Is Computer Science Education in Crisis?

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1 Introduction

Computer science is a very young discipline, and a controversial, much-maligned and misunderstood one - even amongst computer scientists. Some have questioned the *raison d'être* for computer science and some employers mistrust or dislike computer science education. Some (in many cases, themselves computer scientists) debunk it and even go as far as questioning its very existence! It leads me in this paper to examine briefly why computer science education *may be* in crisis.

The breakdown of this short paper is as follows. Section 2 reports on the background to this paper. Section 3 presents a worrying criticism of the discipline. Section 4 concludes the paper and raises a research question which could serve as the basis for an empirical investigation.

2 Background

Back in 1974, D. L. Fisher, then head of the Computer Laboratory at the University of Leicester in the UK, wrote a paper entitled 'Computer Science: a suitable case for treatment?' In it, Fisher expressed some, erstwhile, incandescent views. For example, he wrote lucidly:

> Basically, whether one likes it or not, whether it is true or not, the majority of employers mistrust (perhaps even dislike) computer science education. That education is often considered irrelevant and impractical, and the attitude of the computer science graduate is frequently arrogant and disoriented... Far better results are obtained, particularly in the commercial world, if graduates are taken from any other subject but computer science, for these graduates have an open mind and have none of the preconceptions that cause the computer scientist such terrible confusion. They can accept their new job at its apparent face value, and unlike the computer scientist, they do not have to go through that painful stage, whilst they discover and realise that their university education is of limited value" (Fisher, 1974, 1).

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What made this quote memorable when I first read it was the fact that I had heard similar comments from a couple of other UK industrialists. Not much later after I had read Fisher's paper, I stumbled across Professor Parnas' paper. In what may be described by some as a wholesale debunking of current computer science (CS) education, he writes:

> "In recent years, I have talked to a number of top industry researchers and implementors who are reluctant to hire CS graduates at any level. They prefer to take engineers or mathematicians, even history majors, and teach them programming" (Parnas, 1990, 19).

Fisher's and Parnas' quotes are almost two decades apart but convey the same message which other computer science lecturers/professors may/must have heard too. Elsewhere in the paper, Parnas is even more cryptic:

> "As I look at CS departments around the world, I am appalled at what my younger colleagues - those with their education in computing science - don't know" (*ibid*, 18).

And the eminent computer scientist and Turing award winner, Edsger Dijkstra, also writes:

> "If I look into my foggy crystal ball at the future of computing science education, I overwhelmingly see the depressing picture of "business as usual". The universities will continue to lack the courage to teach hard science; they will continue to misguide the students, and each next stage of infantilization of the curriculum will be hailed as educational progress" (Dijkstra, 1989, 1402).

This list of quotes is by no means exhaustive, but they suffice to make my point that there appears to be a crisis in computer science education.

3 A Worrying Criticism of Computer Science Education

There are many charges levelled at computer science education but we mention just the one here - the charge that Computer Science is education is infantile and immature (Dijkstra, 1989).

> "Computer science graduates "are very weak on fundamental science; their knowledge of technology is focussed on the very narrow areas of programming, programming languages, compilers and operating systems. They confuse existence proofs with products, toys with useful tools." (Parnas, 1990, 18).

To Parnas, we have the worst possible scenario that could have befallen the discipline, and he maintains that the dire predictions of mathematicians and electrical engineers back in the 1960s have turned out to be correct. Indeed, further to his earlier quote in which he lamented what computer scientists do not know he writes:

> "My criticism of the education we now provide is unavoidably a criticism of the preparation of my younger colleagues. A university's primary responsibilities are to its students and society at large. It is unfortunate that they are usually run for the comfort and happiness of the teachers and administrators. In this matter, the interests of our students and society coincide. It is not in students' interest to make them perform engineering without being prepared for that responsibility. Nor is it in their interest to give them an education that prepares them only to be technicians. Too many graduates end up "maintaining" commercial software products, which is analogous to electrical engineers climbing poles to replace cables on microwave towers" (Parnas, 1990, 22).

Dijkstra's (1989) paper is titled "On the Cruelty of Really Teaching Computer Science". Arguing from the viewpoint that computers represent a "radical novelty in our history", he notes that the discipline has been "unfathomedly misunderstood" due to the inappropriate analogy to engineering. Dijkstra is not optimistic. He opines:

> "I now have had my foggy crystal ball for quite a long time. Its predictions are invariably gloomy and usually correct. However, I am quite used to that, and they will not keep me from giving you a few suggestions, even if it is merely an exercise in futility whose only effect is to make you feel guilty" (Dijkstra, 1989, 1402).

Dijkstra's main charge is that computer science education is infantile as it lacks the courage to teach hard science. As earlier noted in this paper, he argues that computer science students are being misguided. The successive computing curricula are of limited improvement: in his words, "each stage of infantilization of the curriculum will be hailed as educational progress".

4 Conclusion and a Research Question

Is there a Crisis in Computer Science Education? This question must be a logical inevitability from the arguments expressed so far. Let me review the evidence. In the March 1995 issue of *ACM Computing Surveys*, computer scientists themselves seem to be in some confusion over what computer science is. In Section 3, some very eminent computer science scholars have debunked the discipline as infantile and immature. Many more who I have not mentioned here question the *raison d'être* for computer science education. Perhaps most worrying of all, are the persistent views that computer science graduates are not suitable for some employers, who appear to distrust computing qualifications (Nwana, 1996).

Prima facie, computer science education *must* be in crisis. But, is it really? I argue that the evidence provided by the accusers in support of their criticisms is largely anecdotal. Therefore, I propose an umbrella research question which could resolve these criticisms: does computer science education meet the needs of its stakeholders? However, since the curriculum is at the core of computer science education and Curricula '91 is the most recent curriculum, the question may be reposed as follows: t*o what extent does ACM/IEEE-CS's Computing Curricula 1991 meet the needs of stakeholders in computer science education*? Stakeholders include computer science academics, industrialists, students, professional computing bodies, politicians and society at large. I am currently researching this question. Only when the results of such a study yields, conclusively, negative results can we possibly suggest that computer science education is in crisis. Until then, I conclude, preliminarily, that there is no evidence of a crisis so far.

For a much fuller exposition of the ideas on which this paper is based, the interested reader is referred to Nwana (1996).

5 References

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