

Why Computer Science?

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I have two teenage daughters. The older one is in college, and is studying computer science (CS). The younger one is in high school, approaching college, and is considering computer science as her field of study (and also considering physics and robotics). I am absolutely thrilled that one of them is studying computer science and the other is considering it seriously.

However, I do have one regret about my daughters. *Both* of them get this same glazed look in their eyes and say something like, “Oh dad, not again!” whenever I start talking about why computer science is such a wonderful field to pursue. I like to think that they get that look only because they have heard me speak on this subject once or twice too often, and not because I don’t speak (and write) well on the subject. But you be the judge. In this piece, I’m going to tell you why computer science is indeed a great field to pursue.

Before I get started, however, I first want to discuss some of the different computing disciplines. It can be quite confusing to a newcomer to determine the difference between, say, “computer science” and “computer engineering,” and how “informatics” might relate to either. (If you want a longer, more formal discussion of this subject, see *Computer Curricula 2005: The Overview Report*, available from <http://www.acm.org/education/education/curricula-recommendations>. I was among its ten coauthors.)

In the United States, three undergraduate degrees are fairly widely offered, and two more are offered by some colleges and universities. The three more common degrees are computer science, computer engineering, and management information systems; the two less common are information technology and software engineering. Of these, computer science is the most common, and it will be my main theme, because I am a computer scientist.

Very roughly speaking, computer science is concerned with both the creation of computer software and the use of computers to accomplish novel tasks, ranging from playing games to understanding medical data. Spreadsheets, email, the World Wide Web, Google, Facebook, and Apple’s Siri are all primarily creations of computer scientists. Computer engineering is primarily concerned with the creation of computer hardware. It is a subfield of electrical engineering. Computer scientists and computer engineers often work together on things that lie at or near the hardware–software boundary, or that involve both software and hardware. Two examples are computer networking, including the Internet itself, and computer security. In the US, almost all colleges and universities offer a bachelors degree in computer science. Computer engineering is offered only at schools that have an engineering program. In some other English-speaking countries, “computer science” is sometimes called “informatics.”

Management Information Systems (MIS) is concerned with the use of computers specifically in a business setting. It can be viewed as half a computer science major combined with half a business major. MIS majors typically require fewer advanced mathematics courses than computer science or computer engineering. Some schools call this subject simply “information systems” and a few call it “information and decision sciences.”

Software engineering is the part of computer science that studies how to build really large pieces of software—software that is so large that it must be built by a medium-large team working over months and sometimes over years. In the US there are not many schools that offer a program specifically in software engineering. Most students who want to become software engineers major in computer science. It may even be an advantage for a software engineer to have the somewhat broader background in computing that a computer science degree gives as opposed to the more specialized training focused only on software engineering.

Information technology (IT) is used with two different meanings. Broadly, IT is used to refer all of computing: computers, smartphones, the Internet, etc. Degree programs in information technology, however, are focused on taking care of specifically the IT infrastructure. This is the major for somebody who would specifically like to be a network administrator, a database administrator, or, more generally, “the IT guy (or gal)” for a company. However, fairly few schools in the US offer a major specifically in information technology.

Now let me circle back to computer science, my main subject. Computer science is a very wide-ranging subject. It has aspects of engineering, of mathematics, and of natural science. All computer scientists must learn to program, that is to write code. However, simply writing code is not that big a part of many computer scientists’ jobs. Many computer scientists, especially those who go to work with just a bachelor’s degree, will spend much of their careers in *designing* and implementing software. What makes this creating, engineering side of computer science so interesting (and today so well paid) are the aspects of design, of understanding customer’s requirements for the software, and of understanding how to large teams can create big pieces of software, combined with the actual writing of the software.

Other computer scientists make very heavy use of mathematics to try to do such things as translate the sound signals of speech into the corresponding printed words, to process visual images, to design algorithms to handle the huge amounts of data that we have today (for example, 500 million Tweets a day), or to prove the correct behavior of complicated integrated circuits.

Yet other computer scientists conduct studies of people very much in the spirit of experimental science, to learn, for example, what layout of a screen on a smartphone makes consumers the happiest, or what design of a web browser’s warnings will make computer users least likely to fall prey to scams.

Now that we have some idea of the things that computer science students study and the things computer science graduates do, let’s move on to the key question: Why study computer science?

I have several answers:

1. Computer science is really, really, *really* interesting.

Of course, this one is a matter of personal taste. You won't really know if *you* find computer science really interesting and exciting until you try it. So, try it!

2. Computer science is in the center of our twenty-first century world. Computer science connects to every other field from A, anthropology, to Z, zoology.

I really mean this. Computer science is the greatest field there is today for somebody with broad interests in lots of different subjects, because computer science connects to almost every other field there is. And, in particular, I'm personally familiar with connections to both anthropology and zoology.

I've heard a couple of great talks from hybrid anthropologist-computer scientists who have worked for large companies like Intel studying how different populations around the world use technology. For example, today, in 2014, texting is ubiquitous in the developed world, and I often text with a lawyer friend and colleague who is in his late 60s. However, I heard a fascinating talk from an anthropologist about four or five years ago, explaining that at that time, in the US only teenagers and twenty-somethings were heavy texters, and most adults over 40 did not text at all, whereas in Japan at that time, everybody texted.

As for zoology, in my department at the University of Illinois at Chicago we have an extremely gifted professor named Tanya Berger-Wolf who uses computer science to study the zoology of zebras in collaboration with an ecological biologist. Her most famous invention is software to uniquely identify individual zebras from their stripes. This is a huge advance for the zoologists who study these animals, because it means they need only to photograph the zebras to identify them and reidentify them when they see a particular zebra a second time. In the past zoologists had to shoot the zebras with a tranquilizer dart and attach a collar to them for identification.

3. Computer science, because it is at the center of our world, is an outstanding way to make a difference.

If you want to change the world, you should study computer science. Computer science is the great power of our time. I just discussed how computer science was used to advance the study of zebras—and that work is currently being expanded to all manner of endangered striped and spotted species of animals, such as tigers and snow leopards. Computer science is of course being used to entertain us (think of games, Facebook, etc.) and to help us communicate better. Computer science is also being used in medicine, in community development, in the design of more fuel-efficient cars, and in just about every other field of human endeavor.

4. And, by the way, the job market is booming.

Nobody should ever choose a field of study just because jobs in that field pay well. You should choose a field that you find interesting, that you think you have some aptitude for, and, I would say, also a field where you think you can make a difference in the world. However, it sure is nice if, *in addition*, the subject you study leads to good, well-paid jobs.

Computer science offers wonderful financial opportunities today, and I believe it will continue to do so. It requires a lot of skill, and we do not have enough people with those skills. US Bureau of Labor Statistics studies consistently show computer science as the field that is going to have the most new well-paid jobs over coming years. We see this with our own graduates. The median starting salary of students with a bachelor's degree from my department is now over \$70,000 a year. An occasional superstar student is offered over \$100,000.

There are also a very wide variety of jobs available. You can work in a small or large computing company or as a computer scientist for just about any sort of company. You can, of course, also start your own company.

I myself am a computer science professor. Like most professors, I believe in continuing on to the doctoral level research degree (most often called a Ph.D.) In fact, I will put in a plug for some of you to pursue specifically my career, and consider eventually becoming a computer science professor. It has been a wonderful way of life for me, and many of my colleagues. Indeed, if you Google for lists of the best jobs, you will very often find *both* two or three computer science job titles (e.g., software engineer, computer systems analyst) *and* professor somewhere in the top ten.

Even if becoming a professor does not appeal to you, I do encourage all students who have the ability to pursue a Ph.D. in computer science to do so. First of all, if you find computer science as interesting as I do, then you'll want to study more of it. Second, it's a glorious thing to conduct research. You get to dig really deeply into some subject you have chosen, and become a true expert on it. Then you get to create some brand-new knowledge: Something that nobody ever knew before.

Also, while getting a Ph.D. in computer science is intellectually challenging, it is financially easy, at least at most reasonably strong schools in the US. *You do not pay tuition to study for a Ph.D. in computer science. You get paid to study for a Ph.D. in computer science.* My department, University of Illinois at Chicago, is typical in this regard. If we admit you and you are one of our top candidates, we will offer you multiple years of guaranteed financial support while you are a Ph.D. student (subject to your making good progress, of course). That support includes both paying your tuition, and giving you a stipend in return for your work as either a teaching assistant or a research assistant. You won't get rich on the stipend, but it will pay for your rent on a shared apartment and an occasional night out. Our goal, which we meet most years, is that all of our full-time Ph.D. students who are making good progress will be supported in this manner. Incidentally, this applies to both domestic and international Ph.D. students. For more information about specifically

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my university's Ph.D. program, either go to our general department website <http://www.cs.uic.edu/> and follow the links pointing to Graduate Admissions, or go directly to <https://www.cs.uic.edu/bin/view/Main/GraduateAdmissions>.

I hope you will soon be studying computer science somewhere in the world, and I would be especially pleased to greet you as an incoming Ph.D. computer science student in my department.