

Introduction

The UNL Computer Science and Engineering Department has been revising its introductory courses. The changes include a new course for prospective majors and non-majors that covers the breadth of computer science, higher standards for enrolling in the traditional introductory courses, and an earlier emphasis on discrete structures.

Computer Science Fundamentals

Computer science education continues to evolve rapidly. High schools are increasingly promoting computer awareness and use by their students. This generally involves training in word processing, windows use, web page formatting with HTML and other equipment/software use. Occasionally there are programming courses in Basic, Pascal, and most recently, in C++ in anticipation of changing AP-course tests next year. All this is supposed to make the students *computer literate*. However, in most cases the students become *PC literate* rather than *computer literate*, and much less *computer science literate* than would be preferred.

As a result the students who enter the University have a wide variety of experiences and expectations. Few are ready for the traditional introductory course in computer science that has as its primary focus the use of C++ for developing algorithms and data structures. Unfortunately, C++ is not a friendly language for beginners. Additionally, this introductory course presents only a narrow “programming-is-everything” view of the entire computer science discipline which perpetuates this common misperception for both majors and non-majors.

The development of *Computer Science Fundamentals* is UNL’s response to the problems discussed above. The major goals of this course are to teach computer science as a “science” discipline and to present the breadth of computer science. For the prospective major this course offers the opportunity to explore the field. For the computer science and engineering majors this course offers an alternative starting point with a broader perspective of the field. For the non-majors this course offers expanded horizons in their general studies with the added bonus of an approved general studies science lab.

Discrete Structures

A pronounced lack of discrete mathematics skills in first year students has induced the Computer Science Department to redesign and reposition its own Discrete Structures course. While many entering students have been exposed to calculus

and most are well prepared for Calculus and Analytic Geometry I, these same students are not prepared for the mathematics more often encountered in early computer science courses. This provided an impetus to explore solutions at the high school level.

A workshop was held in the summer of 1999 that included myself as the chief undergraduate advisor for the Computer Science Department, and teachers representing a variety of high schools and approaches to teaching computer science. The department gained a better understanding of the situation for computer science in the high schools, and the teachers were exposed to the teaching methods and materials being used at UNL. As a result, their high schools are now benefitting from their insights.

An impression reinforced with that workshop is that most schools have little flexibility to create new courses or make radical changes in their programs. Teachers with existing programs were quite enthusiastic about instituting new modules and especially the new direction. However, there was more widespread interest in new ideas for the mathematics program. This led us to look more closely at possibilities for teaching the discrete mathematics at the high school level.

Here are a few excerpts of the participant evaluations that inspired us with this proposal:

I was surprised at the amount of theory and depth of mathematics that is involved with computer science. I appreciate the theory involved that might help to adapt to the rapidly changing applications.

I will definitely try to incorporate some of the topics in my advanced computer classes. I also hope to make our math department aware of some of the math topics used.

It is important for me to know that these math topics are so important in computer science. I will try to incorporate more of this math in my curriculum. It also is important to be able to relay the importance of these topics to our math department.

I have come to see that many other topics are as important in providing a foundation for students to build as a computer language.

Reinforcing our interest in early exposure to discrete mathematics is a recent report to the CUPM Curriculum Foundations Workshop in Physics and Computer Science at Bowdoin College last October. Their thesis is this:

Our general conclusion is that undergraduate computer science majors need to acquire mathematical maturity and skills, especially in discrete

mathematics, early in their college education. The following topics are likely to be used in the first three courses for CS majors: logical reasoning, functions, relations, sets, mathematical induction, combinatorics, finite probability, asymptotic notation, recurrence/difference equations, graphs, trees, and number systems. Ultimately, calculus, linear algebra, and statistics topics are also needed, but none earlier than discrete mathematics. Thus, such a discrete mathematics course should be offered in the first semester and the prerequisite expectations and conceptual level should be the same as for the Calculus I course offered to mathematics and science majors.

While the discussion at Bowdoin College focused on discrete mathematics at the early college level, we see an opportunity to expand its presentation at the high school level. This appears to provide the best avenue of introducing computer science related coursework to the maximum number of high schools with the least effort.

Current Position

The *Computer Science Fundamentals* course is becoming well established at UNL. The traditional introductory courses have not yet changed much. There is anticipation of moving to Java from C++ in the coming year. *Computer Organization* is benefitting some from the fundamentals course. *Discrete Structures* has been moved to the first year and efforts will soon be made to emphasize the tie between the topics to other areas of computer science. A workshop for high school teachers is scheduled for this summer with the title *Mathematical Foundations for Computer Science in the High School*.

UNL has made strides in its first year computer science courses, but there is much yet to be done. It is in this context that the FYI workshop is so inviting.