

Determining Computing Science's Role

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Today, computing science struggles with an identity crisis that threatens to turn it into just another facet of industrial software development. This crisis has caused many to question the role computing science should play and whether it will still belong to the computing profession.

As part of the computing profession, computing science has functioned as an academic component. This doesn't necessarily mean that only people who work in academia can be considered computing scientists, but it does mean that the institutional structures these people belong to typify academia. Further, the cluster of social practices that drive their activities—the set of acceptable discourses, the practices of incorporating new discoveries, and the institutional rewards—is typical of scientific enterprise.

As an academic scientific discipline, computing science has two primary components: education and research, with the latter defined as the free and unconstrained pursuit of knowledge.

Unfortunately, the growing influence of industry and its increasing power to dictate the direction of research and curricula have caused the predominance of the industrial ethos over the cultural and of the economic imperative over the pedagogical. This phenomenon is particularly evident in the US, but globalization of the economy



Computing science's commercialization has powerful implications for society and the profession.

and homogenization of culture spreads it throughout the industrialized world.

VOCATIONAL MODEL

The educational crisis stems from the arrival, during the Industrial Age, of an educational ethos more sensitive to industry's immediate needs than to students' long-term intellectual advantage. This ethos drove the university away from traditional humanist and generalist education toward a more vocational focus that, at least in undergraduate computing science curricula, closely models that imparted by technical colleges.

Vocational colleges prepare technicians to perform occasionally complicated but fairly routine jobs. In their area of education, some of these institutions do an excellent job, but this should not lead us to confuse their training with the education we expect a university to impart.

Universities do not teach their students how to solve the problems they will find in their professional life because it is understood that it isn't

possible to teach someone how to solve a radically new problem. Rather, universities strive to stimulate their students' intellectual curiosity and provide them the cultural awareness—both general and specific to a discipline—needed to see things from an original point of view.

Unfortunately, under pressure to prepare a well-trained as opposed to a well-educated workforce, university education tends to focus on practical, application-oriented curricula. This vocational focus does a tremendous disservice to students, who graduate with only piecemeal skills that soon

become obsolete, rather than with a *forma mentis* that will last a lifetime.

This practice represents a drastic reduction of computing science's educational role as a mathematical discipline and cultural enterprise, replacing it with a hastily assembled curriculum of engineering tricks and other practicalities—one tailored specifically to industry, which has little use for educated workers or curious, unorthodox thinkers.

Students would be better served if the university proposed the vigorous development of vocational colleges and, at the same time, promoted intellectually stricter criteria for their own admissions. In the case of computing science, stricter mathematical requirements should certainly be part of the criteria.

This is not an elitist choice, but a recognition that there are different types of education and that different institutions have different roles. Alas, at a time when administrators run universities as businesses, with corpora-

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tions as their customers and graduates as their product, any measure that decreases enrollments will likely receive little support.

RESEARCH

The crisis of what we might call pure research in computing science derives from related reasons. A major factor in this cultural crisis can be traced to the fascination that computing science departments have for large, expensive projects. There is nothing wrong with this per se, if we ignore that scientific results seldom scale up proportionally to a project's cost.

Problems arise when seeking financing for large projects in this neoconservative age of public sphere reduction. To do so, universities must seek private capital, which usually comes with significant strings attached. Two strings contribute most to the crisis of computing science: the a priori direction these large projects impart to a department's research and the demand that most research should have immediate application to real-world problems.

The first string leads departments to plan their future activity in certain computing science areas and to prefer hiring faculty with the narrow and specialized interests the department has already decided should guide its direction of research. Fortunately or not, important breakthroughs tend never to come from an expected direction, so determining beforehand the areas in which a department will work essentially condemns that group to scientific sterility.

APPLICATION DEFINED

As to the second string, the expression "real world" hides a strong anti-intellectual bias that places it on a collision course with an intellectual discipline such as computing science. The demand for application-oriented research generates a revealing question: What exactly is an application?

In many intellectual disciplines, from mathematics to history, a technique or any form of discourse is

deemed applicable when it can be used to solve problems within the same discipline. So, a mathematical theorem is important chiefly if it opens the way to other theorems—possibly in different areas of mathematics—or if it uses a proof technique that can be applied to other mathematical problems.

Mathematics has many applications outside itself: Conceivably, a mathematical theorem could be used to find the optimal prosciutto-to-bread ratio in a sandwich. Nevertheless, end results such as this do not drive mathematical research. That drive arises entirely from within the discipline itself.

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Even areas such as calculus, which derive and take inspiration from physics problems, soon assume a life of their own within mathematics. So, while Newton's method of fluxions owes much to the physical problems he tried to solve, the systematization of calculus, from Cauchy to Dedekind, responds to criteria of logical coherence within mathematics. Similarly, although positional astronomy can help someone navigate at sea, this application alone does not drive astronomy.

The situation seems to be different in computing science. These days, users always expect an application to be something external to the discipline. Apparently, unlike mathematicians or astronomers, computing scientists can pursue certain lines of research only if somebody else considers them useful. Today, when the rhetoric of techno-enthusiasts has reached its peak, computing science has been relegated to a pure service discipline, useful to others but with no scientific dignity of its own.

This doesn't come entirely as a surprise given that advocates always frame technical rhetoric strictly in

terms of business, legitimizing any cultural pursuit only as far as it agrees with business's premises. At the bottom of application's definition we find the same industrial influence we found in education: An application is anything that can be useful to the commercial status quo.

ECONOMICS ASCENDANT

This rather reductive view of our discipline ignores all aspects of human life outside the merely economic: An application that improves a society's intellectual life won't be approved unless it can provide a profit for a commercial sector.

If the situation continues along these lines, the only hope for computing science might be to sell theorems. Unfortunately, the response I hear from academics to the increasing commercialization of academia is mostly acquiescence, so such an outcome is all too likely.

All the previous considerations can be related to the weakening of the *school* idea, in the original meaning of *skholé*: a place of leisure, a certain space that must be left in human societies where the immediate needs of livelihood can be forgotten, a space sheltered from life's practical necessities.

Different societies created this space in different ways, and with different access possibilities: In Pericles' Athens, it took the form of a wealthy leisure class, while in the Middle Ages it took the form of the monastery. In this respect, we can take as a transition from the Middle Ages' *skholé* the moment when Cassiodorus left the Ostrogoth court, which could no longer provide such a shelter, and took refuge with his library in a monastery in Vivarium. With this symbolic move, culture disappeared from civilized life for some 800 years.

We can, conversely, mark culture's and *skholé*'s return to civilized society, and the beginning of modernity, with the moment when William of Ockham fled from the Minnonite order and took refuge with the king of Germany. From

that moment forward, with various vicissitudes, secular society and the governments it created have guaranteed such a leisure space and widened its availability, mainly through institutions such as the university.

The relationship between society and university has seldom been idyllic: Universities have had to defend their autonomy, with various degrees of success, against the Holy Roman Empire's emperors, the Pope, the nation states' kings, and the authoritarian outbursts of the democratic governments created after the French and American revolutions.

Given the university's particular status, it can be said that whenever these institutions get along too well with power, they are doing something wrong. Through all these vicissitudes, however, the principle that the secular

society would guarantee a cultural space, free from the concerns of everyday life, has never been questioned.

In the 21st century, this leisure space is again in danger—not from government this time, but from a corporate establishment that, in many cases, has taken on quasigovernmental powers. The idea that every activity, in every area of society, should obey the economic imperative and should have practical effects quantifiable in terms of such an imperative, is new. It threatens the very idea of culture when defined as the free pursuit of knowledge for knowledge's sake.

Unlike the blunt and direct threats of past governments, this new menace comes enveloped in the siren's song of easy money. As we all know, the appeal

of that song doesn't make the siren any less deadly.

At the end of the sixth century, when civilized society as embodied in Theodoric's court could no longer guarantee a sheltered space, culture took refuge in the cloister, where it would remain for 800 years. We can't afford to make it disappear for another 800. ■

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