

II. Unit roles and responsibilities

A. The University of Washington in the 21st century

In the University of Washington of the recent past and of the foreseeable future, we believe that the Department of Computer Science & Engineering has roles and responsibilities that are unmatched by those of any other unit.

The strength of a great university derives from the rich interplay of its constituent parts, all of which are important.

It is increasingly true, though, that the transformation of society and the transformation of academia are being driven by advances in, and partnerships with, the field of computer science & engineering. In the 21st century, were the University of Washington to lack excellence in some arbitrary discipline, it is likely that we still would be able to have an outstanding law school. We would also be able to have an outstanding business school, and an outstanding medical school, and an outstanding public policy program, and outstanding humanities and physical science departments. We would be able to educate students who are competitive in the modern world, to meet the pressing workforce needs of the region, to lead in technology transfer and economic development, and to make dramatic changes in how teachers teach and in how students learn.

But the University of Washington would be *tremendously disadvantaged in each of these endeavors* if it lacked an outstanding computer science program.

The law school of the future will be shaped by issues such as intellectual property, copyright, freedom of expression, and contracts in the digital domain. The business school of the future will be shaped by programs in high-tech entrepreneurship, electronic commerce, computational finance, and transactions involving digital goods. The practice, science, and teaching of medicine already are being transformed by advances in imaging, telemedicine, gene therapy, and dozens of other areas. Increasingly, key public policy issues such as cryptography, privacy, freedom of expression, taxation of electronic commerce, and “community standards” in a world without boundaries require a substantial understanding of technology; this must be part of the education of civic leaders. Disciplines ranging from the humanities to the physical sciences are being transformed not just by the application of computers, but by *deep intellectual partnerships* with computer science and computer scientists, in areas ranging from datamining to computational science to the discovery by Watson and Crick that the human genome is a digital code. Every citizen, in order to be competitive in the modern world, will need to be fluent with information technology, as defined by a recent National Research Council report (from a committee chaired by Professor Larry Snyder of our department) – not just literate, but *fluent*; and not just with information, but with information *technology*. And while the purpose of a university education is not vocational training, Washington’s software industry claims 7,300 currently vacant positions and more than 50,000 additional vacancies in the next three years, observing that 75% of its employees hold Bachelors or Masters degrees, and that the position that has the largest number of employees, and has the greatest shortfall, and is the most critical, is the position of *developer* – computer scientists and computer engineers. Finally, educational technology truly does have the potential to change how we teach and how we learn, not just in school but throughout our lives.

Is the University of Washington’s Department of Computer Science & Engineering rising to meet this imperative – to fulfill the roles and responsibilities that the University, as well as the region and the nation, require of us?

B. A high-level view of CSE's strategies in past decade

Rapid change is the hallmark of our field and of our department. From the point of view of our department, the past decade can be divided very roughly into two phases.

During the first phase of the decade, our focus was necessarily inward. We were moved from the College of Arts & Sciences to the College of Engineering in 1989. We assumed responsibility for a nascent undergraduate program in Computer Engineering begun by the Department of Electrical Engineering. Three EE faculty members transferred portions of their appointments to our department, and we were allocated five additional faculty positions. We devoted a great deal of effort to the design of the ill-fated EE/CSE Building, a project that from its inception afforded us an insufficient amount of space, and that ultimately was terminated after the first of two phases of construction due to cost overruns. These issues were all-consuming.

During the second phase of the decade, we had the opportunity to look outward – an opportunity that simply did not exist before. We seized this opportunity, guided by a strategic plan drafted by Ed Lazowska when he was being considered as Chair, and formally adopted by the department shortly after his appointment. At the 50,000-foot level, the key elements of this plan were:

- A re-dedication to excellence and access in our educational programs
- A commitment to seek high-leverage research directions with long-term impact, and to seek integration of our research and educational efforts
- A search for interdisciplinary opportunities with the strongest colleagues campus-wide
- A strengthening of our partnership with the region's computing industry, since it represents a significant competitive advantage for us

The philosophy underlying these elements was that every conceivable advantage must be aggressively seized. Universities have students – if you are not first and foremost an educator, you should work elsewhere. Universities are uniquely charged to focus their research on the long term – if we don't, who will? Universities are inherently interdisciplinary – if you are not outward-looking, you are leaving money at the table. And each university has particular advantages due to its nature and its environment – for our department, the region's forefront computing industry, and especially the existence of Microsoft Research, offer tremendous potential.

A fifth strategic element clearly emerged in the middle 1990s:

- An active program of campus and regional leadership

We have wholeheartedly embraced this as an opportunity and a responsibility: helping to transform and invigorate key units at the University of Washington; assisting ourselves, our UW colleagues, and other educational sectors in taking advantage of educational technology; empowering others to teach the students that we cannot; strengthening the region's resolve to take the steps necessary to create a 21st century “innovation economy”; helping to bring advanced telecommunications services to our region and to its citizens; increasing the public's understanding of the role of a research university.

C. Specific recent accomplishments

One way to grasp concretely our own sense of our roles and responsibilities is to look where the rubber meets the road – at our accomplishments over the course of the past half dozen years. A necessarily incomplete snapshot:

In research

- Outstanding success in faculty recruiting (but, “if only” we had been able to recruit more extensively in 1995 and 1996): Dick Karp (1995, departed 1999); Anna Karlin (1996); Tom Anderson, Brian Curless, Chris Diorio, and Alon Levy (1997); Pedro Domingos and David Wetherall (1998); Henry Kautz, Zoran Popovic, and Narayanan Shivakumar (1999, reneged 2000); thus, serious ramp-ups in computing and biology, networking, graphics / vision / animation, databases / datamining / knowledge discovery / intelligent webware
- Established new, strong ties to a number of programs: Astronomy, Business, Medical Education, Molecular Biotechnology, Genetics, Zoology, others
- Expanded existing ties with a number of programs: Electrical Engineering, Radiation Oncology, Statistics, others
- Numerous and expanding research interactions with Microsoft Research, and with other leadership regional companies
- UW/Microsoft Summer Research Institutes in Computer Science: *Datamining* (1997); *Intelligent Systems: Biological and Computational Perspectives* (1998); *Technologies of Invisible Computing* and *Technologies to Improve Software Development* (1999)
- Continued success in graduate student recruiting (continued escalation in tactics here, too) and production
- In 1999, received a 3-faculty Advanced Technology Initiative cluster in *Computer Graphics and Digital Animation*, as well as an initiative in advanced networking joint with UW’s outstanding Computing & Communications organization
- Also in 1999, played a significant role in the successful University Initiatives Fund proposal to establish the *Program in Biomedical and Health Informatics*, an effort spearheaded by adjunct faculty member Ira Kalet
- Actively engaged in the *Interdisciplinary Program in Computational Molecular Biology and Interdisciplinary Research in Electrical Engineering and Computer Science & Engineering* initiatives
- Faculty continue to be recognized by CAREER, PECASE, Sloan, Packard, and ACM and IEEE Fellow selection
- Department continues to be ranked among the top ten in the nation, both for computer science and for computer engineering, by the National Research Council and *US News*

In education

- Completely revamped our introductory curriculum, hiring two outstanding Lecturers – Martin Dickey and Hal Perkins – to assist with it, as well as with other undergraduate courses
- Dramatically increased undergraduate participation in RAs, TAs, and internships/co-ops

- Restructured the undergraduate advising unit to better integrate the Computer Science and Computer Engineering programs from the student perspective
- Introduced numerous undergraduate “Capstone Design Courses” for our majors (many of which are interdisciplinary in nature), including: *Embedded Systems, Computer Animation, Software System Design, Software Engineering, Computer Telephony, VLSI Design*
- Hired an outstanding Lecturer – Barbara Mones – to carry forward our digital animation education initiatives, building stronger bridges to Architecture, Art, Music, and other programs
- Initiated an expansion of our Bachelors program in Computer Engineering, so that we will soon be graduating a total of 160 majors each year
- Helped design complementary Bachelors programs at the UW-Bothell and UW-Tacoma branch campuses
- Interacted extensively with Community Colleges regarding introductory instruction: online availability of complete curricular materials; course certification for “no-questions-asked” transfer credit; campus visits and Summer Institute for instructors; Tutored Video Instruction
- Introduced a “*Fluency with Information Technology*” course collaboratively with the new School of Information, based upon Larry Snyder’s work with the National Research Council
- Introduced the Professional Masters Program, an “accessible” (evening/distance, part-time) program for forefront professionals in the region’s computing industry
- Introduced twenty-five multi-course “Certificate Programs” in partnership with UW Extension, which enrolled more than 3500 students and granted more than 600 certificates last year
- Made extensive use of educational technology: tele-consulting and Tutored Video Instruction in the introductory course sequence; televised, webcast, and web-archived colloquium series; synchronous and asynchronous distance learning in the Professional Masters Program
- Assumed a leadership role in the successful University Initiatives Fund proposal to establish the *Program on Educational Transformation Through Technology*, an effort to couple the evolution and use of educational technology with research on learning
- Introduced a departmental teaching award managed by our undergraduates; took various other steps to encourage excellence in teaching by faculty and TAs
- Undertook extensive K-12 and UW recruiting outreach: CD-ROMs of Capstone Design Courses; direct contact with high-performing high school students; “Early Decision” program; direct contact with high-performing freshmen and sophomores; we continue to have the strongest undergraduate majors at the University of Washington
- Professors Gaetano Borriello, Carl Ebeling, and David Salesin received the UW Distinguished Teaching Award
- In 1999, the department received an inaugural UW Brotman Award for Instructional Excellence

In technology transfer and entrepreneurship

- Company creation: InkInclination, Numinous, Netbot, AdRelevance, Appliant, Nimble.com, Consystant, Performant, others
- Licensing/sale: WebCrawler, BRUTE, MetaCrawler, Etch, Simultaneous Multithreading, multiple AI, computer graphics, and data integration technologies
- Strong partnership with the Office of Technology Transfer: promoting more enlightened campus policies towards entrepreneurship; devising and adopting UW's first statement of department principles regarding commercial activities; various other activities

In campus and regional outreach and leadership

- Provide visible campus leadership in various areas: technology; educational technology; industrial relations; legislative relations; K-12 outreach; integration of research and education
- Active in "agenda reformulations" in collaboration with various campus units: School of Information; Business School; College of Education; Law School
- Revamped our Industrial Affiliates Program – from 6 to 75 members
- We now televise, webcast, and web-archive our colloquium series
- More than a dozen multi-course Extension "Certificate Programs" currently enrolling more than 3500 students and granting more than 600 certificates per year
- Professional Masters Program with 120 outstanding part-time students
- Extensive K-12 educational technology work
- Strong interactions with the Washington Software Alliance and the Technology Alliance
- Ed Lazowska received the 1998 UW Outstanding Public Service Award

In infrastructure and operations

- Moved from a "mostly Unix" to a "mostly PC" environment (600 of 800 departmental systems) – substantial support from Intel, Microsoft, Visio, WRQ
- Restructured our technical support organization into four largely-autonomous units: infrastructure (that is, core systems), support & operations, educational technology, and computer maintenance
- Modified our administrative organization to improve communication: restructured the advising unit; restructured staff reporting relationships in general; created the Staff Ombudsperson role; gave the Executive Committee an explicit role in faculty and staff merit evaluation and salary determination
- Created an External Advisory Committee of outstanding researchers from academia and industry

In diversity

- Aggressively used the NSF VPW program: Anna Karlin; Mary Vernon; Anne Condon; Carla Ellis; Rimli Sengupta

- Donation from Jeremy and Linda Jaech allowed the creation of a far more effective professional and volunteer outreach and tutoring enterprise (ALVA, service courses, majors) through the hiring of an Outreach Coordinator with computer science credentials

D. From excellence at the core

It should be evident that we take a broad view of our roles and responsibilities, that we sustain an extraordinary level of activity, and that we strive for excellence in all that we do.

Our core mission, though, is to be one of the nation's leading programs in computer science and computer engineering. This is the *sine qua non* for us as a department – our ability to contribute in other areas arises from this. We are hanging on, but only by our fingernails, as will be discussed subsequently. What are the measures by which we judge our performance? Here are a few:

- Are we competing successfully for the finest students at the University of Washington to become our undergraduate majors? Do we get feedback from these students and their employers or graduate advisors – in the long term more than in the short term – indicating that our undergraduate programs are providing excellent preparation?
- Are we competing successfully for the finest Bachelors degree recipients in the nation and the world as our doctoral students? Do most of these students – whose who do not complete the Ph.D., as well as those who do – give us positive feedback about the effectiveness of our program? Are a reasonable number of our Ph.D. graduates viewed as being among the strongest candidates in the nation in their year of graduation? Do our students succeed in their careers in large numbers?
- Are we competing successfully for the finest Ph.D. graduates in the nation to join our faculty? Do these young faculty members grow to fulfill their promise in our environment? As they mature, do they continue to be highly regarded and highly productive? Do they embrace our culture of collegiality, and of investing in younger colleagues? Do they become *leaders* – within and without? Do they choose to remain in our department?
- Are we clearly perceived as one of the University of Washington's top programs by the leaders of the other top programs at UW?
- Are we clearly perceived as a top national program by the leaders of the other top national computer science and computer engineering programs?

One challenge, of course, is to figure out how to make *all* of our activities contribute to our success in our core mission. Sometimes it's a no-brainer. When we decided to move aggressively into the interface between biology and computer science a half dozen years ago, it was because Lee Hood and his Department of Molecular Biotechnology represented an enormous competitive advantage – a resource nearly unique in all of academia. Other times, it's a bit more complicated. Technology transfer and entrepreneurship, for example, are a fact of life in computer science today, but one can only view them with ambivalence. Our "*Departmental Principles Regarding Commercial Activities*," adopted by the faculty earlier this year, begin:

We share a common objective: to have, at the University of Washington, the strongest possible program of research and education in computer science and computer engineering, recognizing that our role as faculty is first and foremost to help our students reach their full potential.

While research and education are our core activities, commercial activities – which range from industrial research agreements to consulting to licensing to company creation – can be a natural offshoot of these core activities. Indeed, the University of Washington has an *obligation* to commercialize in some circumstances.

When conducted appropriately, commercial activities can enhance our strength, and positively impact the region, the economy, and society. However, commercial activities inevitably involve negotiations, self-interest, and the potential for conflict. They add tremendous complexity to the academic environment.

“Companies created” or “technologies transferred” are not direct measures of success. Our goal is to learn how to conduct these activities in a way that contributes to our success in our core mission: having the strongest possible program of research and education in computer science and computer engineering.

Another challenge is to define, carry out, and defend an appropriate educational role for a department such as ours, in a university such as ours and a state such as ours. We shall have more to say on this topic later.