Self-Reflection 2

Ben Little

Sep 26, 2023

Planning

Goals

My stated goal from the first self refelction was to learn about how the meta-theory of complexity theory relates to other areas of computer science and math. Since then, we have covered several different proof techniques, including simulation, diagonalization, and relativization. These–along with research for the final project–have somewhat shed light on this question. Complexity theory is often framed in terms of a specific formal model of computation. However more general results can be formulated using constructions like Hyland's effective topos, where the specific model of computation has been abstracted away. The first theoretical model has its most direct relation to the design of physical computing systems that match a model of computation, but the second is hard to pin down. What sorts of things constitute an effective topos? Are there phenomona in our universe that might operate computationally but don't look anything like the highly anthropic Turing Machines, lambda calculus, or Godel encodings? These are the questions I am now considering.

Meta-cognition

> What concepts have you learned so far and how comfortable do you feel with them? What questions do you still have about them?

Simulation and circuite families feel pretty solid.

Constructions by diagonalization feel fairly comfortable to me. I still feel a little shaky with how TMs with timers fit into the picture because some of the proofs I've read outside of class didn't use these, so I'm not entirely sure when they are needed and when they aren't.

> What proof techniques have you attempted (successfully or not) or learned/relearned? Where else might such proof techniques apply?

I've only ever seen diagonalization in the proof of uncountability for the reals, so learning about the more sophisticated versions used to construct oracles was a big expansion to this technique. I'm curious if this has applications in refuting

state reachability for proofs of liveness/safety, e.g. it may be possible to construct a sequence of transitions that contradicts any finite control mechanism.

> What have you found most and least exciting about the course so far? Most and least valuable?

The proof that P vs NP can't be resolved by relativization is pretty interesting. Relativization in general is new to me and feels pretty different from many other areas of math and CS.

> How is your learning log going? What can I do to help you make the process more smooth or more valuable?

Most of the recent additions have been plans for the final project. I am still catching up on the problem sets, but feel like this is manageable.

Meta-ungrading

Right now I feel behind on paper, but I think I am keeping up with things conceptually. This isn't too surprsising because my comprehension curve usually looks like a step function where I struggle with things until suddenly they are obvious. Right now I would assign myself a B. I am keeping up, but don't feel I am excelling.