香 港 中 文 大 學
The Chinese University of Hong Kong

Course Examinations 1997 - 98

Course Code & Title : CSC 3130 Formal Languages and Automata Theory

Time allowed : 2 hours 0 minutes

Student I.D. No. : Seat No. :

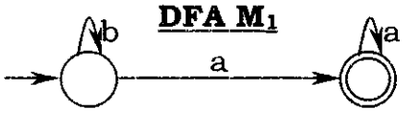
Answer all FOUR (4) Questions.

1. Consider the following problem.

   Given a deterministic finite automaton M and a context free grammar G, determine whether L(G) \ L(M) = ∅, where L(G) is the language generated by G and L(M) the language accepted by M.

   (a) *(10 marks)* Outline an algorithm that answers this decision problem.

   (b) *(10 marks)* Apply the algorithm in (a) to determine whether $L(G_1) \setminus L(M_1) = \emptyset$ for the following deterministic finite automaton M_1 and context free grammar G_1.



CFG G_1

$S \rightarrow ab$
$S \rightarrow aSb$
$S \rightarrow bSa$

2. Let Σ={a,b,c}. Consider the Σ-language L = {ωcω | ω∈(a+b)*}.

   (a) *(15 marks)* Prove or disprove that L is context free.

   (b) *(15 marks)* Prove or disprove that $\overline{L}$ is context free.

3. (a) *(15 marks)* Design a Turing acceptor that accepts the language $\{a^i b^j c^k \mid i=j+k\}$.

   (b) Let L_1 be a recursively enumerable language and L_2 be a recursive language.

   (i) *(5 marks)* Is the complement of L_1 a recursively enumerable language? Explain your answer.

   (ii) *(5 marks)* Is it a decidable problem to determine whether a string ω is **not** in the intersection of L_1 and the complement of L_2? Explain your answer.

4. Consider the following grammar G, in which *S'* is the start symbol.

   $S' \rightarrow aA \mid bB$
   $A \rightarrow abA \mid bB$
   $B \rightarrow bBc \mid bc$

   (a) *(5 marks)* Construct the set of LR(0) items for the grammar G.

   (b) *(10 marks)* Is the grammar G LR(0)? Justify your answer.

   (c) *(10 marks)* Can the string *aabbbcc* be parsed by an LR(0) parser? Show the steps of parsing if it can be parsed; or show why it cannot be parsed otherwise.

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