CSCI 341 Problem Set 10

Computability

Due Tuesday, November 17

Don't forget to check the webspace for hints and additional context for each problem!

Problem 1 (Virtual Writing). In the `bucklang_public` repo in the `/examples` folder, you will see a BuckLang program called "`tape_program_interpreter.buck`". Currently, this program simulates tape machine programs that only include the `move right` command. After line 265 in the program, you will find a few state names and some pseudocode for adding the virtual `write` tape command. Complete the `virt_write` program in "`tape_program_interpreter`".buck.

Solution. (Submit your completed tape_program_interpreter.buck to the Gradescope code submission box for Problem Set 9, along with three output files: one for the string 0, one for the string 11, and one for the string 1000.) □

Problem 2 (Equivalence Problem). The language below consists of all pairs of encodings of Turing machines (and states) that recognize exactly the same words.

$$L_= = \left\{ \lfloor \mathcal{T}_1 \rfloor {*} x_1 {*} \lfloor \mathcal{T}_2 \rfloor {*} x_2 \mid \mathcal{R}(\mathcal{T}_1, x_1) = \mathcal{R}(\mathcal{T}_2, x_2) \right\}$$

(1) Show that $L_=$ is undecidable (I encourage you to use Rice's theorem somehow).

(2) Write a short reflection on what the impact of this undecidability result is. For example, is it possible to write an algorithm to decide if two blocks of code accomplish the same task?

Solution. □

Problem 3 (C + R = D). Prove that if $L \subseteq A^*$ is both recognizable and co-recognizable, then L is decidable. Explain why this implies that $A^* \backslash L_{Halt}$ is not recognizable.

Solution. □