Introduction to Interdisciplinary Computer Science

by *Michael A. Grasso* and *Mark R. Nelson*

Outgrowths from computer science have been applied to new areas of research in many disciplines. Through this evolution, the application of computers has transformed many aspects of our society. This issue of *Crossroads* explores the field of interdisciplinary computer science. The goal is not to look at computer science from traditional perspectives, but to illustrate the benefits and issues that arise from the application of computer science within other disciplines.

Nearly every industry has been enhanced by the application of computer science [2, 3]. Airlines manage travel planning with computerized reservation systems. Banks rely on electronic fund transfer systems. Applications of computer science make it possible for marketers to segment and profile customers, and engage in customized selling. Using sophisticated artificial intelligence techniques, marketers can "mine" information about their customers from massive databases. In manufacturing, CAD systems assist in design, simulation systems are used for analysis, and production is enhanced by robotics and computer-aided manufacturing. Some other industrial applications of computers include transportation systems, communication networks, defense applications, and monitoring systems.

Like many industries, other sciences also benefit from developments in computer science. Computational scientists apply high performance computing and modern computational methods to fundamental problems throughout the sciences and engineering. Key applications include scientific data visualization, simulation, numerical analysis, and computational physics. Collaboratories, which facilitate computer-supported cooperative work, let scientists interact with colleagues and share resources without regard to geographical location.

The application of computer science to health care has also resulted in many advances. For example, decision support systems assist clinicians by suggesting diagnoses and making treatment recommendations. Imaging, patient monitoring, and life-support processes are controlled by computer-based instrumentation. Patient information, test results, and insurance reimbursements are now accessible through hospital information systems. Virtually all recent medical knowledge and literature have been put on-line through a family of approximately 40 databases at the National Library of Medicine (see http://www.nlm.nih.gov/nlmhome.html). Medical services can be delivered at a distance through telemedicine initiatives. As a result of these advances, modern medical centers are dependent on computer technology for the management of clinical data, processes, and knowledge [1].

The use of computers in almost every field and industry is expanding at a dizzying pace. Increasingly, computer scientists with interdisciplinary interests will be called upon to help other disciplines use technology more effectively to solve problems and address new challenges. With these examples and

comments in mind, the following five articles provide a quick glimpse into current interdisciplinary efforts.

In the first article, Jinsoo Park reports on the application of a geographic information system to help environmental scientists address ecological problems. The system uses an extended semantic model to capture spatial and temporal nature of geographic data as well as the dynamic behavior of spatial objects. Such tools can identify ecosystem process interactions over large geographic regions and help predict the consequences of natural resource management decisions.

Next, Vineet Kapur details the development of a sustainable fishing simulation system over the World-Wide Web. This simulation models the interdependencies between fishing strategies, population growth, economics, and political corruption. The system can be used to teach students about ecology and explore our abilities to maintain and enhance an ecosystem.

Wayne Smith talks about how computational science has contributed to mapping the human genome, the complete collection of genes that make up human DNA. Computers are needed not only during data acquisition, but also for data analysis and for the management and distribution of unprecedented quantities of biological information. With this information, researchers expect to learn the underlying causes of genetic diseases and help unlock the secrets of life's processes.

Neal Shaw's paper describes how companies are conducting business in the information age. Electronic commerce has the potential to lower the cost of business and increase consumer options. A comprehensive framework for an electronic commerce architecture is given. This is followed by a review of barriers to widespread acceptance such as security, standards, and infrastructure.

Finally, Susan Yager describes how companies are applying computers and other forms of information technology to communicate more efficiently and provide virtual workplaces for their employees. The application of technology derived from advances in computer science allows companies to create more flexible structures, where experienced employees and critical information can be available wherever they are needed. An overview of organizational structure, current research, and managerial challenges is given.

The application of computer science to these and other disciplines has helped humankind cure diseases, explore our solar system, predict weather patterns, improve productivity, overcome communication barriers, and work in virtual worlds. As computers and information technology become more pervasive, the role of applied computer scientists will become increasingly important. We hope these articles provide an interesting cross-section of interdisciplinary computer science and challenge some to continue this important research.

References

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