

CSci 423 Homework 8

Due: 1:00 pm, Wednesday, 11/7

Eric Shih

1. (10 points) Exercise 3.1 (d) on page 159.

Turing Machine M = On input string w :

- 1. Sweep left to right across the tape, crossing off every other 0.
- 2. If in state 1, the tape contained a single 0, accept.
- 3. If in stage 1, the tape contained more than a single 0 and the number of 0s was odd, reject.
- 4. Return to state 1.

The configuration for TM M for input string 000000 is:

$\sqcup q1000000$

$\sqcup q20000$

$\sqcup Xq30000$

$\sqcup X0q4000$

$\sqcup X0Xq300$

$\sqcup X0X0q40$

$\sqcup X0X0Xq3$

$\sqcup X0X0q50$

$\sqcup X0Xq5X0$

$\sqcup X0q50X0$

$\sqcup Xq5X0X0$

$\sqcup q50X0X0$

$\sqcup q5X0X0X0$

$\sqcup q20X0X0$

$\sqcup Xq3X0X0$

$\sqcup XXq30X0$

$\sqcup XXXq3X0$

$\sqcup XXX0q40$

$\sqcup XXX0X \text{ } q_{reject}$

2. (10 points) Exercise 3.8 (b) on page 160.

- (a) Search from left-to-right for a 0; when one is found, write x on the cell
- (b) Go back to the beginning and search for a 1, if one is found, write x on the cell; if none is found, reject.
- (c) Go back to the beginning and search for another 1, if one is found, write x on the cell; if none is found, reject.
- (d) Go back to step 1
- (e) If there are only xs then accept; otherwise, reject

3. (10 points) Problem 3.15 (b), (c) and (e) on page 161.

- Concatenation: A TM M can be constructed to decide the concatenation of two decidable languages AB . For the input string w , we can partition w into w_a and w_b for every possible way to cut w into two parts. TM M_A will take w_a and TM M_B will take w_b . If both M_A and M_B accept, then M will accept, otherwise it will reject.
- Star: A TM M can be constructed to decide L^* . If the input string w is empty, M will accept. Then for each way to divide w , the substrings will be input to TM M_L . If M accepts all substrings in any one partition, then M will accept L^* , otherwise it will reject.
- Intersection: A TM M can be constructed to decide $A \cap B$. TM M_A decides A and TM M_B will decide B . We then use input string w as input for M_A . If it is not rejected, it is input to M_B . If it is accepted in M_B it is accepted, otherwise it be rejected.

4. (10 points) Problem 3.16 (b), (c) and (d) on page 161.

- Concatenation: A TM M can be constructed to recognize the language AB . TM M_A will recognize A and TM M_B will recognize B . Input string w can be non-deterministically partitioned to w_a and w_b . w_a will be used for M_A and w_b will be used for M_B . While w_a is running, w_b should be run. If M_B accepts, then it will be accepted.
- Star: A TM M can be constructed to recognize L^* . If the input string w is empty, M will accept. w is nondeterministically cut into multiple parts, the substrings should be run as input to TM M_L . If M_L accepts all the substrings, then M will accept.
- Intersection: A TM M can be constructed to recognize $A \cap B$. TM M_A recognizes A and TM M_B recognizes B . An input string, w , is then run on M_A . If M_A accepts w , then w will be used as input for M_B . If M_B accepts, then M will accept.