Core Computing: a Foundation for Information Technology

LSU Department of Computer Science

The recent revolution in information technology, the rapid growth of the Internet/World Wide Web and the proliferation of personal computing, has been brought about largely by the efforts of computer scientists. Few would argue that computer science will not continue to play a central role in the information technology revolution. The Governor's Information Technology Initiative has the goal of rapidly bringing the State of Louisiana to the front of information technology education and research. Since computer science is at the center of information technology, we feel that any effort to strengthen LSU in this area should have as its centerpiece an effort to strengthen computer science. In this proposal, we outline why and how this should be accomplished.

The Governor's plan calls for LSU to emphasize the following five areas: biological computing, material science, wireless technologies, virtual organization and commerce and geoinformatics. All of these areas are interdisciplinary in nature, each having some component that could be considered computer science. While these are all emerging disciplines that are sure to be of importance in the coming years, and while LSU should certainly make all efforts to push into these interdisciplinary areas, one immediately notices that core computer science is absent. These interdisciplinary areas all depend strongly on computer science, and thus we feel that any effort to expand into these areas will be hindered, if not doomed to failure, if LSU does not have a strong base in core computer science. As enticing as hot new areas may be, we feel that LSU should also be mindful of the basics, the areas which brought about the current revolution in the first place.

The LSU Department of Computer Science currently has 11 full-time tenured or tenure track faculty and 5 joint faculty. This makes the department among the smallest at a major research university. Most departments that we are aware of have a computer science faculty of 20 or more. The small size of the Department of Computer Science is detrimental to the university in several ways. First, the department has an undergraduate student body size comparable with that of departments with a larger faculty. The result is that the department is forced to hire a large number of instructors to teach undergraduate courses. The quality of education that LSU's undergraduate computer science majors receive would be greatly enhanced if the tenured/tenure-track faculty were larger. Second, the department's small

size makes it difficult to attract graduate students, who are the lifeblood of any research university. The faculty's small size impedes the department's ability to offer specialized graduate courses, and to offer a range of educational opportunities to attract graduate students. Third, the small size of the computer science faculty means that faculty in other departments have less opportunity to collaborate with computer scientists. While it is certainly possible to collaborate with faculty at other universities, the overhead of such a collaboration can often be prohibitive. It would be preferable to have the required expertise in house—the strengthening of computer science should naturally lead to the strengthening of interdisciplinary ties within the university. Fourth, the small size of the computer science department means that LSU receives less recognition within the computer science community. This makes it more difficult for the department to recruit graduate students and faculty.

We now identify several core areas of computer science which we hope to strengthen. The enhancement of these areas will lay a strong foundation on which other interdisciplinary areas can build. Without this firm foundation, any information technology effort will be severely weakened.

Algorithms & Data Structures An algorithm is a well specified finite procedure for computing some desired result or value. The design of efficient (in terms of time or space) algorithms is critical to making information technology practical. The organization of information in data structures is often critical to the design of efficient algorithms. The emphasis in this area is on the mathematical analysis of theoretical models of computation, primarily when the theoretical analysis gives some insight to observed behavior, or is able to predict behavior.

Systems The low level software and algorithms which run our computers are the subject of this area. The focus is on software that is tightly coupled with hardware (and thus there are close ties to computer engineering). Practical results are primarily sought through experimentation. High performance computing is only made possible through advances in both computer hardware design and systems software.

Networking & Communication This area focuses on the issues surrounding communication among parallel and distributed computers, as well as communication networks such as the Internet. The focus is on communication protocols and their associated algorithms, as well as network design. Research in this area has brought us the World Wide

Web, which in turn has changed the ways in which we live, work and do business.

Artificial Intelligence This area focuses on the problem of getting computers to behave in a more human fashion, and on the solution of difficult problems using heuristic (approximate) algorithms. We are advancing towards computers that can interpret English language commands, recognize people by their appearance, and understand spoken commands. Artificial intelligence has brought these advances about.

Software Engineering This area deals with the creation of large software systems. The emphasis is on issues related to the creation of very large and yet reliable programs, such as the management of programmers, software testing and software safety. In the information age, we rely on computer programs which are increasingly becoming more complex. The failure of such programs can lead to disastrous consequences. Thus software engineering is essential to the continuance of the information technology revolution.

Database & Information Retrieval One result of the information technology revolution is that we are faced with the daunting task of organizing huge quantities of data. The amount of information available online is growing at an enormous rate. Without some intelligent way to order and classify this data, it is totally useless. These areas look at the problems involved in organizing very large data depositories. This sort of organization, for instance, makes possible quick World Wide Web searches.

The above ordering of areas should not be construed to imply an ordering of area importance. LSU should hire new faculty members in each of the above areas, with multiple hirings being preferable.

We realize that this proposal is somewhat out of scope given the interdisciplinary emphasis in the call for proposals. However, we sincerely feel that this interdisciplinary effort needs to be complimented by a strengthening of the basics, without which we would not have gotten to this point in the first place. Information technology is the outgrowth of computer science, and if LSU fails to build its program in computer science, information technology education and research at LSU will suffer.