

# CSCI 341 Problem Set 9

## Computability

Due Monday, November 17

Don't forget to check the webservice 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.

$$L_{=} = \{[\mathcal{T}_1]*x_1*[\mathcal{T}_2]*x_2 \mid \mathcal{R}(\mathcal{T}_1, x_1) = \mathcal{R}(\mathcal{T}_2, x_2)\}$$

- (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  $A^* \setminus L_{Halt}$  is not recognizable.

*Solution.* □