# CS46 Homework 8

This homework is due at 11:59PM on Thursday, April 22. This is a **7 point** homework. For this homework, you will work with a partner. 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 Joshua), 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.

Note: You must submit your solutions in a file named **hw8.tex**, and your submission must compile without errors using `pdflatex`. Any .pdf submissions will be ignored. Any .tex files not named hw8.tex, .tex files that don't compile, or not submitting a post-homework survey will earn up to a **-0.5** point deduction.

1. Consider the language $L = \{\langle M, w \rangle \mid M$ is a single-tape TM that never modifies the portion of the tape that contains the original input $w\}$.

   (a) Show that L is co-Turing-recognizable, by briefly describing the elements of $\overline{L}$ and then describing a recognizer for $\overline{L}$.

   (b) Is L decidable? Prove your answer.

2. Two disjoint languages A and B are **decidably separable** if there is a decidable language C such that $A \subseteq C$ and $C \cap B = \emptyset$.
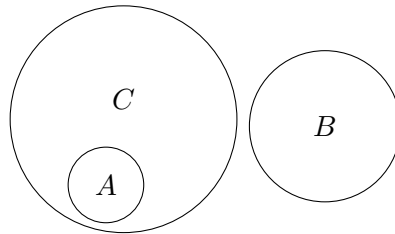
   (a) Give two example languages which are decidably separable.

   (b) Give two example disjoint languages which are *not* decidably separable.

   (c) If A and B are disjoint languages which are both co-Turing-recognizable, show that A is decidably separable from B.

   (d) **Extra credit.** Given a Turing-recognizable language A, let machine$(A) = \{\langle M \rangle \mid L(M) = A\}$. Show that if A and B are Turing-recognizable languages and $A \subsetneq B$, then machine(A) is not decidably separable from machine(B).