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CSC:341 Spring 2024

Lab #6A

Due: March 2, 2024

#1 Just The Facts, Turing Edition

Answer the following short questions about Turing machines:

1. Can a Turing machine ever write the blank symbol (␣) on its tape? (N.b. we can also just write □ (LaTeX: `\Box`)for the blank symbol.)
2. Can the tape alphabet Γ be the same as the input alphabet Σ?
3. Can a Turing machine's head *ever* be in the same location in two successive steps?
4. Can a Turing machine contain just a single state?
5. One difference between Turing machines and our previous machine-based models of computation is the presence of a reject state. Why was this unnecessary for finite automata? Why is it necessary for Turing machines?
6. Describe the difference between a Turing machine that *recognizes* a language versus a machine that *decides* a language.
7. Give a formal description of a Turing machine that does not terminate on any input. (What does δ look like if it loops back and forth?)

#2 Implementation Details

Give implementation-level descriptions of TMs that decide the following languages. (See Sipser pg. 185 for the distinction between high-level, implementation, and formal descriptions. As an example, The Turing Machine M_4 in Example 3.12 is given with an implementation-level description.)

1. $L_1 = \{w \mid w \text{ contains an equal number of 0s and 1s}\}$
2. $L_2 = \{w \mid w \text{ does not contain an equal number of 0s and 1s}\}$