Stanford CS Commencement

Alex Aiken

6/18/17

Greetings to our graduates, families and guests, and members of the faculty. I want to give a very special and heartfelt welcome to Jennifer Widom, a former chair of the Computer Science Department and the new Dean of the School of Engineering. My name is Alex Aiken; I am the current Computer Science Department chair.

I want to start by acknowledging that we are all here today to celebrate the Computer Science graduates. Congratulations to all of you for a job well done!

I'd like share some amazing numbers with you. Today we are celebrating 290 people receiving a Bachelor of Science in Computer Science, 244 Masters of Computer Science, and 33 new Ph.D.s. (Before you panic about the length of the ceremony, the good news is that not all 567 graduates are present; the bad news is that about 500 are!) Computer Science has long struggled with gender diversity, but that is rapidly changing. Today 90, or nearly one third, of the Bachelor of Science graduates are women. To put that number in perspective, consider that a decade ago the department awarded a total of 70 Bachelors degrees. There are more women graduating with a CS degree today than there were CS majors just ten years ago!

These statistics raise an obvious question. Why is Computer Science such a popular major, particularly at Stanford? When I ask undergraduates that question, the first response is that CS is "cool", which I choose to interpret as appreciation for the intellectual breadth and depth of the field. There is also undoubtedly an economic component, more commonly known as "jobs". But I would venture to guess that Mehran's lightsaber skills in CS106A also have something to do with it! I also suspect that everyone present understands that we live in a time when computer science is reshaping the world around us, and this alone makes it a topic that everyone, not just computer science majors, would benefit from knowing something about. For everyone here who is about to embark on a career in computer science, you are

setting out at a moment of incredible opportunity and promise. The progress, excitement, and dare I say it, the hype, surrounding computer science and its possibilities for the future have never been greater.

But, for those of us on the stage who have been in computer science for a long time, there is something familiar about this moment. Since the 1960's we have been through several such booms, each bigger than the one that preceded it. I'd like to tell you a little about that history and how it relates to our situation today.

This story starts about sixty years ago, in the late 1950's. At that time, the first computers had been around for only a few years. The field of computer science did not exist; the topic literally did not have a name. A few mathematicians and electrical engineers had begun to think about the new world of computation. The engineers tended to focus on building better computers: smaller, faster, and with more memory. The computers of the time were marvels, with massive 18KB memories and capable of a blazing 10,000 operations per second, and they only required most of an entire floor of a building to operate. But the engineers believed that with some ingenuity and effort, they might be able to do a little better. The mathematicians had already been pondering what could be computed for decades. When this abstract question with no possible practical application suddenly became very concrete and relevant with the advent of computers, a few of those mathematicians started thinking about the novel questions posed by these new machines.

One of those mathematicians was a man named George Forsythe. George was a numerical analyst and had had the opportunity to program one of the first computers when he worked for the US government in the late 1940's. Like many of us, he was hooked by his early programming experiences, and so by the late '50's he had already been thinking deeply about the new field of automatic computation for a decade. He became one of the earliest voices for the new field and began to give speeches and lobby for increased investment in the study of computation. Here is a quote from a lecture he gave at Dartmouth. Keep in mind that the year is 1961:

“Machine-held strings of binary digits can simulate a great many kinds of things, of which numbers are just one kind. For example, they can simulate automobiles on a freeway, chess pieces, electrons in a box, musical notes, Russian words, patterns on a paper, human cells, colors, electrical circuits, and so on. ... Whether computers are used for engineering design, medical data processing, composing music, or other purposes, the structure of computing is much the same.”

Those words were spoken more than 50 years ago, years before the first practical systems for designing electrical circuits, playing chess, or self-driving cars. To the people of the time who had never used computers and probably had never even heard of them, it must have sounded like hype and crazy talk. To those who had studied the new technology and knew its potential, however, it was already clear that most if not all of these wonders would eventually come to pass – it was not a question of if, but when.

George Forsythe also recognized that computing was something new. Though he was trained as a mathematician, he understood that computing was not mathematics, nor was it like any other branch of engineering. He believed that computing needed its own identity, and he became the most articulate, tireless and influential champion of that point of view. Here is another quote from that same speech in 1961:

“Enough is known already of the diverse applications of computing for us to recognize the birth of a coherent body of technique, which I call computer science...”

And here is another quote, this one from one of his papers:

“The most valuable acquisitions in a scientific or technical education are the general-purpose mental tools which remain serviceable for a lifetime. I rate natural language and mathematics as the most important of these tools, and computer science as a third...”

A half century has passed since those words were written. Much of the world has only come around to George’s point of view in the last few years. What lessons can we draw, and what does it mean for a new graduate in Computer Science?

There is a tendency to look back and think it remarkable that events developed so closely in line with the vision of someone like George Forsythe. We shake our heads and say with awe that it is a rare person who has such an ability to predict the future. But the truth is both more mundane and more profound. It is not a coincidence that things turned out the way George Forsythe predicted. He didn't just see the future, he created it. We have a field called computer science, we have computer science departments, we have computer science education and you are receiving computer science degrees today because he and a handful of other early contributors made it so. The future does not just happen by itself; it happens because someone understands that something is possible, and then gives it a name, and then works to inspire, cajole and lead everyone else to realize that that is the future they want. And in the story of the creation of Computer Science is a practical formula for your own future efforts: have a good idea, clearly articulate it, and then convince people that it is the right thing to do. The secret is to understand and accept that each step is harder than the previous one. Having a truly good idea is not easy, but it is definitely the easiest part; refining the idea until it is as simple and clear as possible and then doggedly communicating and convincing people, that is where the hardest work lies.

So my first message to you is: You can do this. You are uniquely positioned to make a positive difference in the world. And the world needs you. As one observer put it, "We are extremely short of talented people in this field." That observer was George Forsythe, in 1961, and the situation has not changed. I don't have an exact number, but it is certain that fewer than 9,000 people have ever received a Stanford Computer Science degree of any kind. Think about the impact that those people have had on the world, and then realize that I am including you in the total: 6% of all the Stanford Computer Science graduates in history are graduating today.

My second message is that with opportunity comes responsibility. The founders of computer science were optimists and spoke eloquently of the potential of computers to improve the lives of human beings. And that has proven true. But there is a dark side, too, that the optimists did not foresee. The tools of computer science can be used to attack

individuals, take their life savings, even steal their very identities. The potential for damage on a much larger scale due to simple errors in computer systems is also very real, but truly scary are the potential catastrophes from cyber attacks on civil infrastructure and the systematic manipulation of social media already practiced by some governments on their own citizens and, increasingly, on their adversaries. Beyond the potential for deliberately destabilizing societies, computer technology is testing ancient assumptions about how societies function, and it is clear that we do not understand the implications. What do national borders mean in an era when everyone on the planet, including your roommate and shadowy hackers halfway across the world, are equally close to you in cyberspace? What are our shared expectations and rights to privacy in the digital world? How can society adapt to the dislocation caused by the increasingly rapid destruction and creation not just of individual jobs, but of entire industries? Most people simply do not, and perhaps do not want to, understand the scale of the challenges we face. You are among the best equipped to meet these challenges, and your contributions, large and small, will all be necessary.

I am, ultimately, optimistic. You are the first internet generation; in 1995, about when the youngest of you were born, less than 1% of the world was on the internet. But almost all of you grew up with digital technology as part of your lives, and you understand it and relate to it in ways very different from your parents and grandparents. Your generational advantage is real, and I believe that your intuition and experience from growing up in a digital world will lead to new and better ideas about what a digital society should be. We're counting on you and, quite frankly, you don't have much of a choice. Many of you will be the ones making decisions that affect the way millions and perhaps billions of people live and work. Embrace that responsibility and use your talents to steer the world toward a better place.

George Forsythe was hired as a Professor in the Math Department at Stanford in 1957. In 1965, he founded and became the first chair of the then-new Stanford Computer Science Department. He personally hired the original faculty and it is very much because of him that we are here together today. So I'd like to close by repeating his words once more: "We are extremely short of talented people in this field … that I call

Computer Science". It is a little hard to believe looking at all of you here today, but that statement is still true. It is the source of both your opportunities and your responsibilities. Good luck to all of the graduates, come back and see us any time, and thank you for your attention.