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The Open University of Sri Lanka

B.Sc. Degree Programme: Level 05

Final Examination- 2008

CSU 3275/PMU 3293/PME 5293 - Automata Theory – Paper II

Duration: Two and Half Hours.

26.06.2008 1.30 pm – 4.00 pm

Answer Four Questions Only.

1. i) Give the definition for state transition and output transition of a mealy machine.

   ii) Suppose a Mealy machine is defined with the usual notation. Prove for $\forall s \in S^*$ and $i \in I^*$, $a \in I^*$,
   a) $\delta^*(s,ai) = \delta^*(\delta^*(s,a),i))$

   b) $\beta^*(s,ai) = \beta^*(s,a)(\beta^*(\delta^*(s,a),i))$

   iii) Construct a DFA over L = {0, 1} which will accept all the string in which the number of 1's is divisible by three(3) .

2. i) Suppose M1,M2 ,M3 are Mealy machines and ϕ_1 , ϕ_2 are homomorphisms such that $\phi_1 : M1 \rightarrow M2$ and $\phi_2 : M2 \rightarrow M3$. Prove that $\phi_1.\phi_2 : M1 \rightarrow M3$ is a homomorphism, where $\phi_1.\phi_2 = (\alpha, \sigma, \theta)$ and $\alpha = \alpha 2.\alpha 1, \sigma = \sigma 2.\sigma 1, \theta = \theta 1.\theta 2$.

   ii) What do you mean by the statement that *two Mealy machines are behaviorally equivalent?*

   iii) How do two behaviorally equivalent machines become a weaken homomorphism.

   iv) If the α - mapping of the machine in part iii) are given as bijective, do those two machines possess the Identity isomorphism? Justify your answer.

3. i) Prove, for any three Mealy machines $M1$, $M2$ and $M3$ where k1: $O_1 \rightarrow I_2$ k2: $O_2 \rightarrow I_3$, the following are true.

a) $M1 \oplus_{k1} (M2 \oplus_{k2} M3) \leq (M1 \oplus_{k1} M2) \oplus_{k2} M3$

b) $M1 \,||\, (M2 \,||\, M3) \leq (M1 \,||\, M2) \,||\, M3$

ii) Suppose M1 and M2 are two Mealy machines.

a) Show that $(M1 \,||\, M2) \approx (M2 \,||\, M1)$.

b) Is $(M1 \oplus_{k1} M2) \approx (M2 \oplus_{k2} M1)$, where k1: $O_1 \rightarrow I_2$ and k2: $O_2 \rightarrow I_1$? Justify your answer.

4. i) What is meant by the term '*non - trivial*' in the context of decomposing two machines?

ii) Give the definition for SP- partitions.

iii) State the *parallel decomposition* theorem.

iv) State the *serial decomposition* theorem.

5. The machine M(S,I, δ, O, β) is defined as S={1,2,3,4,5,6}, I={0,1},O={a,b}.

M

	State transition (σ)		Output transition (β)	
S\I	0	1	0	1
1	2	3	a	b
2	1	3	a	b
3	4	5	b	a
4	3	2	a	b
5	1	6	b	a
6	1	5	b	a

i) Identify two SP-partitions from the above machine M.

ii) Decompose M parallely.

iii) Decompose M serially.

6.

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

ii) Following are two transition tables of M1 and M2. obtain serial and parallel composition of M1 and M2.

M1

	State transition		Output transition	
S\I	0	1	0	1
00	11	01	0	1
01	11	01	1	0
10	10	00	0	1
11	10	00	1	0

M2

	State transition			Output transition		
S\I	a	b	c	a	b	c
0	0	0	1	0	0	0
1	0	1	0	1	1	1
ø	1	ø	ø	ø	ø	ø