Structured Programming Courses
in Engineering - Present and Future Trends

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Abstract

Until recently almost all engineering curricula around the country required students to take one or more courses in structured programming. In order to keep up with the contemporary demands in the workplace, a need to use new educational approaches in teaching engineering courses has become essential. In recent years, due to the explosive market of high quality, user friendly, versatile and application-specific software, many programs are in the process of redesigning their requirements within ABET guidelines with regard to programming language and additional applications of specialized problem solving software in individual courses. In this paper, the authors present a study of current requirements and upcoming changes. The issues which prompted the project include inadequate application of traditional computer programming in courses, lack of student interest towards these programming courses, and a difference in attitude of engineering faculty from different degree granting programs. A survey of undergraduate engineering programs around the country is being conducted in order to understand current practices and reflection of future trends. The paper presents the methodology of survey, the profile of the respondents, faculty involvement, and factors influencing their choices of language.

Introduction

Computer experience is a vital element of today’s engineering education. Engineering programs throughout the country are trying to keep pace with and stay on top of the constantly changing, upgrading and vastly improving market of computers and software. An important step in implementing, evaluating, or revising any computer ‘training’ in an undergraduate engineering program requires identification of actual customers of the program. Most commonly these customers maybe - students, companies which might hire them, and graduate schools where they may go for further education. Any revision however, must follow the very specific guidelines outlined by the Accreditation Board for Engineering and Technology (ABET). ABET has specific structured programming requirements for different engineering disciplines. This study will reflect how several engineering schools that used to have a common programming language requirement for all engineering freshmen are gradually moving towards change. Some are offering different languages to students in different programs, while others are dropping structured programming altogether and trying to make room for more software exposure without increasing the already hefty total credit hours required for graduation. In addition to considering input from the engineering faculty at our home institutions, information was sought from over one hundred ABET accredited engineering programs in the United States, about how structured programming is being handled in their respective programs. This paper describes the findings of the survey to date.
Methodology

Questionnaires with a cover letter were sent out in self-addressed stamped envelopes to the head of engineering at 110 different institutions. Only ABET-accredited programs were chosen. The ASEE directory of engineering programs was consulted for this purpose. We tried to cover all geographic regions within the United States when selecting the institutions. It would be more accurate to say that we chose the 110 out of relatively smaller engineering programs where fewer major areas were offered or focused on. Some of these institutions offered both graduate (M.S./Ph.D.) and undergraduate programs while others were only undergraduate institutions. Both private and public institutions were among the respondents. Since our focus was on structured programming in undergraduate programs, we requested information about the respondents’ undergraduate programs only. In the questionnaire, the respondents were required to identify which areas of undergraduate engineering programs were being offered within their institution. Information was gathered on whether all engineering students were required to take at least one structured programming course, which language was currently being taught, which engineering majors were excluded from the structured programming requirement, if any, what kind of software were being used as problem-solving tools and anticipated changes which may be coming up. Several of the respondents included additional comments which were informative and some of these comments are presented in this paper.

Results

Of the 110 questionnaires sent out, so far 73 responses (66.4%) were received. FORTRAN still appears to be the most popular programming language in engineering with 60.3% of the responding institutions teaching it in some branch of engineering. C is a close second to FORTRAN being taught at 54.8% of the responding institutions. 35.6% responded that C++ was the language of their choice and Pascal and BASIC were requirements at 15.1% and 9.6% respectively. 4.1% reported that there was no structured programming currently required in any of their engineering programs. 13.7% of the responding institutions said that it was required for certain areas only. At the Rochester Institute of Technology, the Mechanical Engineering department dropped structured programming following a survey conducted a few years ago but C/C++ are still being taught to their Computer, Electrical, Industrial, Manufacturing and Microelectronic Engineering students. At the University of New Hampshire, Civil Engineering majors do not take any structured programming course but are required instead to take a computer applications course. Other majors there are currently looking into such a course. Currently C or C++ appears to be the most popular among Electrical or Computer Engineering programs although it is being taught to students in other areas as well. FORTRAN seems to be the language of choice for the majority of Mechanical, Civil, Chemical, Aeronautical and other programs and it is still the only programming language required for all engineering students at several institutions.

When asked to describe anticipated changes in the status of structured programming instruction within their engineering programs - an overwhelming majority seem to be leaning towards C or C++ in the future for all majors, although except Rose-Hulman Institute of Technology, none other were specific about the time when this change may come about. According to the Associate Dean of engineering at the University of Alabama in Huntsville, there is some sentiment to go to either C or C++ at his institution, except in Chemical. The reason he says, for the chemical engineers not wanting to change from FORTRAN is because so much of the software for design use FORTRAN in the CHEMSHARE library. There has however, been some discussion within their faculty that computer skills should be assumed adequate for a recent high school graduate. Those without adequate skills would take a remedial course in a manner analogous to precalculus which does not count toward graduation in engineering.
At the University of Wisconsin-Platteville, FORTRAN is currently required for all engineering majors. In addition, Civil Engineering majors do some BASIC programming as part of a computer applications course taught within the department. Until the fall semester of 1994, FORTRAN was taught as part of (2/3, to be exact) a three credit course entitled Engineering Methods taught by the General Engineering faculty. Since fall 1994, that course has been split into a two credit FORTRAN programming course and the remaining topics were revised and included with others into a one credit Introduction to Engineering course. There is however, more change on the way on our campus. The engineering faculty voted to drop FORTRAN altogether. Starting spring 1996, FORTRAN will no longer be offered to our engineering students. EE and IE students will take C++ and will be taught by the Computer Science faculty.

Conclusion

Are we at the threshold of a change in the role of structured programming in engineering education? Are we ready to do away with structured programming altogether and replace this experience with more software exposure? Apparently, this debate will continue for several more years to come. This will be obvious from the two following comments we received along with our survey. From Clarkson University in Potsdam, New York, we received this comment: “We just finished our second year teaching Maple and Quattro Pro to freshmen rather than FORTRAN. It is a big success! We consider equation solvers like Maple to be higher level programming languages than FORTRAN. And students are much more likely to be able to solve realistic problems, so computer usage is growing throughout the curricula”. On the other hand, Professor Bob Hopkins of Cooper Union writes “We feel that while most graduates will not become programmers, the discipline gained from the learning of a language is helpful in the engineering problem-solving process.” Engineering educators in the United States have been at the forefront of the development and application of theories to improve and maintain quality engineering education. To remain current, computer skills is just one component of the undergraduate engineering curriculum that needs to be critically evaluated on a continual basis.

References

Biography

ABULKHAIR MASOOM is an Associate Professor in the College of Engineering, Mathematics and Science at the University of Wisconsin-Platteville. He graduated from Bangladesh University of Engineering & Technology with a B.Sc. in Mechanical Engineering in 1977. He completed his Masters in Engineering in Mechanical and Aeronautical Engineering at Carleton University, Canada (1980), and M.S. (1982), Ph.D. (1987) in Engineering Mechanics at the University of Wisconsin. His research interests are in the areas of Applied Mechanics and Mechanical Design.
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