Getting Computer Science Majors: What are we missing?

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Abstract

We present issues and ideas for recruiting undergraduate computer science students. We believe the problem is largely one of marketing. Prestige, respect, societal impact and other desirables of our discipline need to be communicated broadly.

Introduction

We hear it's about to get better, but most computer science departments still need to recruit many new students. And we'd like the blend of students to include different personality types, genders, and races. While there are plenty of ideas on how to do this, and some successful programs, we still aren't getting them to come and stay. Small departments face greater challenges in trying to implement many of the good ideas.

We need to examine the core problems, examples of successful programs, and some of the best ideas for recruiting and retaining undergraduate computer science students. One of the best new ideas is integrating computational thinking into education starting in elementary schools, as advocated by George Fletcher and James Lu in a recent CACM issue.

What are we as educators missing when it comes to understanding why students aren't coming to the discipline? To a large extent, we believe it could be a marketing issue. Where are the heroes, the role models that children can aspire to? For baby boomers with maybe 7 available television channels, shows like Star Trek offered us characters that not only did cool stuff, they were the kind of people we wanted to be. Prestige, respect, societal impact and other desirables of our discipline need to be communicated broadly. Yes, we need the new courses, curriculums, and outreach programs. But perhaps we need a bit more.

Note that the purpose of this article is to present some hypotheses. The goal is to recruit high quality students that become productive, happy Computer Scientists. To get there, it seems we must diagnose the reason for the continuing low enrollments following the dot-com bust. What are we missing?

Success Stories

Most schools have been involved in a number of valuable outreach and recruitment activities. These include outreach to mostly high school and some junior high, in which students visit campuses and perhaps have those students come to campus to participate in contests. The reach of these programs does tend to be regional and does require significant effort on the part of mostly individuals that are taking the tasks on as extra work. As one faculty member reports [CSTA, 2008]:

> *"It doesn't count for tenure, it doesn't help you publish technical articles, it doesn't count for service work, and it doesn't bring in the big money grants. And the rest of the faculty do not respect the work that we are doing". Participant from a recent Computer Science Teacher's Association meeting,*

Without large scale, national efforts, this work seems unlikely to have a significant effect on overall recruitment. We need to think bigger.

Similarly, attempts to make computing "fun" at the college level may get some initial interest sparked, such as with robotics, or more recently, games. We need to look closely at whether we are trying to entertain students and give them the motivation to pursue a challenging course of study that brings intrinsic rewards. What is the usual attention span of a young adult? Perhaps not long enough to see them through the difficulties necessary to significantly develop knowledge and skill. And we wish to instill the sense of pride that comes from perseverance through challenges. In this way, we want to emulate developing musical ability rather than how to load music on the MP3 player.

Obstacles

There are a number of obstacles that stand in the way of implementing successful ideas and activities. Some of the big ones are money, time and desire.

Money for computers and software is not such a big issue. Computers are usually already available, and when they are not they are fairly inexpensive. Open source software is free and often high quality. However, some of the successful programs that target secondary school students may require purchasing computers, robots, or other equipment.

Time for faculty to engage in recruitment and retention of majors is a big issue. Enthusiastic, motivated faculty members are often in demand for other activities – research, teaching, mentoring, and the seemingly endless and sometimes worthwhile service activities. There is a "pecking order" at some research-oriented universities, wherein faculty that focus on teaching and service are undervalued. At teaching-oriented colleges, high teaching loads may leave little time for other activities.

Even if money and time are available, some schools seem unwilling to address the problem. In some cases, colleagues fight attempts to increase enrollments. Perhaps they don't want the extra work that comes with larger enrollments. Maybe they resent us, or feel badly, because they don't want get involved (another example of not wanting to work harder?). The only options here seem to be: (1) try to engage them, or at least find a way to get their support, (2) do what seems right anyway, or (3) give up. Option 1 is preferred, but can be elusive, and option 3 doesn't solve the problem

Personality and Behavioral Differences

Personality models, such as MBTI or the OCEAN model [Larsen and Buss, 2008], can be used to help understand differences in student and faculty behaviors. We focus on student behaviors here and the MBTI personality model.

Most people prefer to be environments where they feel accepted and respected, not just for their capabilities (e.g. programming skills), but for *who they are*. We tend to leave (flight) or argue (fight) with other people when we are not in such environments. Others may judge these coping behaviors instead of our true selves. Thus the abilities and potential of students may not be accurately judged by teachers, parents, and other students.

The MBTI model distinguishes between "thinkers" and "feelers". Feeling types tend to consider how decisions and behaviors will affect others, unlike thinkers. Using a Star Trek example, thinkers include Spock (a Vulcan) and Data (an android without an "emotion chip") while feelers include Deana Troi (the ship's counselor in the Next Generation series) or Dr Beverly Crusher. Thinkers may be may be oblivious to how they are being perceived by others – they just don't think about it! Thus, seemingly innocuous statements like "I learned 3 programming languages in junior high school", when spoken in a boastful tone, may cause those less experienced to feel inadequate, especially when there seem to be a majority of a group expressing themselves this way. While it may motivate some students to learn, feeling inadequate is often a precursor to flight, i.e. leaving. Most women are "feeling" whereas most men are "thinking" in the MBTI model.

It seems that if we want to attract and retain a diverse population of students, we need to create an environment in which students can feel accepted and confident. We don't seem to do that now, probably because Computer Science tends to have a disproportionate (to the general population) number of introverted thinking personalities. This includes professors. It may not be that we don't have enough women in the field (we don't), but that we do not have diversity of personality types.

Culture and Perception

When one looks at the stereotype of a "computer geek", they are judgmental, opinionated, and uncomfortable around people that are not "like them". While perceived as smart, they certainly aren't that inspirational to most young people; if they were, we'd probably have more Computer Science majors. A recent study reports that "students who left the CS major have an overwhelming perception that CS is an asocial, coding-only field with little connection to the outside world." [Biggers, et al., 2008]. In another report [Ciciora, 2009]:

> *"Despite technology's growing impact on society, academic geeks, or nerds, still suffer from negative stereotypes in popular culture, which may explain why women and minorities are avoiding careers in information technology, says University of Illinois at Urbana-Champaign professor Lori Kendall. The concept of the nerd remains an anti-social white male,*

and it has become more prevalent than ever as a stock character in TV shows, movies, and advertisements, Kendall says."

Until our culture changes this perception, getting more students is going to be hard.

If facts were enough to interest students in Computing, then we should have plenty of majors. The long term job prospects and pay are great. So money and job security is not enough.

There has to be interest and identification. If we're not interested in something, especially something that takes a lot of work, we won't persevere. If we cannot envision ourselves as a Computer Scientists, we won't study it.

One way to change perceptions is to change the words we use. A new term, Computational Thinking, is described as follows [cs4fn, 2008]:

> *One of the exciting things about learning Computer science is that you learn a new and fundamental way of thinking and problem solving; a way of thinking that is critical in the 21st Century. It is called "Computational Thinking" and the idea that this is one of the big advantages of studying computer science, whatever your ultimate career, is causing a big stir. Some are even claiming it should be added to reading, writing and arithmetic as a core ability that every person should learn.*
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> *So what is Computational Thinking? Well it is a collection of diverse skills to do with problem solving that result from studying the nature of computation. It includes some obviously important skills that most subjects help develop, like creativity, ability to explain and team work. It also consists of some very specific problem solving skills such as the ability to think logically, algorithmically and recursively.* ***Computer Science is unique in the way it brings all these diverse skills together.***

So, What Now?

Given this rather discouraging state of affairs, what can we do? Broaden our view of what it means to be computationally sophisticated and how various types of thinkers can contribute to constructing better, more useful, systems. It really does take a village.

Curriculum is a key area to examine. Not just standard college-level Computer Science curriculum. We need to examine new, interdisciplinary college programs and we need to look at seriously embedding computational thinking into K-12 education. All student need to come to college with basic reasoning and problem solving skills. It cannot be about the particular tools (programming languages), but how one frames a problem and derives computational (algorithmic solutions to it). One outcome hoped for it that this levels the playing fields for diverse genders, ethnicities, and personality types – people

that value different things. All of whom have something to contribute to improving the quality of the software artifacts we produce.

At a national level, this society must change the image of people that build software. We need to appeal to the youngest kids ("Pete the Programmer"?) and those older (MTV, the Comedy Central network, movies). We need heroes. Teachers and parents need to get the message as well, but so do other adults. Astronomy has done a pretty good job, we should at least be able to do that well.

References

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