

Strategic Visioning for Computing and Information Technology at Michigan State University

Advancing Knowledge. Transforming Lives.

The Information Age and Michigan State University

Computing and information technology are revolutionizing all aspects of our world at unprecedented rates. Digital devices are becoming arbitrarily small, extremely fast, virtually free, always interconnected, and hence ubiquitous. What was once intractable and unthinkable has become mundane and can be done in the palm of your hand.

The impact of the Information Age will be increasingly pervasive, profound, and persistent. It already affects every discipline including those in the humanities, social sciences, business, law, natural sciences, medicine, and engineering. Moreover, innovative interdisciplinary research based on information technology is creating new research disciplines and producing leapfrog advances in a variety of emerging new fields. The most profound impacts of computing and information technology, in fact, may lie outside of the traditional sciences and engineering. Its results will forever revolutionize the world in which we live and hence the academy in which we work.

The dawning of the Information Age presents strategic opportunities for the academy in general and for Michigan State University in particular. Every aspect of our three-fold mission of instruction, research, and service will be affected. Academic institutions that strategically leverage the opportunities will become world leaders and thrive. Those that do not will risk varying degrees of obsolescence and irrelevance.

The Need for a Broad Vision and Leadership

By pursuing a vision with respect to computing and information technology that is both broadly inclusive and cohesive, Michigan State University can capitalize on a rare opportunity for new levels of achievement in instruction, research, and service. The Department of Computer Science and Engineering is eager to work with other units on campus in formulating a plan for achieving a single, high-level unit whose academic charter and responsibility include computing and information technology across the University. There are many possible options for the organization and position of this unit. A well-conceived plan will focus our efforts, but will not trace a direct path to the goal; bends and turns will occur as it takes shape, influenced by emerging opportunities within the bounds of a broad academic charter and by those leaders within the University with the foresight to collaborate in developing a shared strategic vision and in bringing this vision to fruition.

An emerging national trend forecasts that Michigan State University will at some point form a unit centered on computing and information technology. If we establish one now, we will be among a small, elite group of peers who are already starting down this path. We can leverage leadership today as a strategic advantage for some time to come. If we take the position of a follower, we may miss the opportunity to establish a strong national identity in this area.

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The development of cohesive programs around such a broad theme as computing and information technology will require careful coordination and nurturing. It must engage diverse constituencies from across the University. A single academic unit that encompasses these programs would provide the infrastructure and oversight necessary to achieve a comprehensive and innovative set of programs. An incremental alternative—in which multiple units grow their own options and specializations in computing and information technology as the need arises—is ill advised. It inevitably produces myopic programs with mismatched interfaces, making them hard to identify and navigate.

A shared vision for computing and information technology will result in stronger and more efficient programs, including new and innovative research and curricular programs. Ultimately, it will result in entirely new disciplines and initiatives. Combined, these results will enable the University to attract faculty and students with interests in these evolving and emerging programs. We will be positioned to attract, cultivate, and promote researchers in a wide variety of areas. Drawing from diverse disciplines, we can expect that these new areas will appeal to a more gender-balanced and racially and ethnically diverse population than the well established, traditional areas of science and engineering. In short, we will have an academic “home” for excellent people who might not be able to find one at other institutions. Moreover, the University will be better able to compete for research dollars arising from emerging research funding programs.

Commitment of Computer Science and Engineering

As Michigan State University looks to the future, we must honor our heritage while embracing our future. We must not retreat from bold steps that are needed to assure a competitive edge for the entire University. However, bold steps require both commitment and leadership. Computer Science and Engineering (CSE) is committed to helping the University realize its potential in computing and information technology. Towards this end, we pledge:

- To provide leadership in casting and realizing a unified and holistic vision for information technology at Michigan State University.
- To create a new culture in which interdisciplinary programs and programs in emerging new disciplines will be nurtured and thrive.
- To develop flexible organizational and curricular structures that support the creation (and possible subsequent termination) of innovative research and instructional programs.

In the remainder of this document we discuss the paths taken by other universities, and how Michigan State University can leverage its current strengths and foster new collaborations in order to establish a unique identity in this area.

The Current National Trend

The first computer science departments were established in the early 1960's. During the subsequent forty years, a variety of computing-related departments, programs, curricula, and degrees have been developed at universities throughout the country. These endeavors have emerged in response to the needs of business, industry and other academic disciplines for computing.

Within recent years, it has become apparent that the discipline of computer science is expanding to encompass partnerships with many other disciplines. Several major universities have capitalized on this trend by establishing innovative academic units with missions centered on computing and information technology. Examples include the School of Computer Science at Carnegie Mellon University (1988) and the College of Computing at Georgia Tech (1990), both currently ranked in the top 10 in computer science. (It is worth noting that, as recently as 1993, Georgia was ranked 32nd.) In all, more than twenty-five such units exist in the United States, with more in planning stages.

As with many innovative endeavors, the composition and thrust areas of these programs vary from one institution to another. However, their missions in research and instruction are much broader than traditional computer science, drawing upon strength areas and collaborations across their respective institutions. Some involve an explicitly stated "theme" that provides them a unique national identity. For instance, since its inception, the College of Computing at Georgia Tech has emphasized a concentration in "human-centered computing," and Georgia Tech is now regarded as the premier institution for its research and educational programs in this area. Moreover, a key component of their stated mission is an "aggressive interdisciplinary orientation." This emphasis on collaboration manifests itself in several ways, including numerous joint degrees with other schools and colleges at the university, collaborative research efforts between the College of Computing and all of the colleges, and joint appointments with several other units. The result is a highly diverse, interdisciplinary faculty engaged in very strategic research, instruction, and service.

Computing and Information Technology Research at Michigan State University

The University has many existing strengths in computing and information technology, in a variety of departments, programs, and curricula across the campus. Research involving a significant computational component is found in a wide range of disciplines, from computational ecology, to physics, to computational linguistics, to medical information systems. In addition, the University has demonstrated a commitment to key research areas in information technology that require effective collaboration across disciplines. Examples of such catalyst initiatives at the University include the Supply Chain Security initiative spearheaded by the Colleges of Business and Social Science, the MATRIX Center based in the College of Arts and Letters, the MIND Laboratory in the College of Communication Arts and Sciences, and the MSU Cyber Security Initiative led by CSE. Existing instructional programs at the University also reflect the importance of computing and information technology. Besides CSE, examples include Accounting and Information Systems, Bioinformatics, Computational Chemistry, Computational Mathematics, Computational Statistics, Criminal Justice, Electrical and Computer

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Engineering, Geographic Information Systems, Marketing and Supply Chain Management; and Telecommunication, Information Studies and Media.

A unit dedicated to computing and information technology can be formed by reorganizing and re-engineering existing programs, while creating a new academic culture where existing disciplines will be strengthened, new ones will be established, and interdisciplinary collaboration will be nurtured. We can engage a broad community of scholars at the University in assessing the University's assets in computing and information and considering possible models for the new unit. It is important to focus not only on determining institutional needs, but also on identifying both strengths in core areas and opportunities for leveraging these strengths to grow in strategically chosen new directions. We should seize opportunities to develop important theme areas in which the University can achieve world prominence.

Providing Necessary Leadership

Given its strength in key areas and its commitment to interdisciplinary research, Computer Science and Engineering is positioned to provide leadership and to collaborate with colleagues in other departments and disciplines in making this vision of computing and information technology a reality. In the past 15 years, CSE has developed research groups with national visibility in software engineering and formal methods, intelligent systems and robotics, and distributed computing and networking. These and other "traditional" computer science areas provide a research core for computing and information technology and are central to the University's threefold mission. Moreover, CSE is also strong in several emergent areas, including location-aware computing, augmented reality, data mining, bioinformatics and natural language processing, many of which are inherently interdisciplinary.

Numerous on-going research projects in CSE address problems that are national priorities, including high assurance software for protecting critical infrastructures from cyber attacks, self-configuring sensor networks for military reconnaissance, security and social impacts of biometrics, intelligent robots for performing dangerous tasks, predicting the biodegradability of chemicals in the environment, and rigorous development of software for automotive and other embedded systems. Faculty members in CSE are also participating in a variety of interdisciplinary projects across the campus. Examples include haptic interfaces for tele-medicine, sensor networks for ecosystem monitoring, high performance simulations of mechanical engineering processes, computer simulations of the evolution of complex biological organisms, design and manufacturing automation, cyber security, computer forensics, and design of intelligent vehicle and transportation systems.

CSE is also providing leadership in developing curricula related to computer and information technology. It provides three large service courses, offers a number of interdisciplinary courses, and supports various interdisciplinary specializations and programs. With enrollments of approximately 2000 students per semester, the largest service course, CSE 101, offers three "tracks," designed to meet the needs of different units across campus. The second service course, CSE 131, focuses on developing technical problem-solving skills and provides an introduction to computing for

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approximately 400 engineering students per semester. The third service course, CSE 231, is a first programming course for approximately 250 students per semester and is available to any student in the University having taken Calculus.

CSE has also recently piloted several new interdisciplinary courses, including two lecture series, one in computer security (joint with Human Medicine and Criminal Justice) and the other in bio-complexity (joint with Zoology), and courses in digital evolution, natural language processing, information extraction and question answering, and data mining. CSE looks forward to working with other units in development of courses that treat computational aspects of linguistics, biochemistry, physics, and other disciplines. Such course development will provide insights into real-world needs for computing and pave the way for new research collaborations.

In summary, Computer Science and Engineering can provide leadership in collaborating with other units across campus to help the University realize its full potential in computing and technology. Furthermore, we feel that by taking an inclusive approach and leveraging existing strengths, Michigan State University will accelerate its transition to being a national leader in these critical and pervasive areas.

Conclusions

Michigan State University takes pride that it is both a premier land grant university and one of the select AAUP universities. The vision outlined in this document provides the University with a new-century opportunity to meet the challenges associated with both of these prestigious designations. It speaks directly to the challenge posed by the Provost and Vice President for Academic Affairs, Lou Anna K. Simon, in her remarks to the Academic Council on September 23, 2003:

“With our land-grant mission and heritage in mind, what kind of a university would society create for the 21st century, in order to respond to the challenges we face today, and those we anticipate tomorrow?”

Timely action will position the University to provide leadership in defining research agendas for emerging multi-disciplinary fields and to provide our students with the skills they will require to adapt to an ever-changing work environment. As the University actively considers alternatives for consolidation, restructuring, and repositioning of administrative units, bold actions taken today can be particularly strategic in preparing us for the challenges of tomorrow.