Formal Languages and Automata Theory
Homework Set #2

William Shoaff

Summer 2018 (May 20, 2018)

Definitions: A machine is built from a collection of devices (simple parts): Control states, inputs, outputs, stacks, counters, and tapes. A machine can be programmed with a of instructions: Transition, Scan, Write, Push, Pop, Increment, Decrements.

A program usually has initializers: Input holding the program's argument, Control in a start state, Empty stack, Blank output tape, Counter set to 0 A program usually has terminators: ACCEPT, REJECT, EOF, EMPTY

- A machine/program is an accepter, if on input w it completes its computation with that with result ACCEPT when w is in the language of the machine; if w is not in the language, then all computations end in a blocked (dead) state or run indefinitely. An accepter can output "yes" but cannot say "no,"
- A machine/program is a recognizer, if on input w it completes its computation with that with result ACCEPT when w is in the language of the machine; if w is not in the language the result is REJECT.
- A machine/program is a transducer, if on input w it completes its computation with result r on its OUTPUT.

A machines/programs can be deterministic or non-deterministic. The behavior of a deterministic machine is uniquely determined by a function on the content of its devices. Machines that allow allow relational choices in behavior based on their configuration are non-deterministic.

A machine with with only input, output, and control is a finite automata. A Finite automata can be visualized as a edge-labeled graph. Transition tables can also describe finite automata.

1. (2pts pts) pts Give a DFA that accepts strings over $w \in \{a, b\}^*$ such that $|w| \equiv 0 \pmod 3$.

2. (2pts pts) pts Give a DFA that accepts strings $w \in \{a, b\}^*$ that contain the pattern $ababb$.

3. (2pts pts) pts Give a DFA that accepts strings $w \in \{a, b\}^*$ such that the number of a's and number of b's are both even.

4. (2pts pts) pts Give a NFA that accepts strings $w \in \{a, b\}^*$ where the third from last symbol is a.

5. (2pts pts) pts Give a NFA that accepts strings $w \in \{a, b, c\}^*$ such that the last symbol in the string has appeared before.

6. (2pts pts) pts Give a NFA that accepts strings $w \in \{a, b, c\}^*$ such that the last symbol in the string has not appeared before. Hint: First convert the NFA from the previous problem to an DFA using the The Rabin–Scott subset construction algorithm. Second complement the states of the DFA.