:

Art, Theatre, other non-science students needing science credits
Science students interested in simulation and visualization
Advanced High School students
High School teachers interested in teaching computer simulation

Special:
There are some number (dozens, or more) of SOU students who take time off from full time enrollment. The possibility of taking Extended Campus classes for credit may be cheaper for these students than regular SOU classes. I think there is a market in science distribution fulfillment for these students who work locally while trying to figure out their lives and academic goals.

I am working on an idea with Medford School District about developing curricula based on computer simulation. This is a very important topic area in the 21st century, both for professional practitioners and well informed general public. It is more likely that the School District can get grants to support such teacher training if the training classes are offered for academic credit.

These markets would ***not*** be addressed by Community Education non credit classes, nor by regular SOU classes. These teachers and time-off students would probably not take either non credit Community Education classes, nor full price regular SOU classes.

Course content:
Computer Science, and especially Information Science, is far more than just programming. Just as there are things one can do by writing code that can't be easily done by other means, so there are many useful tasks which are better approached using high level tools than by low level coding. Obvious examples are using PERL, MATLAB or other high level scripting languages to implement capabilities which would be prohibitively difficult tasks if written in Java, C etc. Pete Nordquist's use of lex and yacc for compilers is another good example.

NetLogo is a simulation development and execution environment available as freeware from Northwestern University. Written in Java, it runs well on most modern computer systems. The programming environment is based on Logo, and quite easy to use. GUI building features are integrated into NetLogo. These are quick and reliable high level tools. A simulation application can be developed and coded in very short time by an experienced user. Learning the system is straightforward -- there are good tutorials and literally hundreds of working simulations included in the distribution.

Students will work in two basic areas. First, to introduce the concepts and practice of system simulation, they will study the behavior of several systems which are familiar from daily life such as water waves and traffic dynamics. Lab tasks will include exercising the simulations by keeping a logbook in which students record the system parameters and behavior under many different conditions. Students will write brief clear reports about their lab activities.

Second, students will make simple but meaningful changes to the GUI and the simulation code. For example, a wave system may be driven by a sine wave driver action. An assignment to change the driver waveforms to linear, $\sin^2(x)$, $\sin(x^2)$ etc. would allow the student to make code and GUI changes to add such functionality, and show them that substantial results can be accomplished quickly and easily using high level code and tools.

The lab work is a major part of the class. The process of scientific investigation by empirical study will be learned, as well as some writing skills used to describe the observed results. These are not

difficult tasks, and the emphasis is on learning the process of experimental investigation, clearly communicating the observed results in brief succinct form, and devising explanations (theories) for the different types of behaviors of the system. Class discussions will help guide students in this learning and communication process.

Written and verbal communication is a very important part of this class, and students will work in flexible groups to help this process. Students will co-develop their reports in their group, and read the reports from other groups. The purpose is not to "grade" the reports per se, but to let students learn from each other's efforts what type of language communicates clearly and what doesn't. Emphasis is on short exercises, and many of them. Students will give brief evaluations of others in their group to help identify both exceptional students and those who need extra help.

MATLAB will be used to help students understand whatever math is involved in the simulations. MATLAB is available in PCE and PCW, and can be installed on any computer on campus which can connect to the license server. It is a high level, easy to use math prototyping environment. Students hopefully will find that basic math functions like trigonometry can be understood by graphing these functions, which is typically takes about three lines of MATLAB code. Students will be introduced to 3D graphics in the same way. The purpose is not to do difficult math, but rather to see what these math objects look like and study how they behave by using very high level code.

Cost to students for required books about NetLogo is zero. MATLAB documentation is also included in the distribution, so again, no required cost to students. A lab notebook should be purchased for the class. Most students will want to use a blank CD or USB stick to keep an archive of their work. Total cost to student should be no more than a few dollars.

Storage requirements on SOU servers for student accounts will be no more than 5 MB for NetLogo and MATLAB script files. Images or quicktime movies of simulations would take more space, but students could be required to put such data immediately on their CD or USB stick. The NetLogo installation is about 40 MB