The Poetry of Computer Science, the Computer Science of Poetry: Philosophy of Computation

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1 Course Motivation

> Computer science is no more about computers than astronomy is about telescopes.
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> (Edsger Dijkstra)

When the word "computer science" is uttered, few people think of philosophy or poetry. Similarly, few people know that the "father of computer science", Alan Turing, was also a philosopher, or that the "mother of computer science", Ada Lovelace, was also a poet. Amongst the glamour and wads of cash at nearby Silicon Valley, the history of computer science is rarely discussed, and the motivations of major thinkers frequently forgotten. This is a shame, because what motivated these thinkers were in fact not money nor glamour but some of the most universal, basic, visceral questions such as

> I propose to consider the question, can machines think? (Alan Turing)

> [I will have] the most *harmoniously* disciplined troops; – consisting of vast *numbers*, and marching in irresistible power to the sound of *Music*. Is not this very mysterious?...But then, *what* are these *Numbers*? There is a riddle – (Ada Lovelace, at her deathbed)

The neglect of philosophical motivations is doubly a shame because, decades since its founders' deaths, computer science has steadily advanced its light, and we are now in a much better position to start answering these questions! Some ideas from computer science, such as uncomputability, P vs. NP, and quantum computing, have slowly seeped into such diverse areas of thought as child development, language, evolution, culture, epistemology, metaphysics, morality, and on and on. But the idea that computer science has philosophical roots and implications has been slow to be snuggled into the cultural zeitgeist.

We lament not so much the lack of discussion on the philosophy of computation, but the lack of *awareness* that such discussions are possible. Because of the lack of awareness, computer science is instead frequently viewed as materialistic, elitist, and a means to an end. We want to foster an academic culture where a sizable portion of students are actively talking about the philosophy of computation, so that computer science becomes more of an end in itself. We believe such a culture will not only provide a major motivation to study computer science for many more people, but also make the department more welcoming to people of diverse backgrounds, diverse viewpoints, and diverse areas of focus and competence.

This DeCal is about the beautiful parts of computer science unjustly ignored. We will meet once a week for 80 minutes. All majors and all grade levels are welcome. Attendance, active participation, and completion of reading assignments is required. This is a reading-intensive class: over the course of the semester, you will read no less than 500 pages, mostly fairly accessible journalism-style writing, and a few research papers. The class will culminate in a final project presentation, for which you can either (1) write a collection of poems about computer science, or (2) a program that writes poetry, or (3) an essay about philosophy of computation. The grade breakdown is 25% for class participation, 25% for completion of assignments, and 50% for the project.

2 Schedule

The class is organized into three clusters. Each cluster will take three to four weeks of discussion.

2.1 Cluster 1: The Computational Perspective

In this cluster, we provide a solid foundation about what it means to think of the world in terms of computation. We will read the excellent *The Information: A History, A Theory, A Flood* by James Gleick for setting of history and context. Interested readers may also refer to *Logicomix: An Epic Search for Truth* by Doxiadis & Papadimitriou for a dramatic portrayal of the ground-shaking discovery that a great number of things – indeed most things – are not provable. We will also read excerpts of *Why Philosophers Should Care About Computational Complexity* by Scott Aaronson.

- Week of September 4: Introduction, a Very Brief History
- Week of September 11: History and The Perspective: First part of *The Information*
- Week of September 18: History and The Perspective: Second part of *The Information*
- Week of September 25: Uncomputability and Intractability: Parts of *Logicomix* and *Why Philosophers Should Care About Computational Complexity*

2.2 Cluster 2: Poetry, Culture, and Free Will

In this cluster, we apply the computational perspective to topics not often explored with computation. We will talk about philosophy of language, neural embeddings of words (word vectors) and their philosophical implications, how to write programs that write poems, and a possible interpretation of culture in terms of computation. The cluster ends with a discussion of what free will might have to do with uncomputability. Readings include *The Ghost in the Quantum Turing Machine* by Scott Aaronson, *Culture, Dialectics, and Reasoning about Contradiction* by Kaiping Peng, and *Multimodal Distributional Semantics* by Elia Bruni.

- Week of October 2: Philosophy of Language, Word Vectors, How to Write Programs that Write Poems: *Multimodal Distributional Semantics*
- Week of October 9: Culture: *Culture, Dialectics, and Reasoning about Contradiction*
- Week of October 16: Free Will: *The Ghost in the Quantum Turing Machine*

2.3 Cluster 3: The (Perhaps) Incoming AI Overlords and AI Ethics

Our last cluster addresses that question posed by Lovelace and Turing all those years ago: *Can machines think?* We will talk about both sides of the debate, whether the "AI scare" is just overblown hype or not, whether we can and how we would program a moral AI. Readings include parts of *Minds, Brains, and Programs* by John Searle, *Superintelligence* by Nick Bostrom, *Universal Knowledge-Seeking Agents* by Laurent Orseau, and *Moral Philosophy Will Be Part of the Tech Indstury* by Stuart Russell.

- Week of October 23: Strong vs. Weak AI: *Minds, Brains, and Programs*, parts of *Gödel, Escher, Bach*
- Week of October 30: AI ethics: *Universal Knowledge-Seeking Agents*, *Moral Philosophy Will Be Part of the Tech Industry*
- Week of November 6: AI ethics: *Superintelligence*

2.4 Project Presentations

The last two weeks of class will be dedicated to presenting your projects!