CpSc 3500 — Goddard

Warmup 4: TMs and their Languages

1. Let X be the set of all binary strings that either have even length or are odd-length palindromes. Draw a TM for X.

2. Give an **example** of (or state that does not exist):

   (a) a language that is recursive but not r.e.

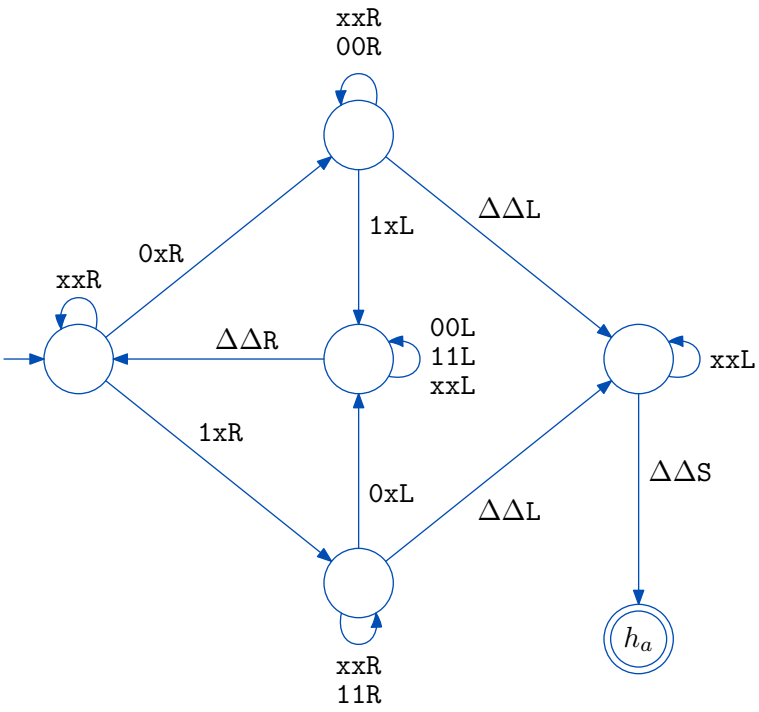
   (b) a language that is regular but whose complement is recursive

   (c) a language accepted by a TM that does not have a context-free grammar

   (d) a language accepted by a nondeterministic TM but not by a deterministic TM.

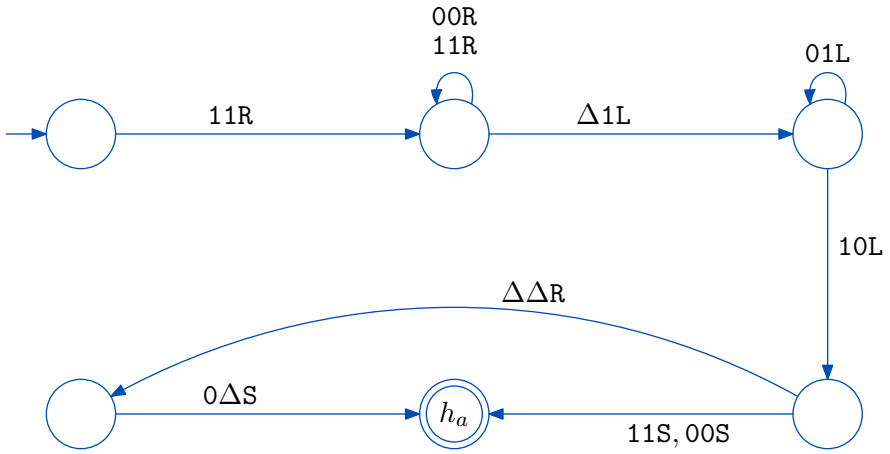
3. State Church's thesis.

4. Consider the following TM with input alphabet $\{0, 1\}$:



   (a) Give two strings of length 3 accepted by the TM.
   (b) Give two strings of length 3 NOT accepted by the TM.
   (c) Describe in succinct-ish English the language of this TM. Be precise.

5. Consider the following transducer.



   (a) What is the output if the input is `11` ?

   (b) What is the output if the input is `1000` ?

   This transducer computes an arithmetic function treating the input (and output) as the binary of a positive integer. What function does it compute?

6. Consider a TM that is not allowed to write the same character to a cell that it just read. (For example, `00R` would not be allowed.) Show that this version has the same power as a standard TM.