CSCI 432/532, Spring 2024

Problem Set 8

1. For each of the following languages over the alphabet $\Sigma = \{0, 1\}$, describe a Turing machine that decides the language. You don't need to give a full set of states and a transition function; just describe the steps that the Turing machine would take.

   (a) All palindromes.

   (b) $\{0^a 1^b 0^{ab} : a, b \geq 1\}$

2. Say that a ***write-twice Turing machine*** is a single-tape Turing machine that can alter each tape square at most twice (including the input portion of the tape). Show that this variant of a Turing machine model is equivalent to the ordinary Turing machine model.

To think about later:

1. Say that a ***write-once Turing machine*** is a single-tape Turing machine that can alter each tape square at most once (including the input portion of the tape). Show that this variant of a Turing machine model is equivalent to the ordinary Turing machine model.

2. A ***Turing machine with left reset*** is similar to an ordinary Turing machine, but the transition function has the form $\delta : Q \times \Gamma \to Q \times \Gamma \times \{R, RESET\}$. If $\delta(q, a) = (r, b, RESET)$, then when the machine is in state q reading an a, the machine's head jumps to the left-hand end of the tape after it writes b on the tape and enters state r. Note that these machines do not have the usual ability to move the head one symbol to the left. Show that Turing machines with left reset recognize the class of Turing-recognizable languages.