Test 1 Review
CS-450

May 3, 2013

1 AFSA

Question 1:
a) Design a AFSA for $x \in \{0,1\}^*$ — x has a 0 fourth from the end and x represents in binary an integer evenly divisible by 3
b) Construct the computation tree for m on 10101

Question 2:

a) Design a AFSA for $x \in \{0,1\}^*$ — x does not have a 0 fourth from the end and x represents in binary an integer that doesn't evenly divisible by 3

b) Computation tree for m on 10101

Question 3:

a) Design AFSA $L = \{x \in \{0,1\}^*\}$, x represents in binary evenly divisible by 15.

b) Design $L_2 = L_1^{'}$

Question 4:
Let $M_1 = \{x \in \{0,1\}^*\}$ / x begins or ends with 00
Let $M_2 = \{x \in \{0,1\}^*\}$ / x has both 00 and 11 as substring

a) Design AFSA $M_3 = M_1 \cap M_2$.
b) Design AFSA $M_4 = M_1 \cup \bar{M}_2$
c) Design AFSA $M_5 = \bar{M}_3$

Question 5:
Convert the AFSA to DFSA

M	0	1
1	$2 \wedge 3$	1
2	$3 \vee 4$	$2 \vee 4$
3	$3 \vee 1$	3
4	$1 \wedge 4$	$2 \wedge 3$

The initial state is 1, and the final state is also 1

Question 6

Given the AFSA, where 1 is the initial state, and 1 and 3 are final states

M	0	1
1	1	$1 \vee 3$
2	$2 \wedge 4$	$3 \wedge 4$
3	3	4
4	$2 \vee 3$	$1 \vee 4$

a) Draw the computation tree for string 101100 and explain if it is an accepting computation

b)Convert M to its equivalent DFSA. Represent all of the states in CNF and simplify them. Dont forget to indicate final states.

2 Two way FSA

Question 7:

Given machine M, where 1 is initial state, and 3 is final state

M	a	b
1	2L	3R
2	4L	2R
3	2L	4R
4	4R	1L

a) Construct the Rebound Table
b) Convert machine M to 1 DFSA using the Rebound Table
c) Simulate the 2 dfsa to see if ba or bb string got rejected or accepted

Question 8

Given machine M, where q_1 is the final state

M	0	1
q_0	q_0R	q_1R
q_1	q_1R	q_2L
q_2	q_0R	q_2L

a) Construct the Rebound Table for machine M

b) Simulate the 2dfsa to show that 1001 is accepted by M

Question 9

Given the following 2-way deterministic fsa (2dfsa), where state 1 is the initial state, and states 2 and 3 are final states.

(a) Simulate the 2dfsa and show how the string babb is accepted.

(b) Construct the rebound tables and the equivalent 1dfsa partially only for consuming the string babb

M	a	b
1	2R	3R
2	4L	2R
3	4R	2L
4	1R	4L

3 Turing Machine

Question 10: Design DTM for $L = \{a^n b^n | n \geq 0\}$

Question 11: Design DTM for $\{ww^r | w \in \{a, b\}^+$

Question 12: Desgin DTM for $\{0^n1^n0^n | n > 0\}$

Question 13: Design DTM for $\{x = \{a, b\}^* | N_a(X) = N_b(X)\}$

Question 14: Desgin DTM for $\{ww | w \in \{a, b\}^*\}$

Question 15: Design DTM for

$$f(m,n) = \begin{cases} \text{m-n}, & \text{if } m > n. \\ 0 & \text{otherwise.} \end{cases} \tag{1}$$

Question 16: Desgin DTM for $f(m, n) = m + n \forall m, n \geq 0$

Question 17: Design DTM for $f(m, n) = m * n \forall m, n \geq 0$

Question 18: Desgin DTM for

$$f(m,n) = \frac{m}{n}, \forall m, n \geq 0 \tag{2}$$

Question 19: Design a DTM to recognize $\{a^m b^n c^{m+n} | m, n > 0\}$.

Question 20: Design a DTM to recognize $\{0^a 1^b 0^c | a + c = b$, where $a, b, c \geq 0\}$.

Question 21: Deisign a DTM to compute the function $f(m, n) = m$ MOD n, where m and n are positive integers. Note that m and n are represented as 0^m10^n on the input tape initially.

Question 22: Design a DTM to compute the following function $f(m,n)$ where both m and n ≥ 0. Note that m and n represented as unary numbers and separated by a 1 on the input tape initialy. The ceiling operator $\lceil x \rceil$ will return the smallest integer that is greater than or equal to x.

$$f(m,n) = \begin{cases} \lceil \frac{m}{2} \rceil - n, & \text{if } \lceil \frac{m}{2} \rceil > n. \\ 0 & \text{otherwise.} \end{cases} \tag{3}$$

Question 23: Desgin a DTM for $\{0^{2^n} | n \geq 0\}$, the Language consisting of all strings of 0s whose length is a power of 2

Question 24: Design a DTM to recognize $\{w\#w | w \in \{0,1\}^*\}$

Question 25: Design a DTM that recognize the language $\{a^i b^j c^k | i * j = k$ and $i, j, k \geq 1\}$