SPECIAL REPORT

of the

ACADEMIC PRIORITIES, PROGRAM AND BUDGET AND RESEARCH COUNCILS

concerning the

ESTABLISHMENT OF A SCHOOL OF COMPUTER SCIENCE
AT THE
UNIVERSITY OF MASSACHUSETTS AMHERST

Presented at the
722nd Regular Meeting of the Faculty Senate
December 11, 2012

COUNCIL MEMBERSHIP

ACADEMIC PRIORITIES COUNCIL
Margaret Allard, Richard Bogartz (Chair), Elizabeth Chilton, W. Curt Conner, Kathleen Debevec, Bryan Harvey, A. Yemisi Jimoh, John Kingston, Ernest May, J. Eliot Moss, Deborah Picking, Monroe Rabin, James Rinderle, Jan Servaes, Scott Stangroom, Barbara Stanley, Susan Sturgeon, Jerri Willett

PROGRAM AND BUDGET COUNCIL

RESEARCH COUNCIL
ACADEMIC PRIORITIES COUNCIL

At the September 20, 2012 meeting of the Academic Priorities Council, Lori Clarke, Professor and Chair of Computer Science, presented a supporting case for the establishment of a School of Computer Science. Among the points raised were: that Computer Science relates to departments all over campus; it is oriented outward in its interdisciplinary character; a school would make this extensive interaction with other departments more visible; they have started a BA degree along with their BS degree so more students will be able to be dual majors; they are implementing an Informatics degree for work in applied Computer Science which initially involves three areas: Big data; Health Informatics; and Multimedia. They do not need additional resources beyond what they expect to accrue from more students enrolling in their programs. Some discussion followed. Bryan Harvey then moved that the APC recommend approval of the formation of a School of Computer Science. The motion was seconded by John Kingston. Following brief additional discussion the motion passed unanimously.

PROGRAM AND BUDGET COUNCIL

At a meeting on May 16, 2012, acting on the unanimous recommendation of the Program Subcommittee, the Program and Budget Council unanimously recommended approval of the proposal to create a School of Computer Science. Because this is only a name change, there are no significant costs.

RESEARCH COUNCIL

The petition by the Department of Computer Science for the establishment of a School of Computer Science is the result of a two year self-assessment by faculty members within CS. This change reflects both internal shifts in foci of teaching at the undergraduate and graduate level, research directions of individual and collective faculty groups, as well as a growing trend within their discipline and across disciplines as computer sciences and computational thinking are evolving nationally and internationally.

The CS proposal was provided to the RC as part of the agenda for the 9/14/12 meeting. Lori Clarke, CS Dept. Head, lead a brief discussion of the context and motivation for the proposed change. This realignment is fully in line with Sen. Doc. No. 12-021A “Special Report of the Provost concerning Schools within Colleges” that was submitted to the Faculty Senate by Provost Staros on February 2, 2012.

No new funding is being requested to establish the School of Computer Science, and, as the college will be comprised solely of a single department, little if any other administrative reorganization will be required.

To maintain a leading position in research and teaching in the computer sciences and computational thinking at the University of Massachusetts, the recommendation is made for the Research Council to approve the Proposal for the Establishment of a School of Computer Science.

MOVED: That the Faculty Senate approve the Establishment of a School of Computer Science at the University of Massachusetts Amherst, as presented in Sen. Doc. No. 13-022.
SCHOOL TITLE: School of Computer Science
DEPARTMENT(S) INCLUDED: Department of Computer Science
COLLEGE College of Natural Sciences

SIGNATORIES:
The following persons certify approval of the attached proposal:

1. Lori A. Clarke, Department Head/Chair 4/13/2012

2. Steven Goodwin, Dean of the School/College Date

3. Academic Priorities Council Chair Date

4. Faculty Senate Secretary Date

5. Provost/Vice Chancellor for Academic Affairs Date

jc: Proposer
Scheduling Office, 213 Whitmore
Faculty Senate Secretary, 105 Hampshire House

1 In parallel to filing this proposal, the department is carefully considering a name (as it has since passing the schoolhood motion) that denotes a strong intellectual foundation, and best positions, represents and distinguishes the University's computing education and research programs for the future, while retaining a clear connection to the core strengths in Computer Science that has made the department a national leader. It is thus possible that we would request a slightly different name before the Senate votes on this proposal.
Proposal for the Establishment of a School of Computer Science at the University of Massachusetts Amherst

This proposal is being submitted in accordance with Faculty Senate Document Number 12-021A (dated February 2, 2012), which describes the procedure for forming a new School. Sen. Doc. No. 12-021A specifies that a proposal contain six components:

i. **The proposed name of the new School and a list of participating units.** The proposed name of the new School is the “School of Computer Science.” The unit involved in forming this School is the current Department of Computer Science.

ii. **A rationale based on the desirability of establishing a particular identity and its potential impact on recruitment of students or faculty, public relations, development, research, instruction, outreach, or any other goals or activities of the participating unit(s).** Precedents at other universities of comparable stature may also be noted. See body of proposal below.

iii. **In the case of multi-unit Schools, an agreement that specifies how the Director will be selected and any cooperative relationships.** Not applicable.

iv. **Evidence of support from the faculty of the participating unit(s) and any other major stakeholders.** The proposal to develop a School of Computer Science has been in discussion in the Department of Computer Science and with our dean, for over a year. The proposal to establish a School of Computer Science was approved unanimously by the faculty of the Department of Computer Science on May 4, 2011.

v. **Signature approval by the Dean of the College in which the School will be organized.** If any participating Departments or Programs report to other Deans, the signatures of those Deans are required as well. The signature of CNS Dean Steve Goodwin, and Department Chair Lori Clarke and on the cover page for this proposal.

A Proposal for the Future of Computing at UMass Amherst

The faculty of the Department of Computer Science has a vision for the future of computing and computational thinking at the University of Massachusetts Amherst that we believe can best be achieved through the establishment of a School of Computer Science. In this vision, faculty with interests and expertise in computing in a very broad spectrum of disciplines across the campus come together to define and develop new and expanded research, educational programs, and collaborations consistent with national trends that have brought excellence and distinction to many of the nation’s leading university campuses, particularly those in the AAU. The School will be the intellectual focal point for broad interdisciplinary activities in research, teaching and outreach that engage UMass community members across the campus in computational thinking, building upon the Department’s nationally prominent research activities and its already-strong connections to other campus academic units in research, teaching and service. The renaming of the Department of Computer Science to the School of Computer Science reflects this vision, and results from a two-year process of reflection, discussion and planning within our Department. The name change itself is an important, visible and highly prominent symbol to the Department, to the University, and to our field of not just our past, but more importantly our future, focus.

With this initiative, UMass Amherst will join other major universities across the nation that have capitalized on the growing understanding of the centrality of computing by undertaking different kinds of organizational innovations. Some campuses have only expanded the purview of their Computer Science departments, but bolder campuses have created computationally-focused institutes or programs that span disciplines, while still others have established colleges or schools of computing and/or informatics (see Appendix B). What these bolder initiatives have in common is that they do not shrink from contemplating new administrative entities that support more effective engagement between Computer Science and other fields, allowing an expanded mission/footprint for computing as indicated by

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contemporary understandings, offering new educational programs, and forming broader and stronger interdisciplinary research connections. There have been numerous examples of Computer Science units surging into positions of national and international leadership (particularly those at CMU, Cornell, Georgia Tech, and Indiana) by using their organizational flexibility and self-determination to very rapidly identify emerging opportunities for exciting interdisciplinary research, and then rapidly positioning themselves to build and exploit indicated synergies.

The School of Computer Science would be established within the College of Natural Sciences - the most straightforward and least disruptive approach, thereby minimizing distractions from the challenging tasks required to expand research outreach to the rest of the campus and launch new degree programs. At a later date, the School could consider pursuing affiliations with other colleges, given the breadth of cross-campus, interdisciplinary collaborations already underway in research, teaching, and service. Michael Dunn, the founding Dean of the School of Informatics and Computer Science at Indiana University (one of the first such schools in the country) noted when visiting UMass in 2001 that each such school must evolve in its own academic ecological niche; this results in the various administrative positionings seen in such schools in universities across the country. The Computer Science faculty, and Dean Steve Goodwin, believe our best initial positioning is within the College of Natural Sciences.

Recognizing the financial challenges that the University is facing, a School of Computer Science provides an opportunity to establish a campus-wide intellectual, educational, and administrative focal point for these efforts without placing undue burdens on the University. No new funding is being requested to establish the School of Computer Science.

In addition to catalyzing intellectual and research collaborations, our faculty also envisions working towards developing new degree programs at both undergraduate and graduate level; indeed the Department of Computer Science is already hard at work on developing these programs in collaboration with other units on campus. These degree programs\(^3\), which again indicate the central role that a new School of Computer Science can play, will enrich campus educational offerings and provide the Commonwealth with new and timely streams of valuable human and intellectual resources. These new programs would bring important new distinction to the campus, attracting new students, fostering new areas of excellence, and thrusting UMass Amherst more strongly into the national spotlight. We have identified two immediate opportunities for possible program initiatives, building upon existing undergraduate and graduate degree programs as well as connections to other campus units:

- In a dramatic expansion of the Department’s current MS degree program, the School could develop an accelerated one-year MS degree, a five-year BS/MS degree, and professional Masters Degree programs in selected areas.
- In a timely initiative, the School could develop a new undergraduate Informatics major to complement and radically expand upon the existing IT minor (which itself was launched with leadership from the Department of Computer Science). A new Informatics major would draw broadly upon cross-campus interdisciplinary connections and existing campus strengths to build an exciting new program with broad appeal and distinction.

In the Appendices to this proposal, we discuss the emerging notion of computational thinking that infuses not only the sciences and engineering, but the humanities and social sciences as well (Appendix A), survey the positioning of top Computer Science departments and schools (Appendix B), and discuss the still-evolving organizational structures of computing as a discipline (Appendix C) and in particular its broader, more expansive and more outward-looking view of itself as a discipline – the background against which our proposal for establishing a new School is set.

\(^3\) These new programs will be officially proposed to appropriate campus bodies at a later date. This present proposal only concerns the creation of the School of Computer Science.
Appendix A: Computational Thinking

The term Computational Thinking - promoted significantly by Dr. Jeanette Wing, former Chair of the Computer Science Department at Carnegie-Mellon University and most recently Director of the Computer & Information Science and Engineering Directorate at the National Science Foundation - has gained currency over the past five years as describing the broad intellectual footprint that computing can have across academia and infused throughout society. We thus excerpt from her discussion [1] of computational thinking below. For other recent articles on a modern view of computer science (including a National Academies of Science workshop on Computational Thinking), see [2-8].

“Computational thinking involves solving problems, designing systems, and understanding human behavior by drawing on concepts fundamental to computer science. … [It has] the following characteristics:

**Conceptualizing, not programming** … Thinking like a computer scientist means more than being able to program a computer. It requires thinking at multiple levels of abstraction; …

**A way that humans, not computers, think.** Computational thinking is a way humans solve problems … Equipped with computing devices, we use our cleverness to tackle problems we would not dare take on before the age of computing and build systems with functionality limited only by our imaginations.

**Complements and combines mathematical and engineering thinking.** Computer science inherently draws on mathematical thinking, … its formal foundations rest on mathematics. Computer science inherently draws on engineering thinking, given that we build systems that interact with the real world. The constraints of the underlying computing device force computer scientists to think computationally, not just mathematically. Being free to build virtual worlds enables us to engineer systems beyond the physical world;

**Ideas, not artifacts.** It’s not just the software and hardware artifacts we produce that will be physically present everywhere and touch our lives all the time, it will be the computational concepts we use to approach and solve problems, manage our daily lives, and communicate and interact with other people; and

**For everyone, everywhere….”**
Appendix B: Computer Science Programs: Where are they organizationally?

Computing research and education programs grew out of departments and programs in engineering, mathematics, the physical sciences, computer centers, and, less frequently, other disciplines such as business, fine arts, social sciences, linguistics, etc. The initial academic home of computing programs depended on local factors, with many campuses having two or three or more computing programs. Today there are five defined computing degree programs (with associated “bodies of knowledge”): computer science, computer engineering, information technology, (management) information systems, and software engineering. Degree program names and the organizational unit(s) offering the degree have varied widely.

The discipline of Computing is still evolving today. As computing has become more interdisciplinary, new degree programs have arisen that do not fit easily into the established definitions. As computing and computational thinking (see Appendix A) have become more recognized as core skills and central intellectual issues across disciplines, there is a growth of “computation across the disciplines” curricula. This trend was reflected on our campus by our introduction a decade ago (with CS Department leadership) of the University’s innovative IT (minor) program.

Given the evolving, complex array of educational programs, it is not surprising that there is an equally broad array of organizational structures for computing. Most colleges and universities have some form of computer science degree. Since the large majority of institutions are small and/or do not have engineering programs, computing degrees are offered by computer science departments (or computer science and mathematics departments) in an Arts and Sciences college/division or in a liberal arts college faculty. From the 1970s and up to the early 1990s, it was common for Computer Science Departments in large research universities to be located either in Engineering or in Arts and Sciences (or Natural Sciences); a few pioneering programs were independent. Of the top-25 computer science programs, MIT, Cornell, Illinois, Cal Tech, UCLA, Michigan, Columbia, Harvard, UCSD and Penn all began and stayed in engineering schools; while Stanford, Berkeley, Princeton, Washington and Rice moved to engineering (many retaining degrees in A&S). The other 11 departments, including UMass Amherst, remained in Arts & Sciences or were independent.

Beginning in the 1990s, two new trends emerged. First, colleges, schools, faculties and cross-disciplinary units focused on Computing have been created at top-25 institutions such as Carnegie-Mellon, Cornell, Georgia Tech, Cal Tech, and Illinois, as well as at UC Irvine, Indiana, Northeastern, Albany, UNC Charlotte, and others. A second significant trend was the emergence of “i-Schools” combining information studies, communications and library sciences. The i-Schools at Berkeley, Carnegie Mellon, Illinois, Maryland, Michigan, North Carolina, Pennsylvania State, Pittsburgh, Syracuse University, Texas, Washington, UCLA and 20 others make up the i-School consortium (http://www.ischools.org/). These i-Schools work closely with or contain (Indiana, Georgia Tech and UCI computing colleges are i-Schools) the academic unit where Computer Science is located. Both trends reflect the broader, more expansive and more outward-looking view of Computing and the many disciplines with which it interacts. The footprint of Computing on a modern campus is indeed large (see Appendix C).

Building on the strength of its core computer science programs and the department’s history of interdisciplinary collaboration, a new School of Computer Science here at UMass can continue to be a national leader in defining the broad directions of Computing research and education.
Given its relatively young age, the discipline of Computer Science has evolved more rapidly than most science and engineering disciplines over the past few decades, and has grown far beyond just the study of computer systems and their architectures, languages, applications, and theoretical principles. Perhaps because of the sheer challenge of building efficient and reliable computers, systems software (operating systems, compilers, databases, networks), and large-scale applications, this artifact-based view of computing arguably dominated our field into the 1990s. Beginning in the 1990s, however, Computer Science began to take a broader, more expansive and more outward-looking view of itself as a discipline. One harbinger of this change was the circa-2000 growth of information technology programs and the emergence of IT and Informatics schools (see also Appendix B). Today, Computer Science has come to view itself as the study of computation and informatics, of ways of representing information processing and interactions, and of ways of “thinking computationally” (see Appendix A, and [1-5]).

Computer Science provides a way of thinking about fundamental problems that underlie core challenges in many other disciplines. It is now critical to fields ranging from Biology to Physics, from Linguistics to Economics, from Nursing to Architecture, from Art to Education. Computer Science is both a facilitator of work in these diverse domains and a beneficiary - the more widely and integrally computing engages with other disciplines, the more these experiences help us to understand the fundamental nature of computation and information. Ultimately this close and broad engagement increases the effectiveness and value of all human endeavors. The importance of this engagement is crucial as we plan the future positioning of Computer Science at the University of Massachusetts Amherst.

While the evolution and growth of CS at UMass has in many ways paralleled that of the discipline, the Department’s vision for its future is also grounded in its roots. The Department was conceived around a unique interdisciplinary vision – cybernetics – that integrated aspects of artificial intelligence, theory, robotics, vision, and systems. Central to this vision were scientific exploration, the integration of several intellectually diverse fields, and the study of complex systems, whether technological systems (e.g., compilers, operating systems, large networks, data centers, sensor systems) or naturally occurring systems (e.g., biological systems, scientific collaboration networks, healthcare systems, or the US securities industry). In contrast, other computer science departments arose from electrical engineering, management, accounting, library sciences or mathematics and statistics – each with its own particular focus that has reflected the academic ecological niche in which it evolved. While the UMass CS Department has grown beyond its founding vision, its cultural orientation, and much of its distinction, continue to derive from its interdisciplinary, collaborative and outward-looking scientific exploration of the notion of computation and informatics, and their application to many domains of human knowledge.

Consistent with national trends and its interdisciplinary origins, the Department has broadened its horizons over the past decade, building and maintaining strong connections to departments in every college on campus. In the early 2000s, the Department played an instrumental role in developing the popular cross-campus IT minor, involving 17 departments in almost all colleges on campus, the library and several administrative units. At the same time, the Department led a multi-year Board of Higher Education- and industry-funded statewide program that pioneered the notion of “IT-across the curriculum” on many campuses of public higher education in the Commonwealth. The Department recently revised its existing B.S. degree and minor to add flexibility, and established a new B.A. degree program that facilitates students’ pursuing a liberal arts degree or a double major with other disciplines. The Department is also working to develop an Informatics major, a broadened set of MS degree offerings, and a 5-year B.S./M.S. program. Enrollments in CS and Informatics are growing nationally, and it is noteworthy that growth in these areas is faster in research institutions and in Massachusetts.

Biology, Psychology, Bio-statistics, Economics, Computational-Science/Astronomy, Legal Studies, Nursing, Education, Art and Architecture, Political Science and Public Policy, in addition to our long-standing collaborations with Engineering, particularly ECE. Over a three-year period ending in 2008, the Computer Science Department had the largest number of outside-the-department research collaborations (measured by both number of funded grants and total grant amount) than any other department in the University. The department was also extremely active in the campus’ interdisciplinary, “cluster hire” initiative, submitting proposals with many different units across campus. The Department is poised to further expand its interdisciplinary emphasis, restoring and enhancing strengths in biocomputing and bioinformatics, and to grow in social sciences and linguistics. Interdisciplinary growth in other areas such as healthcare informatics is also proceeding.

References