Introduction to Disciplines and Wicked Problem

As soon as I sat down to complete my first programming assignment five years ago, I realized that coding was one of the only things I could happily sit and do for hours. Knowing that the thing I'm making will do something. The ability to create things without expensive materials or a special workplace. How pretty dark mode in VSCode looks. I was hooked immediately. I first dropped my biology major for a combined major in physics and computer science, and then eventually dropped physics for more coding. I'd always been drawn to fields with wide-ranging applications, so in hindsight choosing computer science seemed inevitable. Computer science is the study of computers and computational systems. This includes all digital devices, from phones to microwaves. Computer scientists deal mostly with software, which is a set of instructions that computers can understand.

One of the things that really drew me to computer science is that software is *literally everywhere*. I can barely think of any fields that don't interact with software in some way. Like in many other fields, the term 'computer science' has expanded to cover a huge range of different technologies, each becoming more distinct as time goes on. Under the umbrella of computer science lies networks, information theory, cryptography, programming languages, software engineering, artificial intelligence, computational science, and robotics, each of which has their own subfields. Of these, I'm most interested in artificial intelligence and computational science. Artificial Intelligence (AI) is essentially the study of making computers better at performing tasks that humans do naturally, like recognizing faces and objects, making decisions based on common sense (something like 'if I'm thirsty, I should drink water'), learning to play games, read, write, and even compose music. All these tasks are generally straightforward (except for music composition) for a human, but they are very difficult for computers to perform the same tasks. One of the most active fields of AI right now is machine learning; the use of self-updating function approximations to achieve a certain task. Machine learning takes a huge amount of data to train but has shown remarkable results with things like Tesla's self-driving car and GPT-3, which is a language model that can write convincing stories and even have conversations. I'm very fascinated by the field of machine learning because of its potential to transform the face of employment. Doctors can take more patients faster and diagnose better with the help of machine learning. Self-driving cars will make the streets safer and reduce traffic, and language models like GPT-3 will help us access and share knowledge more easily.

While AI is certainly flashy and exciting, I think computational science may rival it in applications. Computational science is the application of computation to the other sciences. It's frequently used in the construction of aircraft and spacecraft, as well as biological research and medicine. I think that digitalization of the sciences should be able to make our lives easier and more productive, reduce economic disparity, and increase the rate of progress. I'm especially interested in the application of software to healthcare and medical research. Because healthcare and biotech research are so laden with data and coordination problems, this field is primed for software to radically improve efficiency.

The space between medicine and computer science is called medical informatics and is concerned with using computers to acquire and analyze data for improving healthcare and clinical research. Because of the complex and unstructured nature of information in medicine, this field has lagged behind others in terms of digital adoption. Many clinics still rely on paper for their records or on clunky electronic medical records that don't fully support their practices. Medicine is often thought of as a single field, but there is an incredible amount of specialization into subfields, and doctors often have difficulty communicating across these divisions. On top of this, biological research often uses different terminology than medicine, worsening the communications problems even more. There is simply too much information for any one person to know, and specialization can lead to problems with communication. It's vital to be able to communicate effectively with a team where everyone has different backgrounds. Computer science lingo must be translated into medical lingo, research lingo and business lingo, and vice versa. This makes writing an important part of the field because it's difficult to communicate between such distinct professions. There are technical documents which specify how the software works, how to add to it, and what the ideas were behind the implementation. But there are also external documents that must explain how to use the software to a doctor who is so busy they may only have a few minutes to read, and to researchers who aren't interested in adopting yet another new technology that *might* improve their research. One of the main challenges I've come across in this field is how difficult it is to write to each specific audience.

The 'wicked problem' that ties my interests together is the local knowledge problem[i]. It was first outlined as an argument against central economic planning, and goes like this: The problem with centralized planning is that every individual has some advantage over everyone else because of the knowledge that they happen to have due to their specific circumstances, like geographic region, culture, profession, family dynamics, etc. It's why specialization is ever-increasing in an advancing society. The 'Renaissance man' That became so popular in the 1400s is completely impossible in the information age. For some fields, a Bachelor's degree is no longer considered enough, and before long even a Master's may not constitute enough education. With this level of specialization, it becomes harder and harder to effectively distribute information, and a single person can't hope to become an expert in fields as diverse as literature and math in one lifetime. This is a huge problem for science. As knowledge expands, it gets harder and harder to remain cognizant of all the relevant research in your field, and forces even further specialization. Now we end up in a situation where two groups of people can tackle the same problem while being completely unaware of each other. In medicine, this appears at the clinical trial level; it's difficult and expensive to find patients for trials because the only way to do it is to simply send people out to clinics to ask them about patients. Doctors in pursuit of distributing their knowledge spend a huge chunk of their time writing notes instead of sitting with patients and it still fails. I think that one step in the right direction will be advanced language models like GPT-3 because of abilities like paraphrasing writing and advanced search.

I want to analyze the website of a company that has had a lot of success in solving the knowledge problem in cancer research: Flatiron Health[ii]. Flatiron has created a technology platform that connects researchers, patients, and doctors; reducing the cost of clinical trials, improving patient care, and lessening the time spent by doctors entering data. The front page of Flatiron's website is very aware of the distinct groups of people that it is trying to connect. It has a very short blurb at the top which addresses researchers, doctors and hospital administration; pointing out that "transforming cancer care takes all of us". I think this is a succinct way of describing the knowledge problem; people simply don't communicate enough with each other. Below the opener, the website has three sections, each of which is focused on one of the three groups. Each card has a link to get more information. The first card's title is "For community oncology", and addresses clinicians. It states that Flatiron is "the platform for a better patient experience, a healthier practice and smarter research. This very efficiently hits all of the major goals of clinicians, and it includes a captioned picture of an oncology doctor at work. The next card follows this structure for life science research, and the third does the same for hospital administrative staff. I think this is a great setup for a website aiming to capture the attention of three different groups because it's able to focus on each group individually rather than trying to capture the attention of all groups at the same time. The website does a good job of communicating its benefits to each group in only one or two sentences as well, which is important when trying to connect to an audience of busy doctors and researchers. On clicking through one of the group's panels, a page shows up that outlines each of the specific value-adds afforded by to that group by Flatiron. Overall, I think Flatiron does a great job engaging its target audiences with clean organization and directly addressing each group.

Reading through a site like Flatiron's makes me feel optimistic about the future of healthcare, but also about the future of computer science in enhancing research. I have no idea what kinds of technology the future might bring us, but I'm excited to get to play a part in it.

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[i] https://en.wikipedia.org/wiki/Local_knowledge_problem
[ii] https://flatiron.com/