The Origins and Impact of CIS

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Abstract

Looking forward to 2020 I recount some of the key events and ideas that led to the formation of the *Faculty of Computing and Information Science (CIS)* in 1999. We are celebrating the twentieth anniversary of this unique academic unit. A celebration provides opportunities to think about the future of our unique academic unit. Its value to Cornell is well established and the opportunities for greater impact have never been better because of the widely understood and increasing importance of computer science and information science.

I want to be explicitly clear that without President Hunter Rawlings there would be no CIS. He enriched and embraced the vision that my computer science colleagues and other influential CIS founders made real. He advocated for us and helped us shape our identity. Twenty years of experience have validated Cornell's vision for CIS. The annual reports on the progress of CIS provide rich data for an historical perspective.

1 Looking Back

First, when we look back now to 1999 when Cornell created CIS it is more clear to everyone that this new branch of science has become *much more important and impactfull even than we imagined*. We aspired to be "visionary", and by now *events and forces have almost overtaken our early vision*. In my research group on automated reasoning we now catch glimpses of the future on a regular basis as our proof assistant helps us and some of the best mathematicians in the world solve very challenging open problems, some with wide applications in science and engineering. Every CS and IS professor in CIS can describe an exciting research agenda, and these faculty are working hard to advance it. This includes me, and I would like to briefly mention one very exciting research idea before my mike is turned off.

Second, it is clear that Cornell must rise to the new challenges and expand our leadership role. Having 1,600 CS majors is one sign of the times. This is the character of Cornell, it's in our genes, extending the "any person any study" beyond the campus and beyond the expected. We did not expect our "thought assistant" (called Nuprl) to help create new mathematics. It was designed to help people avoid mistakes and enable them to compute precise answers. *Now it*

does much more than that! It has led us to new results, and it has drawn some of the best mathematicians in the world to work with us here in Ithaca.

To add a bit more detail, I want to quote the first sentence from the CS Vision Statement mentioned as a catalyst for CIS. Perhaps each of the 26 CS faculty of that time helped craft this sentence – until we all believed in it as did the intellectually engaged President. Here is that sentence verbatim from the *1996-97 Annual Report* page 5:

In the great American universities of the 21st century it must be possible for any student to bring to bear on any subject the ideas and technology of computer science.

2 Some Questions and Issues

I've been asked to make sure I comment on *how the idea for CIS came about.* So let me address that first.

I was the CS Dept chair when Hunter Rawlings became president. All the chairs and deans were invited to meet Hunter when he was introduced as the new president. He gave an inspiring speech about Ezra Cornell's vision for the university. As he was giving that speech, I saw a way to turn Ezra's theme into a vision for a possible new academic unit. Ezra said "I would found a university where any student can receive instruction in any subject."

Hunter created committees to look into new opportunities for the colleges. The committee I was on for engineering and science gave me an opportunity to propose the creation of a new college level unit. To express this vision, I created a variant of Ezra's quote that Hunter liked. The one quoted just before this section.

Hunter with agreement from Engineering dean John Hopcroft formed a committee to look into the role of computing. This gave us a forum for testing and developing what became the founding ideas for CIS, and it led me to propose a new college level unit that we called a *Faculty of Computing and Information Science*. I drew on my time abroad in the UK where *colleges* are called *faculties*.

3 Computing and Information Science circa 2020

Time has validated our vision for CIS. The impact of computing and information science on nearly every aspect of modern life is a fascinating story now told from many viewpoints and embraced by many nations. It is a challenge for science fiction to keep up with scientific facts in this field.

I know from my own research that certain kinds of *machines* are changing the game in advanced mathematics as I mentioned at the start. We have called some of these machines "proof assistants" because they help us produce completely rigorous and trustworthy mathematical proofs. These are the "*thinking machines*" I know best. But I think we might find a more widely understood name for them. In a sense they are *thought assistants*.

Proof assistants are machines that extend the range of methods and tools for solving very hard technical problems. Those of us in this field know that these machines will soon be indispensable and even legally required for certain critical tasks. Right now it is thrilling to watch a brilliant master "user" solve an important open mathematical problem. This has happened more than once at Cornell, and it is amazing to see, especially if the contribution of the proof assistant is clear and critical. Over the next decade there will be many more examples of this phenomenon. What will this mean for mathematics and science and the field of Artificial Intelligence (**AI**)? What will it mean for our understanding of the human condition? This phenomenon will touch the humanities, as our information scientists demonstrate.

These ideas about the future are expressed well in books and articles. One of my favorite is from 1997, *Darwin among the Machines* by George B. Dyson. He says in the Preface:

"In the game of life and evolution there are three players at the table: human beings, nature, and machines. I am firmly on the side of nature. But nature, I suspect, is on the side of the machines."

There is an optimistic way to see this because thought machines help human beings understand nature and our place in the universe. Computer scientists are making machines smarter to make ourselves wiser. Wisdom is more than knowledge, and while I know a smart machine that we call Nuprl, I know yet of no wise machine.