The Open University of Sri Lanka

B.Sc. Degree Programme: Level - 05

048

Final Examination – 2008/2009

CSU 3275/PMU3293/PME5293 - Automata Theory -Paper II

Duration: Two and Half Hours.

Date: 04.07.2009 1.30 pm - 4.00 pm

Answer Four Questions Only.

1.

i.

a. State the definition for the serial decomposition.

b. "A non trivial SP partition is sufficient for serial decomposition". Do you agree with this statement? Justify your answer.

ii.

a. "The number of outgoing arcs from a state of a DFA is always equal to $|\Sigma|$". State whether the above statement is true or false with justification.

b. Design a finite automaton (state machine) that models the behavior of a simple TV set. The channel selector of the TV has three positions (1/2/3), and the voice control has two (lo/hi). The TV is assumed to be always on, so the automaton does not need to have any distinct start or final states. Clearly state any assumptions you make.

2.

i. Define the SP property of partitions.

ii. Given below is a transition table of a Mealy machine M.

	State Transition				Output Transition			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
U	U	W	U	U	1	0	1	0
V	V	Y	X	X	1	0	1	0
W	W	U	Y	U	1	0	0	0
X	X	W	X	U	1	0	0	1
Y	Y	W	U	W	0	1	1	0

a. Find the SP Partitions on M.
b. If you are to decompose M serially, what are the additional features you need to know?
c. Hence, decompose M serially.

3.

i. For any three Mealy machines $M1$, $M2$ and $M3$ with k1: $O_1 \rightarrow I_2$
k2: $O_2 \rightarrow I_3$, prove that the followings are true.

a. $M1 \oplus_{k1} (M2 \oplus_{k2} M3) \approx (M1 \oplus_{k1} M2) \oplus_{k2} M3$
b. $M1 \,||\, (M2 \,||\, M3) \approx (M1 \,||\, M2) \,||\, M3$

ii. Suppose M1 and M2 are two Mealy machines.
a. Show that $(M1 \,||\, M2) \leq (M2 \,||\, M1)$.
b. Is $(M1 \oplus_{k1} M2) \leq (M2 \oplus_{k2} M1)$, where k1: $O_1 \rightarrow I_2$ and k2: $O_2 \rightarrow I_1$? Justify your answer.

4.

i. Let M be a deterministic FSM and let $\Sigma = \{a\}$. Suppose that $\delta(q, a) = q$ for some state q. Prove by mathematical induction that for all input strings, where $w \in \Sigma^*$, satisfy,

$$\delta(q, w) = q$$

ii. Give an NFA for the language of binary words in which a pair of 1s occur four places apart. For example, "10001" is in the language. Note that other 1s may also occur in the word so "10101" should also be accepted.

5.

i. Compare the differences of states, inputs, outputs and state/output transitions of two Mealy machines in parallel and serial composition.

ii. The following is a transition table of two Mealy machines M1 and M2.

M1

	a	b	c	a	b	c
Q0	Q1	Q3	Q2	0	0	1
Q1	Q3	Q2	Q3	1	1	0
Q2	Q3	Q3	Q0	0	0	1
Q3	Q3	Q3	Q3	1	1	1

M2

	0	1	0	1
00	00	10	0	0
01	00	10	1	1
10	01	11	0	0
11	01	11	1	1

a. If M1 is to be serially composite with M2, what would be the states of the composite machine?
b. Give the state and output transition tables of the composite machine.

6.

i. Obtain all the SP partitions of the machine given below.

	a	b
S1	S4	S1
S2	S2	S1
S3	S4	S3
S4	S4	S3
S5	S4	S4

ii. Draw the Hasse diagram for the above machine.