Automata Theory

Homework 3: due 1 December 2016

1. Universal Turing machine

   - Input: A Turing machine $M = (Q, \Sigma, \Gamma, \delta, q_0, H)$ and a string w. The Turing machine is represented by a transition table.

state	input symbol		
	0	1	#
0	$(2, 0, S)$	$(2, 1, S)$	$(1, \#, R)$
1	$(1, 1, R)$	$(1, 0, R)$	$(3, \#, S)$
2	$(2, 0, S)$	$(2, 1, S)$	$(2, \#, S)$

     Assume that $\Sigma = \{0, 1\}$ and $q_0 = 0$. The states for which the transition function is undefined are halting states.

   - Output: The output of M on w.

   Explain how your universal Turing machine works in your report.

2. Turing machine L that computes $\lceil \log_2 n \rceil$

   - Input: n in unary notation ($n \geq 1$)
   - Output: $\lceil \log_2 n \rceil$ in unary notation

   Draw a figure of your Turing machine L in your report. Also explain how L works in your report. Store L in a file `logn.txt` as a transition table.

3. Implementation

   - Your implementation of the universal Turing machine doesn't have to be a real Turing machine.
   - Run your universal Turing machine with your Turing machine L and the Turing machine in Example 4.4 of the Lecture Notes. For each Turing machine, run your universal Turing machine with various inputs.
   - Hand in your report, programs, executable files, and an example running to `gmgu@theory.snu.ac.kr`.
   - Write down the environment you run your program.
   - Write comments appropriately in your program.