CS120: Intro. to Algorithms and their Limitations Anshu & Hesterberg

Sender–Receiver Exercise 1: Instructions (Extension class)

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One of the skills we want you to develop in CS120 is to be able to manage the complexity of mathematical proofs by thinking about them at different levels of abstraction, ranging from a high-level intuitive proof outline to being able to work out the low-level formal details. Importantly, these are not two separate skills—rather you need to learn to be able to *move between* these different levels of thinking about proofs, e.g., extracting the high-level intuition from a formal proof, and turning a high-level proof strategy into a detailed formal proof. The reason this skill is particularly valuable for you as computer scientists is that software and hardware systems can be extremely complex to design and understand; to manage that complexity, we need to be able to work at a high level, but to complete an implementation or analysis, we also need to be able to fill in the technical details.

To develop this skill, we will do half-hour active learning exercises where half of you (the "Senders") are tasked with reading and understanding a formal proof, and then explaining it a high level to a classmate (a "Receiver"), who is then tasked with writing it down and filling in the formal details. In addition, these exercise will also have the benefit of reinforcing important concepts related to the content of the course.

The structure of the exercise is as follows. Some classes are marked on the course calendar as having a Sender-Receiver Exercise. Anyone planning to attend such a class synchronously (in person or on Zoom) can follow the document of instructions for college students, also available on `https://harvard-cs-120.github.io/cs120/`, and do the exercise in the first 30 minutes of class. (Those attending synchronously on Zoom will be sent to breakout rooms in pairs.) Everyone else should find, e.g. on Ed, a partner with the opposite role (Sender or Receiver) and find a 30-minute meeting time *before* the corresponding class when both partners are available (e.g. on Zoom). *Before that meeting time (or before class, if following the college class instructions),* both the Sender and Receiver should study the reading assigned to them. The Receiver reading is short and only contains the theorem statement and motivation. The Sender reading contains a proof of the theorem and should be studied more carefully. If you are a Sender, you should try to extract both the main ideas (low-to-high level translation) and the technical details. You may create some bullet notes or a high-level summary for yourself to help you in your presentation during the meeting. Avoid the temptation to write a fully detailed script or to memorize the proof; instead try to internalize the ideas so that you can reproduce the proof based on an intuitive understanding.

The exercise will proceed as follows:

1. Once the exercise starts, the Sender describes the theorem and proof to the Receiver through an oral, interactive dialogue. The Sender should avoid writing, but may draw a diagram or two to get the explanation started (but further manipulations of the diagram should be left to the Receiver). The Receiver should be capturing their understanding by writing pictures and notes (which can be on the Receiver instructions document, which we will distribute as a pdf on Ed). The Receiver should ask questions of the Sender during the interaction. After the high-level understanding is transmitted, the dialogue should continue on to filling in as many formal details as possible.

2. After the exercise is complete (or at the end of class), we will have you fill out a reflection survey, which will provide valuable feedback for us and (for receivers) is part of your participation grade.

We encourage you to be creative and experiment with different strategies for how to make this exercise as effective as possible. Some things that students have found useful in the past are:

- Good pre-exercise preparation by both the Sender and Receiver.
- Arriving on time so that you have full time for the exercise.
- Making sure that the synchronous interaction is a two-way dialogue, with questions and suggestions from the Receiver, rather than a one-way explanation.
- A top-down approach to explanation, so that the Receiver knows where the argument is going and how the pieces are relevant to the end goal.
- A judicious use of diagrams drawn by the Sender or the Receiver.
- Trying to think of solutions/proofs on one's own before going into the presented one.