

CS46 Homework 6

This homework is due at 10:00PM on Sunday, March 29. **This homework has three parts; this L^AT_EX file is only part 1.**

For this homework, you will work with a partner or alone. It's ok to discuss approaches at a high level with other students, but most of your discussions should just be with your partner. Your partnership's write-up is your own: do not share it, and do not read other teams' write-ups. If you use any out-of-class references (anything except class notes, the textbook, or asking Lila), then you **must** cite these in your post-homework survey. Please refer to the course webpage or ask me any questions you have about this policy.

Part 1. Your solutions to this part should be written using L^AT_EX and submitted using **github** as a file called **hw06.tex**. Write clear and unambiguous Turing machine descriptions. Your explanation of *why* and *how* a Turing machine works should be separate from your description of that Turing machine. Give the Turing machine description first, then explain it separately.

1. **Another Turing machine extension.** Let's consider an extension which gives a Turing machine tape which is infinite in both directions. We keep everything else the same, and specify that the input string is given on a tape which is blank everywhere else, with the read/write head on the first character of the input. So the starting configuration on input w in state q_0 looks like:

$$\cdots \square \square q_0 w \square \square \cdots$$

Notice that now the tape head can *always* move left, no matter where it is.

Prove that Turing machines with doubly infinite tape are no more powerful than usual Turing machines (that is, with singly-infinite tape). Your proof should be formal (so if you are building a Turing machine, you must give a description for how to build all of the transitions.)

2. **Closure properties.** Show that the collection of Turing-recognizable languages is closed under the operations of:
 - (a) union
 - (b) concatenation
 - (c) Kleene star
 - (d) intersection

Parts 2 and 3 of this homework go in other files. Make sure you have committed and pushed all your files when you submit.