

Computing the Profession

Peter J. Denning

Computer Science, 4A5
George Mason University
Fairfax, VA 22030
pjd@gmu.edu

This is an abstract of the keynote speech at the 1999 SIGCSE Conference, given on the occasion of Peter Denning's receipt of the 1999 SIGCSE Award for Outstanding Education in Computer Science. It is based on his essay, "Computing the Profession," in *Educom Review*, November 1998.

Fellow Computer Scientists and Engineers:

To most of the hundred millions of computer-users around the world, the inner workings of a computer are an utter mystery. Opening the box holds as much attraction as lifting the hood of a modern car. Users expect computing professionals to help them with their needs for designing, locating, retrieving, using, configuring, programming, maintaining, and understanding computers, networks, applications, and digital objects. They expect academic computer science to educate and train computing professionals, to be familiar with the changing technologies, and to maintain research programs that contribute to these ends. Students of computing look to faculty for a comprehensive, up-to-date view of a world with many fragments, for making sense of rapidly changing technologies, for assistance in framing and answering important questions, and for training in effective professional practices.

Information technology is transitioning from a set of computing-related disciplines into a full-fledged profession. This transition is happening in response to the rapidly widening influence of computing technology, which has provoked broad concerns for reliable, dependable, secure, and professionally managed computing systems. Information Technology is also called Computing or Informatics. (See "Computing the Profession," by P. Denning, *Educom Review*, Nov 1998.)

Much attention has been focused recently on professional education and certification for software engineers. This has turned out to be a divisive issue between computer scientists and software engineers. But these divisions are just the tip of an iceberg. The profession is much broader and the problems much more widespread.

The IT Profession comprises a surprising variety of specialties, most all the children of computer science -- subsets, extension, or derivatives of traditional CS. They all share a common scientific technical core but different professional standards and practices. Each has a professional identity and most have professional societies. I count two dozen such fields: computer science, information science, information systems, management information systems, software architecture, software engineering, computer engineering, network engineering, knowledge engineering, database engineering, systems engineering, system security and privacy, performance analysis (capacity planning), scientific computing, computational science, artificial intelligence, graphics, HCI (human-computer interface), computational statistics, numerical modeling, digital library sciences, cognitive sciences, web service design, multimedia design, instructional design, system administration, and more. (There are undoubtedly others!)

In the past two years, IT workforce shortages and IT worker preparation have become celebrated causes. The workforce issue has revealed publicly how unprepared our education system is for the IT profession. Unfortunately, the public debate has focused on numbers (e.g., 350,000 unfilled IT jobs nationally in 1998), a focus that makes the problem appear as a lack of flow in the pipeline that will soon be filled as students are attracted to the vacancies. This focus hides the true extent of the problem. The real problem is *a severe mismatch between the demands of the market for IT professionals and the supply systems of education*. The problem will not be resolved without extensive cooperation between people in the marketplace for IT professionals and people in the education supply system. This will demand significant changes in how IT-related educators view their mission and organize themselves to deal with the realities of the markets and IT professions.

This problem has significantly impaired our collective ability to provide professional education, certify competence and skills of IT professionals, maintain professional competence, set standards of ethical practice, and ensure that state-sponsored licensing of IT

professionals is reasonable -- and address all these needs worldwide.

This situation is unsettling for many of us. We view ourselves as the "parents" of a thriving profession and are troubled by the growing tensions between segments of computer science. We no longer feel in "control" of our own discipline; many novice groups are appearing, placing demands, and claiming central roles. Many of us feel as if we are often engaged in power struggles with specialties that ungratefully seek separation from computer science. As educators, we are overwhelmed at the magnitude of the work to be done to upgrade our programs to handle professional education and the lack of new resources available to help us do it.

As traditional computer scientists, we face a dilemma. Should we cling to a conservative view, insisting that our offspring not separate and the newcomers not merge? If so, we run the risk of being sidelined in the new profession. Should we seek a leadership position in the new profession? If so, we must cross a chasm separating our current concerns from those of the multitude of clients who seek our expertise. To cross the chasm, we must embrace the birth of a new profession.

Bases of a Profession

The path across the chasm consists of six major segments. Each is based on accepting a basic truth about the profession and acting on it.

- (1) Like every other profession, IT is based on a set of durable human concerns for taking care of others, for seizing opportunities, and for removing blockages to progress; the need for a profession will not soon disappear.
- (2) Practices are as important a part of knowledge as discourses, mental models, conceptual frameworks, processes, and rules.
- (3) Concerns and practices first show up when technology is applied in real circumstances: applications domains are the front lines of the profession.
- (4) Innovation is the ultimate reward of research; R&D portfolios must expand to include innovations in ideas, in teaching practices, in products, and even in business designs.
- (5) Much innovation occurs at the boundaries between fields; the practices of one appear at the margins of the other, moving eventually to the center.
- (6) In addition to the traditional formal degrees, the system of higher education must accommodate professional practice, continuing professional education, certification where appropriate, the full spectrum of professional specialties, and involvement with customers.

With such changes, familiar, vexatious dichotomies such as "computer science versus X", "research versus application," "researcher versus practitioner," and "education versus training," are likely to disappear.

Through its research, the IT Profession must anticipate future breakdowns that others will encounter. A close interaction between computer researchers and others is essential so that the questions under investigation remain connected to real concerns, both short and long term. Otherwise computing research can drift into irrelevance and cease to earn public support.

We computer scientists and software engineers, who are at the heart of the computing profession, are being invited to embrace commercial applications, interactions with other fields, and the concerns of their customers. If we do not, clients of the profession will turn elsewhere for the help they need. It hardly needs pointing out that, in this case, we will effectively isolate ourselves from the IT Profession. An historical tendency toward insularity is, in my view, behind the current tensions between software engineers and other computer scientists.

What of the questions about separation or reconciliation that frustrate traditional computer scientists and software engineers? The view of profession shows that software engineering and computer science are parts of the same profession. Software engineering does not have to be a subset of a computer science department to accomplish this. What matters is that the two groups recognize their common core and collaborate on their common interests. Both groups have to come to grips with the fact that they are no longer in control of the profession; the pragmatists are. A bigger threat to the profession is a potential conflict at the dean's level. If two deans divide the specialties between their schools without arranging for a common core and interchange of students and faculty, turf battles are likely to isolate the specialties and reduce communication among them, thereby weakening the IT Profession on that campus.

As "parents" of the new profession, computer scientists have the opportunity to play a special role among the IT specialties: being custodian of the common core of science and technology. Articulation of the core must be done in collaboration with people from the many specialties.

Computer scientists, software engineers, computational scientists, and other information technologists have a marvelous opportunity to transform their academic disciplines into the IT Profession. They will have to face, and cross, the chasm between their practices as inventors and visionaries, and the pragmatic interests of their many clients and customers. It will not be easy. They have shown they can do it before, and they can do it again.