CSE3502 - Theory of Computation April 2, 2014

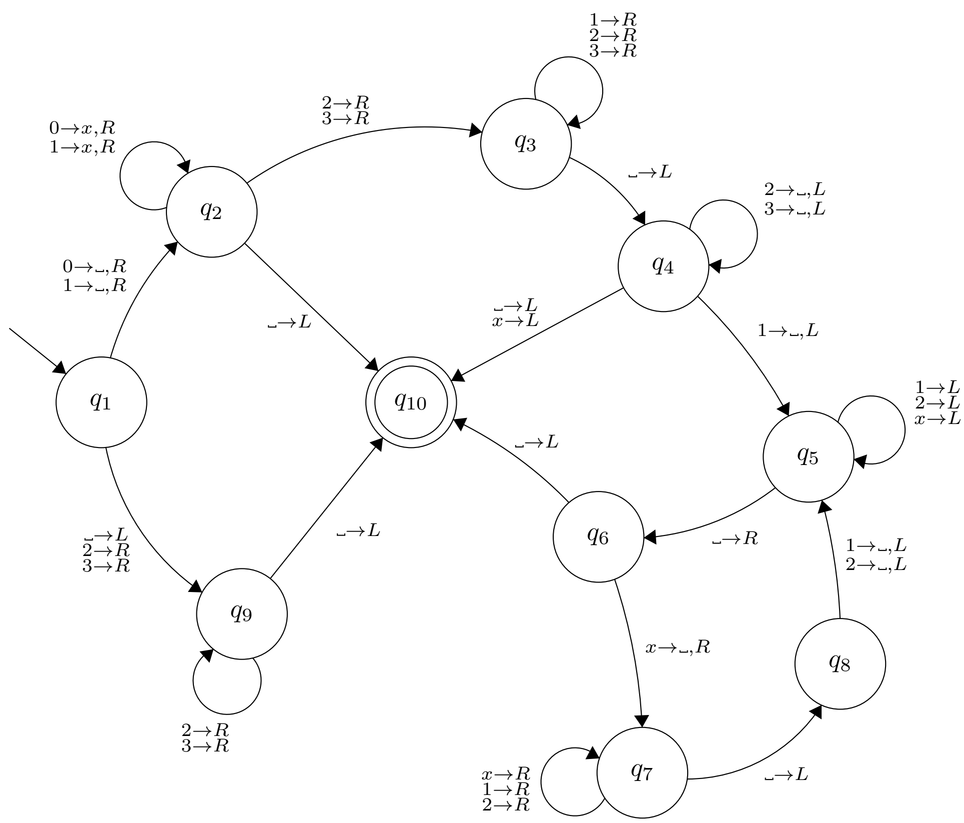
Due: Before class on April 8, 2014

Homework 6

1. Did you do the reading? YES/NO/SORTA
2. Did you do the reading before class? YES/NO/SORTA
3. How long did you spend on this homework (rounding up)? ____________hours.

1 Turing Machines

Consider the following Turing machine. It uses the convention that if there is no arrow drawn from a particular state for a particular symbol then it transitions to the reject state $q_1 1$ and moves left.



Give the sequence configurations this machine enters from start to halt given the following inputs.

- 1
- 2313
- 222
- ε

2 Multitape Turing Machines

For the next two questions, you may augment the definition of a multitape TM given in class so that the transition function is of the form

$$\delta : Q \times \Gamma^k \to Q \times \Gamma^k \times \{L, R, S\}^k,$$

where S indicates that the tape head should stay in the same place rather than move left or right. This is often very convenient with multitape TMs. This is the definition used in the second and third edition of the book. For both, you may assume that the input language is $\Sigma = \{0, 1\}$.

2.1 In class, we saw how to use a multitape Turing machine to simulate a nondeterministic Turing machine. One important step in that simulation was to copy the input from the first tape to the second. For this question give a description of a 2-tape Turing machine $C = \{Q_c, \Sigma, \Gamma, \delta_c, q_c, c_{accept}, c_{reject})$ that copies the input string from tape 1 to tape 2. When done, it should return both heads to the beginning of the tapes and accept. Describe the transition function using a state diagram.

2.2 Let $M_1 = (Q_1, \Sigma, \Gamma, \delta_1, q_1, \text{accept}_1, \text{reject}_1)$ and $M_2 = (Q_2, \Sigma, \Gamma, \delta_2, q_2, \text{accept}_2, \text{reject}_2)$ be one-tape Turing machines. Describe a 2-tape Turing machine that accepts the language $L(M_1) \cup L(M_2)$. Give a formal description that includes the full 7-tuple. Describe the transition function directly from the transition functions δ_1 and δ_2.

3 Turing-Recognizable vs. Turing-Decidable

3.1 Suppose A is a Turing-recognizable language such that $A = B \cup C$ where B is Turing-decidable and $\overline{C}$ is Turing-recognizable. Prove that A is Turing-decidable.