



The Open University of Sri Lanka
 B.Sc. Degree Programme –Level 05
 Department of Mathematics and Computer Science
 Final Examination -2014/2015
CPU3144: Theory of Computing
 Duration Two hours

Date: 20th October 2015

Time: 1.30pm-3.30pm

Answer Four Questions only

01. (i) Define Automation.
 (ii) Give the formal definition of a Deterministic Finite Automation (DFA).
 (iii) When does a DFA accept a string?
 (iv) What are the differences between a Non-Deterministic Finite Automation (NFA) and a DFA?
02. (i) Write the definition of a substring, a prefix and a suffix of a string.
 (ii) Write down the set of substrings, set of prefixes and the set of suffixes of the string *aardvark* over the alphabet $\{a, \dots, z\}$.
 (iii) What is the condition that a prefix is said to be a proper prefix and a suffix to be a proper suffix.
 (iv) Write down three substrings that are not substrings of *aardvark*.
- 03 (i) What is meant by Chomsky hierarchy of grammars.
 (ii) Write the names of the Chomsky hierarchy of grammars.
 (iii) Using your answer to part (ii) name the grammar type given below.

$$G = \langle N, \Sigma, P, S \rangle$$

$$N = \{S\}$$

$$\Sigma = \{a, b\}$$

$$P = \{S \rightarrow aSb, S \rightarrow \epsilon\}$$

- (iv) Given a Grammar $G = (\{s\}, \{a, b\}, S, P)$ with P defines $S \rightarrow aSb$

$$S \rightarrow \epsilon$$

Obtain a sentence in the language generated by G and the sentential form.

04. (i) What is a Regular Expression and a Regular Language.

(ii) A language is a set of strings over an alphabet. What are the conditions this set has to satisfy for the language to be regular.

(iii) Write the corresponding regular languages for the Regular Expressions given below.

(a) $(a+bc)$

(b) $a(b+c)$

(c) a^*b^*

(d) $a^*(b+cc)$

(iv) Let $\Sigma = \{a,b\}$, write the regular expression for the following sets.

(a) All strings in Σ^* with number of a's divisible by three.

(b) All strings in Σ^* with exactly one occurrence of the substring aaa.

05. State with justification, whether each of the following statements is true or false.

(i) $\{a^m b^{2n} \mid m \geq 0 \text{ and } n \geq 0\}$ is regular.

(ii) Any finite subset of $\{ab\}^*$ is a regular language.

(iii) If $L_1 = \{\epsilon, 0, 1\}$ and $L_2 = \{01, 11\}$. Then their composition is :

$L_1 L_2 = \{01, 11, 001, 011, 101, 111\}$

(iv) No infinite subset of $\{a^n b^n \mid n \geq 0\}$ is regular.

06. (a) Define the behavioural equivalence between two Mealy machines.

Let M_1 and M_2 be two Mealy machines. Show that

(i) M_1 is behaviourally equivalent to itself.

(ii) If M_1 is behaviourally equivalent to M_2 , then M_2 is behaviourally equivalent to M_1 .

(b) Define the homomorphism of a Mealy machine into another Mealy machine.

Let M_1 and M_2 be two Mealy machines defined in Table 6.1 and Table 6.2 respectively.

	$\delta(s, i)$		$\beta(s, i)$	
	i_1	i_2	i_1	i_2
s_1	s_1	s_2	o_2	o_1
s_2	s_1	s_2	o_1	o_2

Table 6.1 – M_1

	$\delta(s, i)$		$\beta(s, i)$	
	j_1	j_2	j_1	j_2
t_1	t_2	t_1	p_2	p_1
t_2	t_2	t_1	p_1	p_2

Table 6.2 – M_2

Let the triple $\phi = (\alpha, \sigma, \theta)$ be defined by

$$\alpha(s_1) = t_2, \quad \alpha(s_2) = t_1$$

$$\sigma(i_1) = j_1, \quad \sigma(i_2) = j_2$$

$$\theta(p_1) = o_2, \quad \theta(p_2) = o_1$$

Is ϕ a state behaviour assignment? Justify your answer.

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