Video Resources for the Lower Division Computer Science Curriculum

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This I3 proposal requests support for pilot work for a proposed NSF CCLI project. Here is the project summary from that proposal (submitted May, 2009):

This project aims to improve the effectiveness of Computer Science pedagogy by developing, evaluating, and sharing the practice of providing short video modules that students can view before class and review after class. This two-year study will develop and evaluate materials for four lower division courses, and assess the costs of creating and using these materials. In the longer term, the project aims to extend this approach to the remaining curriculum, while at the same time providing a model for creating and sharing such materials that can be widely adopted elsewhere.

The project will also examine the feasibility of making a sample of the created materials more useful for students with disabilities, by providing captions for deaf students and audio descriptions for blind students. These findings can help provide the basis for making the Computer Science curriculum more accessible to these students.

The developed and evaluated process for creating modules will aim for very low cost, by using undergraduate students to produce the videos, and freely available infrastructure such as YouTube to deploy the videos. The process will encourage the student producers to exercise their creativity in developing the modules, and will provide recognition to those students whose efforts are most appreciated by their peers.

The effectiveness of the development process, and the value of the modules, as well as of the pedagogical improvements that the modules will enable, will be assessed using a range of methods, including observation of the number of modules produced, the costs of production in effort and time, historical comparisons of student performance in courses, and survey, interview, and self-assessment techniques.

Intellectual Merit

The project will produce new knowledge about active learning pedagogy in Computer Science, building on the growing literature in that area. It will also produce new insights into how “Web 2.0” technology exemplified by YouTube, that facilitates user-created content, can be harnessed to serve important educational goals.

Broader Impact

The results of this project will have direct impact on the undergraduate students in the four courses that will be supported, and on the students who will create the video modules. Because the work will be freely available to the public, students anywhere can
use the modules, and the modules can inspire other faculty (and students) to create and share materials of their own design. The data obtained on the cost of making these materials more accessible to students with disabilities will shape future work in this important area. (End of project summary.)

The proposed project has a start date of 1Q 2010; the pilot work is planned for summer and fall, 2009. The aim of the pilot work is to create a sample of video modules for use in CSCI1300 Computer Science I: Programming, and other courses offered by the participating faculty. We do not plan to include accessibility enhancement in this early pilot work.

In the pilot we will try out a simple production process, involving screen capture from a computer, on which a demo is being done, or example code is being shown, with voice over. Here are example modules for the 1300 course:

*Virtual machine software installation.* To ease platform problems for our students, we are introducing a virtual machine approach, using VMWare. But students will need to install this software on their own machines, and installation procedures will differ. We will use video modules to provide platform specific guidance. Other tool related topics include installing Python, installing the Code::Blocks IDE, and using Code::Blocks, including the vexed question of where in the project directory structure to place data files.

*Using a machine emulator.* We use an online emulator for a machine with a very small instruction set as a way of introducing machine concepts. We will prepare a video showing how to enter and run a program in absolute machine language on the emulator.

*Pitfalls in list copying.* List assignment in Python can be confusing, because of the mechanics of copying. A short video can explain the situation in a form that students can review as often as they need to.

*Performance comparison.* A short demo can dramatically highlight the performance difference between Python and C solutions to the same problem.

Using modules like these, we hope for the following gains:

*Time that would have been spent in lecture conveying material like this can now be used for more effective, interactive learning activities, including clicker concept questions;

*These materials will be available to students for review at any time;

*With these topics moved out of class time, students who need to cover these topics can work on them as much as they wish, without taking class time for students who find the material easy. This is a major challenge in the lower division Computer Science curriculum, because of the huge spread in student background on entry to the program.
Evaluation

In the pilot project our emphasis will be on assessing the ease of the production process, preparing for evaluation of the modules themselves in the main project. Modules will be deployed on YouTube, and we will be able to track how often they are downloaded, giving us some indication of how useful students find them. We will also ask students to rate the value of the modules, and invite them to comment on strengths and weaknesses.

Staffing and facilities.

We will employ an undergraduate student to work with faculty on design and production of a set of modules. We have existing equipment and software adequate for the task, and funds with which to buy a camera for auxiliary footage, and a microphone.

Profs. Clayton Lewis, Dirk Grunwald, and Ken Anderson will supervise the student, and use the modules in their classes in fall, 2009.

Impact on development of faculty, STEM education, and the CU community.

Prof. Lewis agrees to participate in CU’s STEM community meetings, and to present results of the work at the annual symposium. Our experience should lead to publishable results for the Computer Science education community. We also believe short video modules have potential value in many fields outside Computer Science, offering the benefits cited above. While there may be less use of screen capture as a specific technique in other fields, our production process should be easy to adapt to the use of a tablet computer with voice over for more traditional lecture material, as well as conventional recording of standup lecturing if desired.

We also believe we have much to gain from interaction with colleagues in other fields who have more experience with the interactive learning activities we intend to expand in our courses.

Deployment of these materials on YouTube offers important benefits to CU as a whole. YouTube is very visible, and many universities are making heavy use of it to attract interest (and to provide content of public interest). For example, Berkeley has 403 videos posted, and MIT has 932. At this writing CU has 13.