University of Washington
Department of Computer Science & Engineering

Vision Statement and Strategic Plan
January 2000

Vision

Since its inception, the University of Washington's Department of Computer Science & Engineering has viewed its mission as *leadership* and *impact* in information technology – institutionally, regionally, nationally, and internationally – in education, in research, and in service. We have pursued this mission within a special and unusual culture – an open and collaborative culture in which we invest in and support one another and the department, and recognize that our role as faculty is first and foremost to be educators, helping our students to reach their full potential. We believe that the synergistic combination of these elements continues to be essential. The challenge is to preserve this synergy – to maintain and enhance our leadership, impact, and culture – in a rapidly changing world.

Twenty years ago there were few cash machines, fax machines, cellular telephones, video games, or CAT scanners. Today there are cash machines in every store, fax machines in every office, cellular telephones in every pocket, video games in every home, and CAT scanners in every hospital. Twenty years ago the personal computer software industry barely existed. Today Microsoft is the most valuable company in the world, Nintendo of America, another Washington State information technology firm, is a multi-billion-dollar business, and Amazon.com, only a few years old, has a market capitalization of close to 30 billion dollars. Twenty years ago physical experimentation and mathematical analysis were the two fundamental paradigms in science and engineering. Today, computer-based simulation and visualization is firmly established as a third.

In the face of this remarkable transformation, it is startling to recognize that the *real* computing and communications revolution still lies ahead! *The true power of information technology is as a human enabler* – transforming all aspects of our lives: commerce, education, employment, health care, manufacturing, government, communications, and entertainment, as well as all of science and engineering. *This power is only beginning to be harnessed.* The next decade will see increasingly powerful and diverse digital devices and information services brought to homes, businesses, educational institutions, and individuals across America and around the world. The result, with visionary technical and political leadership, will be increasingly effective, ubiquitous, and equitable access to the world's knowledge, information, and entertainment resources, to health care and other social services, to telecommuting, banking and shopping services, distance learning, and social interaction. The next decade also will see increasing, and increasingly deep, *intellectual partnerships* between computer science and engineering and other disciplines – from astronomy to zoology, with biology and business and law and librarianship in between. The result will be a transformation of these disciplines, and a transformation of computer science as well.

Washington State is at the center of all of this, and stands to contribute and to benefit enormously. We have major corporate players in computing and communications technology such as Microsoft, Adobe, AT&T Wireless, and Teledesic; leaders in Internet technology such as Starwave, Go2net, and RealNetworks; pioneers in electronic commerce such as Amazon.com and Drugstore.com; numerous software companies that together comprise the fastest growing software industry in the nation such as B-

Square and WRQ; and a number of strong programs in critical fields at the University of Washington, including a Department of Computer Science & Engineering that is ranked among the top ten in the nation and that has a demonstrated record of institutional and regional – as well as national and international – leadership and impact.

Any imaginable vision for the University of Washington of the next decade – and any imaginable vision for our region – will have an outstanding Department of Computer Science & Engineering as a cornerstone, a sine qua non. Our own vision is to rise to meet this imperative: to lead the way, in partnership with others, in capitalizing on our many advantages, achieving a forefront position in areas of high impact in information technology that will benefit the University, the region, and the nation. *An enormous opportunity exists – one that the University of Washington cannot afford to miss.*

Positioning: Assets

The Department of Computer Science & Engineering is well-positioned to pursue this vision:

- At the root of our positioning is 30 years of recognition within the University of Washington that whatever our department will have to offer will arise from strength at the core of our discipline: from conducting research that is of major and lasting influence, from striving for excellence in our educational programs at all degree levels, from exercising visionary leadership, and from understanding the synergy among these missions that makes the whole so much more than the sum of the parts. We feel that we have been successful: Computer Science & Engineering is a highly regarded department with significant institutional, regional, national, and international interactions and influence.

- As our core strength has become solidified, we have been able to devote increasing effort to "looking outward." Examples include the following:

  - Recent faculty hires have emphasized areas that will be particularly critical well into the next century:
    - We have built a first-class young group in databases, datamining, and knowledge discovery – key technologies for managing and integrating the burgeoning information on the World Wide Web and for enabling advances in other disciplines ranging from astronomy to molecular biology.
    - We continue to add strength in computer graphics, computer vision, and digital animation; these areas are intellectually exciting and inherently interdisciplinary, in terms of both education and research.
    - We continue to broaden our efforts in the interface between biology and computing. Despite the unfortunate return of Dick Karp to Berkeley, our activities in computational molecular biology continue to thrive, with five faculty members and postdocs, a large number of graduate students, an active seminar series, and interactions with a number of colleagues in various biological departments. In addition, we have faculty working in biologically-inspired computing and implantable computers, as well as focusing on laboratory embedded systems.
    - We have moved aggressively into networking, through faculty additions and also through infrastructure initiatives in partnership with UW's outstanding Computing & Communications organization.
    - Similarly, we have moved aggressively into "invisible computing," focusing badly needed attention on the 98% of microprocessors that are not deployed in what we traditionally think of as "computers." This area represents one of our many links to Electrical Engineering, a key partner of the past and the future.

- Our educational programs have diversified considerably in the past half dozen years:
  - Our Professional Masters Program has achieved wide regional visibility and acclaim.
  - Similarly, our televised, webcast, and web-archived colloquium series has been well received and recognized.
  - Within the University, our undergraduate curriculum in computer animation has been a home run, as has our collaboration with the School of Business in software entrepreneurship. Our new "FITness" (Fluency in Information Technology) course, and the related collaboration with the new School Information, continues this trend.
  - We have worked closely with UW-Bothell and with UW-Tacoma to create alternatives for students desiring a Bachelors-level education in computing.
  - We also have partnered extensively with the state's Community and Technical Colleges and with K-12, on infrastructure as well as on curriculum.
  - We have been closely involved with UW Educational Outreach, working to develop a number of highly successful certificate programs in information technology, to increase our summer course offerings, and to develop the Professional Masters Program.
  - Working with all of our partners in the state's education system, we continue to strive to ensure that a diverse suite of educational opportunities in information technology is available to the citizens of Washington.

- Interdisciplinary research collaborations, as well as interdisciplinary educational collaborations, are on the upswing, involving units such as Applied Mathematics, Architecture, Art, Astronomy, Biochemistry, Business, Chemical Engineering, Chemistry, Civil Engineering, Electrical Engineering, Genetics, Mathematics, Molecular Biotechnology, Music, Public Affairs, Radiation Oncology, Statistics, and Zoology. We are a member department of the newly formed interdisciplinary graduate program in Computational Molecular Biology. The UW/Microsoft Summer Research Institutes and other ties to Microsoft Research are further examples of external and outward-looking research collaborations that have yielded major benefits.

- Other aspects of regional and national outreach have increased dramatically: our revitalized and refocused Industrial Affiliates Program; our close partnership with the Washington Software Alliance and many of its member companies, our involvement with the Technology Alliance; diverse interactions with the venture community; a variety of close ties to the state capital in Olympia; and leadership on national boards such as the Computing Research Association, the Computer Science & Telecommunications Board, and DARPA ISAT and DSSG.

- We have developed broad and deep relationships with a number of our Affiliate companies, most noticeably including Boeing, Compaq, Intel, and Microsoft; these relationships include donations of money and equipment, but are successful primarily due to the interactions and exchanges of people (including faculty, graduate students, and undergraduate students).

- We also have devoted ever-increasing effort to educational excellence. We recognize that there are many important educational needs. We recognize that we cannot be all things to all people. We strive instead to do the best possible job in those areas where we are uniquely positioned to contribute. We seek to deeply and seamlessly integrate research and education – essential synergy, and the unique role of a research university. We seek to have undergraduate major programs that provide an education as outstanding as any in the nation, to students as outstanding as any in the nation. We seek to "keep current" the forefront employees of our region's forefront information technology companies. We seek to have a Ph.D. program recognized for outstanding effectiveness, in which the students think of themselves as our partners. We seek interdisciplinary opportunities, recognizing that so much of what is exciting in the modern world lies at the interfaces between traditional fields. And

we seek to provide leadership in education within the University and the region, empowering others to meet the needs that we cannot. Examples of recent accomplishments in our core programs:

- The Professional Masters Program and various interdisciplinary initiatives noted above.
- Our remodeled – and soon to be remodeled again – introductory curriculum, which now reaches 2,500 students per year and soon will be complemented by the FITness curriculum for "the other half" – those students who require "fluency" but not hard-core programming.
- Leadership in educational technology.
- Our increasingly diverse and widely recognized Capstone Design Course offerings.
- The ongoing expansion and diversification of our Computer Engineering program.
- A significant increase in the number of undergraduates involved in research.

In the aggregate, these accomplishments in core strength, in "looking outward," and in educational excellence have garnered – among many other accolades – three UW Distinguished Teaching Awards, an inaugural UW Brotman Award for Instructional Excellence, the UW Outstanding Public Service Award, the UW Annual Faculty Lectureship, and a host of national faculty recognitions including Sloan, Packard, and ACM and IEEE Fellow Awards. Over the past decade, *every* eligible junior faculty member has received a National Science Foundation CAREER, PECASE, NYI, PYI, or PFF award.

Positioning: Liabilities

While we are well positioned in many ways, *our situation is far more precarious than might first appear*. Among the factors that give cause for grave concern:

- During the past three years, we were authorized to grow from 29 faculty members to 34. Despite recruiting at full speed, departures and retirements have caused us to remain at 29 (now doing the work of 34, since we have fulfilled the commitments that we undertook to obtain these positions), and we have several strong faculty members who continue to waver about whether to remain in academia. Further, we have committed to additional high-priority responsibilities such as an expanded undergraduate program. *We must focus intensively on retention of our highly productive faculty members.* In particular:

  - The proportion of time that our faculty members devote to peripheral activities increases relentlessly, with a corresponding decrease in our sense of personal effectiveness. At the same time, our field is unique in the availability of non-UW jobs in the Seattle area where people with faculty credentials can be highly effective (as well as broadly respected and handsomely compensated). *We must struggle harder to create a low-overhead environment in UW CSE – an environment where faculty members feel highly effective. This will require changes at the highest levels of the University, as well as continued internal efforts*

  - Universities *do* have competitive advantages relative to startups and industrial research. First, universities have students. Second, universities are inherently interdisciplinary. Third, university research programs are uniquely charged to focus on the long term. Fourth, university jobs offer tremendous flexibility – education, research, leadership, and entrepreneurship. *Individually and collectively, we must aggressively seize each of these competitive advantages.*

- Entrepreneurship is a fact of life in our field. We in the Department of Computer Science & Engineering 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 add tremendous complexity and stress to the academic environment:

- Innovation occurs at the department level, and the burdens related to entrepreneurship are borne there – management overhead, leaves of absence, conflict of commitment, graduate student issues, and so forth. But current UW policies do not allow departments to benefit significantly from the entrepreneurial activities of their members – the lion's share of the benefits are centrally retained. *We must fight for changes in UW policies related to entrepreneurship. We must persuade UW to re-invest where the innovation occurs and where the burdens of entrepreneurship are borne. And we must encourage those among us who found companies to recognize the contributions that our environment makes to their success.*

- Entrepreneurship creates the problem of *conflict of commitment* – a struggle between extraordinary internal and external demands. *We must continue to clarify our expectations for one another in this regard.*

- We must ensure that our culture and our policies continue to encourage and support faculty who wish to have impact in ways that are more traditional than leaving for startups. We must strongly encourage and reward "academic entrepreneurship" – entrepreneurship within the academic community, and externally-directed entrepreneurship that allows the faculty member to remain in the department and continue to be highly productive in that context. *We must find ways to support all kinds of entrepreneurship, especially those that reduce disruption to our core mission.*

- We are now 15 to 20 years behind our peer departments in the quality and quantity of our space – debilitated by the need to operate with roughly 1/3 of the average space of our peers, and facing the daunting task of raising $40 million privately to solve the long-term problem. *The CSE Building must continue to be unequivocally the University's top funding priority, and we must obtain incremental space with minimal hassle over the next few years in order to survive until its completion.*

- Enrollment demand and workforce demand continue to soar. We are in the spotlight – worse, we are under the microscope and under the gun. *We cannot be all things to all people, but we must continue to embrace statewide leadership as part of our core mission, to establish partnerships, and to tend to the strength of our political base, which allows us to say "no" to inappropriate requests.*

Strategic Plan

In this section we describe the general elements of a strategic plan for achieving our vision, building upon our current position. In the next section we discuss specific actions that must be undertaken.

- Our "secret weapon" is the unique culture that has distinguished the University of Washington's Department of Computer Science & Engineering since its inception: an open and collaborative culture in which we invest in and support one another and the department; treat all members of our community as full members of our community; recognize that our role is first and foremost to be educators, helping our students to reach their full potential; strive for minimal partitioning both vertically (between ranks) and horizontally (between research areas); and attempt each year to recruit people stronger than the year before, heavily investing in the development of these people. We

commit to tend carefully to this culture. Maintaining it becomes ever-more-difficult as our size, our pace, and our diversity increases.

- Faculty retention is a critical issue. We will focus on increasing the faculty's sense of effectiveness, and on seizing the competitive advantages that a university has to offer. The University of Washington's Department of Computer Science & Engineering must be the place of choice for the strongest individuals in our field who want to be faculty members.

- Entrepreneurship is a fact of life – in many ways a *positive* fact of life. We have developed considerable experience – much of it not easy – in balancing the interests of commercialization and more traditional scholarly activities. We are committed to finding principles and mechanisms for allowing our faculty and students to be involved in commercial activities – and thus to have opportunities for direct, immediate, broad-based influence – in a way that strengthens, rather than compromises, our program.

- Entrepreneurship applies to internal non-commercial activities as well – the establishment of exciting new scholarly initiatives. We will continue to aggressively support "academic entrepreneurship," as exemplified in the past few years by our capstone design courses, our computational biology thrusts, our K-12 and community college programs, and a host of other initiatives. *Those who lead will be encouraged and rewarded.*

- We will continue to seek high-leverage research directions with lasting impact, and to seek integration of our research and educational efforts. New directions in research will be sought by identifying critical motivating problems from our own field and from application disciplines, and by identifying areas where we have a particular competitive advantage – e.g., because of institutional or regional strengths. Lasting and significant impact must remain a key criterion for the selection of research problems. We must resist inducements to work on short-term problems, since industry covers this ground admirably and with far greater resources than a university can bring to bear.

- We will seek additional deep intellectual partnerships with a broad range of departments such as Architecture, Art, Astronomy, Molecular Biotechnology, Music, and Zoology. In addition, we will continue to pursue additional ties and partnerships with "complementary" programs such as Computing & Communications, Electrical Engineering, Information, Statistics, and Technology Transfer, where ever-greater interaction can increase everyone's effectiveness.

- We will seek additional ways to seize the competitive advantage that Microsoft Research and Microsoft as a whole offer us: 600 of the strongest researchers in our field, and 6,000 of the strongest engineers, living within minutes of our door.

- We will continue to dedicate ourselves to excellence and access in our educational programs. We cannot be all things to all people – we cannot meet all needs. However, the University of Washington's Department of Computer Science & Engineering must continue to be the place where top students can fulfill their educational objectives, becoming prepared for highly-leveraged life-long careers related to our rapidly changing and increasingly ubiquitous discipline. In our doctoral program, we must continue to focus on the education of first-rate, research-oriented graduate students. And our department must exercise campus-wide and statewide educational leadership, creating opportunities for a broad range of students.

- We firmly believe that our field, information technology, represents an enormous competitive advantage for other units at the University of Washington – because of our own strength, and because

of the region's strength. We will continue to work with the university to leverage this advantage for programs such as Business, Law, Information, and others.

- We recognize the transforming effect that technology will have on education, and will continue to strive to be an institutional and regional leader.

- We will continue to strengthen our partnership with our region's computing industry, through working closely with individual companies and with the Washington Software Alliance. Our industry is one of the most vital in the nation. Benefits of closer ties include better educated and more employable students, as well as the identification of high-leverage research directions and a clear path for technology transfer. An additional key benefit is the political support of the industry for our Department, for the College of Engineering, and for the University.

- We will continue aggressive fundraising efforts, both for our building and for direct support of our faculty and programs. Acquiring funding to make the building a reality is a short-term and absolute top priority; we need to work with the College and the University to make sure that all the other work we have done and support we have been given is not for naught. Endowed professorships and chairs are also key, allowing us to recognize our faculty and to provide financial flexibility.

- We will seek additional ways to recognize and reward high-performance staff members, who are essential to our success and our culture.

- We will use an ever-broadening set of metrics to measure our success. Classic metrics such as graduating top-notch students that are ready for careers in industry, industrial research, and academia, and publishing in first-rate, highly-competitive conferences and in archival journals retain their importance. But many other metrics are of increasing importance. Examples include: building systems that people use, or that influence the systems that they build; developing all forms of intellectual property that advance our field; etc. As fast as the field of information technology changes, we have to be prepared to change the ways in which we assess influence, which is our central goal.

Specific Actions

Many individual actions are necessary to implement our strategic plan and achieve the vision we have outlined. Many of these are already in progress, but some have yet to begin. Many can be carried forward by re-focusing existing resources, but some will require additional resources. Specific actions include:

- We will hire additional staff, to increase the amount of time that faculty can devote to scholarship. We will raise state funds, discretionary funds, and endowments for this purpose.

- We will focus intensively on seizing the four key competitive advantages of universities: students, interdisciplinarity, a long-term focus, and flexibility.

- We will be relentless in advocating more enlightened policies at the University level regarding entrepreneurship, and equally relentless in evolving our own policies and procedures in this arena.

- We will be similarly relentless in our pursuit of funding for the CSE Building, and in our pursuit of acceptable interim expansion space.

- We will thoughtfully but very aggressively fill our numerous vacant faculty positions. We will be conscious of the need to utilize many of these positions to hire "outward-looking" computer scientists and computer engineers, dramatically broadening our perspective and establishing ties throughout the University.

  - Our External Advisory Committee has stressed the need to "look outward" during hiring, and they have pushed us to be "opportunistic without being scattered."
  - One specific example where we are already working for such hires is in animation and graphics, where we have received an Advanced Technology Initiative cluster: we will hire a senior person with proven leadership skills in the area, and we will hire an additional junior person, as well as helping Art or Music to hire someone with complementary skills as part of the cluster.
  - But we should not restrict our interdisciplinary hires to designated slots: we are rich in slots, and we should use some of those to build relationships with other departments where interactions would give us and the University a boost.
  - One thing that clearly separates us from the other top departments is the lack of a "Turing-caliber" individual – a person who has received, or is likely to receive in the near future, the top technical prize in our field. Our competitiveness would be greatly enhanced by hiring a Turing-caliber senior person in any area of strategic importance. Consistent with this goal is the need to acquire a set of endowed chairs that can be used to recruit and retain faculty.

- We will ever-more-actively encourage research and education ties on the part of additional individuals at Microsoft, and other affiliate companies.

- We will take advantage of the prodigious amounts of production and experimental bandwidth that has become available to us in the past year through the efforts of UW Computing & Communications, and of the extraordinary degree of control that we can exercise over this infrastructure. This bandwidth and control can drive forward research in many subfields.

- We will actively encourage collaborative research: within the department, within the University, and with external organizations.

- Beyond this, we will examine the balance of research styles in the department. By informal policy, we assert to support and allow all styles of research, ranging from small projects to large ones. However, we are heavily balanced towards small projects. If we determine that we prefer, for any number of reasons, a different balance, then we need to consider how to encourage and support such activities. (Lack of space is an enormous impediment in this regard.)

- We will smoothly and quickly manage the recently-funded expansion of our Computer Engineering program. This includes admitting new students, perfecting the new curricular elements, and coordinating all aspects with the existing Computer Science and Computer Engineering programs.

- We will continue to engage our undergraduates in research assistantships, teaching assistantships, and co-ops/internships, believing that each of these significantly enhances the educational experience.

- In addition, we will continue to actively recruit outstanding students to UW, to provide increased flexibility within our programs while maintaining curricular coherence and integrity, to emphasize teaching quality, to continually incorporate new technological advances into our curriculum, and to prepare our students, at all levels, for a wide variety of careers.

- We will refine and expand our capstone design course offerings. These courses allow undergraduates to take on complex, group projects that require them to apply sets of concepts, abilities and skills that

they have acquired in earlier classes. The goals are to teach how to combine diverse sets of ideas and knowledge, how to work effectively in groups, and how to manage engineering tradeoffs given constrained schedules. Our existing offerings are strong; we will continually broaden the options available to students.

- For our senior-level project courses (other than the capstone courses), we will consider whether or not we should and can separate the project from the course *per se*. Doing so would allow students with significant project experience – be it from capstone courses or from co-ops or internships – to learn the fundamental material about some topics without an enormous time commitment. It may be possible and beneficial to do this, giving the students the flexibility to choose an appropriate balance of depth vs. breadth. (Of course, all students will be required to have an appropriate amount of project experience.)

- We will undertake an overall curricular review, making intellectually sound changes in our undergraduate curriculum that will better prepare our students for their careers.

- We will make several significant improvements in our introductory programming sequence. These improvements are likely to include: developing at least one additional alternative course sequence, with the intention of better addressing the needs and backgrounds of the incredibly diverse population that takes these courses; developing challenge exams that allow us to properly place (and perhaps grant credit to) students with prior instruction or experience; and continuing to refine efforts to teach these courses using alternative delivery mechanisms, including tutored video instruction (TVI) and asynchronous web-based instruction.

- We will further enhance ties with Electrical Engineering. Progress is continually being made. We firmly believe that the EE/CSE Initiative has paid off handsomely for the two departments, for the College, and for the University. There are many exciting research areas at the boundaries between our two disciplines. These include human/computer interaction (speech, haptics), networking (coding, compression, protocols, wireless), and high-performance architectures (digital signal processing, reconfigurable hardware). We are developing collaborations in each of these areas and creating joint programs. We also need to pursue ways to reduce barriers for our CSE and EE faculty to teach joint courses.

- We are committed to educating a broader range of students. Larry Snyder's national leadership in Information Technology Fluency is the basis for a new course in this area; determining ways to spread this material effectively through the university and the state is an important next task.

- We will strive to increase the educational opportunities available in information technology throughout the State. As a pilot program, we are working with UW Educational Outreach and UW Bothell to define a carefully articulated set of certificate programs that, in principle, could lead to a C&SS degree at Bothell. We are in early stages of discussions with UW Educational Outreach, Shoreline Community College, Edmonds Community College, and the Puget Sound Center for Teaching, Learning, and Technology to pursue ways to unify and improve the quality of statewide instruction in introductory computer programming (and perhaps other related courses); an approach like this promises not only to improve the quality of instruction but also to increase the productivity of the instructors statewide.

- We will further strengthen our industrial outreach efforts, hiring additional highly capable staff to head these efforts. In addition, we will continue to strive to better explain what we do, and why we do it, not only to industry, but also to our alumni, to government officials throughout the State, to the media, and to the general public.

- We will re-examine one element of our departmental culture: the principle that all faculty members will have the same balance of research, teaching, and service. Our entire department is structured around this notion, as can be seen in our workload policies, our evaluation policies, etc. We are beginning to recognize that this approach may not stand up to the changes we've seen through the department, the academy, and society. We need to carefully and thoughtfully consider whether to change this element of the culture; and if we decide to change it, we need to take careful steps to do it in an equitable way that maintains the overall culture we've worked so hard to develop.

Summary

Computer science and engineering is truly the tool for the coming decade, and beyond. *The true power of information technology is as a human enabler* – transforming all aspects of our lives: commerce, education, employment, health care, manufacturing, government, communications, and entertainment, as well as all of science and engineering. *Any imaginable vision for the University of Washington of the next decade – and any imaginable vision for our region – will have an outstanding Department of Computer Science & Engineering as a cornerstone, a sine qua non.* Our own vision is to rise to meet this imperative: to lead the way, in partnership with others, in capitalizing on our many advantages, achieving a forefront position in areas of high impact in information technology that will benefit the University, the region, and the nation.

The Department of Computer Science & Engineering has a clear vision, excellent positioning, a sound strategic plan, and a specific set of actions to implement this plan. We also have an unparalleled track record of performance. Computer Science & Engineering remains an excellent place for the University and the College to leverage their resources.

An enormous opportunity exists – one that the University of Washington cannot afford to miss.