

## Enriching Computer Science Faculty Careers With a Workshop on CS2

We propose to hold a workshop on CS2 at Denison University in the summer of 2008.

### **Background**

On June 14 and 15, 2007, Denison University served as host for a workshop on the beginning programming course, CS1, for computer science. The workshop was open to colleges in our Mellon POD and to the GLCA colleges. Eighteen faculty members attended and turned in highly positive comments on our evaluation forms. Without exception, the attendees expressed their opinion that the workshop was beneficial to their career.

At the end of the workshop we asked both those who attended and other POD and GLCA members whether they would be interested in doing a follow up workshop on CS2. The response was a positive one.

Based on this background information and the importance of helping CS faculty members provide challenging, up to date, and meaningful experiences in their early CS courses, we propose to hold a workshop on CS2 during the summer of 2008.

### **Rationale**

CS1 and CS2 refer to the beginning courses in Computer Science in the ACM (Association of Computing Machines, the professional organization for computer scientists) curriculum guidelines. Since Computer Science has been taught for almost three decades, one might think that the material needed for these beginning courses would be well established.

However, nothing could be farther from reality. Since the 1970's, when liberal arts colleges first began granting degrees in Computer Science, an enormous number of changes have taken place in the field. Those changes affect not only professionals practicing the discipline, but academics in the field, as well, especially those who teach introductory courses. For example, programming languages used in the introductory courses have changed many times during the past two decades, and with each change come differences in syntax and semantics. More importantly, changes have also occurred in the paradigms used for designing and implementing software. Since at liberal arts colleges almost all faculty teach CS1 and CS2, and do so regularly, these curricular issues have a direct impact on the careers of CS faculty.

Current faculty find that they cannot teach their beginning students the same languages and paradigms that they themselves learned as beginners in the field. Moreover, deciding what they do need to teach is not at all obvious. Faculty at all levels, those just beginning in the academic world, those at mid-career, and those who have been teaching for many years are challenged every time they need to or choose to teach introductory Computer

Science. They face daunting and often conflicting advice about what should be taught and how it should be taught.

For these reasons, it is not just a matter of faculty finding time to read current literature, but rather a matter of finding the opportunity to discuss various approaches to CS1 and CS2 with other faculty in similar kinds of institutions in order to enhance the capabilities of faculty to teach these courses effectively.

Every year CS departments are faced with addressing the following issues when they plan their first year courses, some issues being unique to liberal arts schools and their goals:

1. What are the goals we want to achieve with our students?
2. Can we serve both majors and non-majors in the same course?
3. When and to what extent should we introduce objects, which are used to model elements of the real world?
4. What application areas can we use that both enable students to achieve the goals that have been set and at the same time are interesting and up to date? For example, there has been a great deal of interest recently in digital media manipulation for demonstrating programming techniques.
5. If we use Java, the current most popular language for beginning students, in CS1, should we continue with it in CS2 or should students be introduced to another programming language.
6. What IDE's (Integrated Development Environment) are supportive, simple (easy to use), and available to students on whatever platform they might have?
7. How much mathematics do students need before entering the course and how much should be introduced in the course?
8. Some institutions put discrete mathematics directly into their CS2 course. Others require a course in discrete math as a co-requisite to CS2. Still others allow their students to take discrete math during any semester of their college career. What are the arguments for each approach?

In fact, these issues have become topics of pedagogical research in the field. Each year the professional organization that addresses CS education (SIGCSE – Special Interest Group Computer Science Education) holds a conference at which faculty share research results, much of which continues to involve CS1 and CS2. Faculty who carry out and share research in the area of introductory computer science acquire visibility in the broad CS community and perform an important service to that community. A workshop at which our POD members can share their own experiences and concerns can help faculty choose individual or collaborative research projects to enrich their own research agendas.

We note that faculty at every stage of their career find the teaching of CS1 and CS2 a challenge. One faculty member in our Mellon POD recently remarked that he needed to teach introductory CS for the first time in 20 years, and he found the challenge both intriguing and daunting even with his vast experience.

In the liberal arts environment, non-majors may be included and encouraged to take CS1, often satisfying a general education requirement. In this case, the difficulty is amplified as the faculty member seeks a balance in designing a course which is challenging, is interesting, and has material that is appropriate for the non-major while still achieving the goals for the major. Failing to achieve this balance may result in frustrated students (and poor course evaluations) on one hand, or a course that fails to prepare the majors for CS2 on the other.

Most faculty also find that the languages and paradigms they learned as students have now been superseded by more recent CS innovations. Moreover, many textbooks, while accurate with regard to syntax and semantics, simply provide material in such a way that it leaves a plethora of choices concerning which ideas should be emphasized and which can be omitted. Unless the professor has a strong grounding in what the goals of CS2 should be, these choices are not easy to make. Additionally, these large texts can be daunting to the CS2 students, sometimes diffusing their focus from the fundamental concepts by so much peripheral material.

Those who attend the workshop will have the opportunity to learn from each other what approaches to CS2 have worked and which ones have not. They will become more adept at designing and planning CS2 curriculum and will be able to share their ideas both with other faculty at their own institutions and in the broader community, thereby acquiring credentials for serving as a consultant in this area and the ability to become an even better teacher than they were.

### **Expert Input**

Henry Walker, who has been a leader in SIGCSE and in the AP testing for highschool students, will be our keynote speaker. His many years of experience with curriculum issues in CS make him an ideal choice to lead discussions about our beginning courses.

### **Scheduling**

The workshop will be held on June 16 and 17, 2008. On the first day of the workshop, each participant will tell how CS2 is handled in his/her department and will raise questions that their department is struggling with. The group will discuss pros and cons of each approach and share ideas about how one might address the questions that have been raised.

On the second day, those who have developed special supporting materials for their CS2 classes will present those materials which will serve three purposes:

1. Others may find materials that will be just what they have been looking for to effectively integrate into their own CS2 course.
2. Some may have used similar ideas and can share their experience, both good and not so good, with regard to the approaches presented, thereby alerting possible users of problems that might arise when using the materials.
3. Some may discover topics they wish to address with pedagogical research methods so that they can share conclusions with the wider community.

**Anticipated Outcomes of the Workshop**

Computer Science faculty will have the opportunity to enhance their teaching careers by acquainting themselves with ideas both in CS2 education and pedagogical research. Our discussions will not only identify important questions in CS2 education, but will provide a context in which interested faculty may participate, adding a new area of research to their existing repertoire. They will have a chance to develop and/or access some course materials and get hands on experience with appropriate tools. We will set up a website for the sharing of materials in the future among the participants, and, of course, they will in turn share those materials with others in the field and with their students.

Success of the workshop will result in better teachers who are more effectively addressing the needs and the liberal arts goals of their students and their institutions, and who will be doing so in interesting ways. This applies to computer science majors and non-majors alike, thus serving the broader academic community. The implication for the faculty member's career is improved assessment and evaluation for the CS2 classes.

Participant lists with email addresses will be made available so participants can keep in touch with their new network of associates in the field.

Those who find research topics here may work with other members of the POD to investigate those topics and eventually share results with SIGCSE or other professional organizations interested in Computer Science education.

In summary, the CS2 Workshop will enhance the careers of faculty who attend by making them more capable and confident teachers of CS2 and opening a new area of research for them to pursue. They, in turn, will share their newly developed ideas with others in their own departments and in the wider community, thereby making it possible for colleagues to enrich their careers as well.