UNIVERSITI SAINS MALAYSIA

Second Semester Examination
Academic Session 1995/96

March/April 1996

CSA402 - Finite Automata and Formal Languages

Duration : [3 hours]

INSTRUCTION TO CANDIDATE:

- Please ensure that this examination paper contains **THREE** questions in **FOUR** printed pages before you start the examination.
- Answer **ALL** questions. If you choose to answer in English, you must at least answer one question in Bahasa Malaysia.

ENGLISH VERSION OF THE QUESTION PAPER

1. (a) Design the nondeterministic automata accepting the following languages:

(i) $a(ab)^* \cup bba(ba)^*$

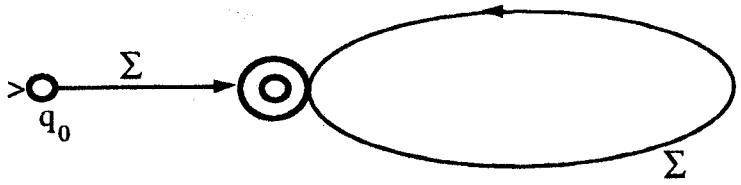
(ii) $(\{a\} \cup \{b\})(ab)$

(iii) $\{w \in \Sigma^* \mid \Sigma=\{a,b\}$ & w contains the odd number of a's$\}$

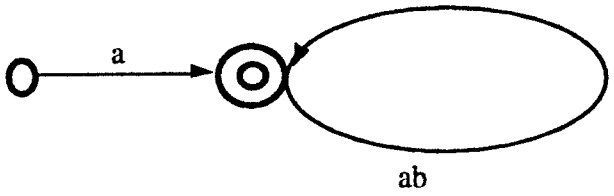
(50/100)

(b) What languages are accepted by the automata below. Give their description as regular expressions.

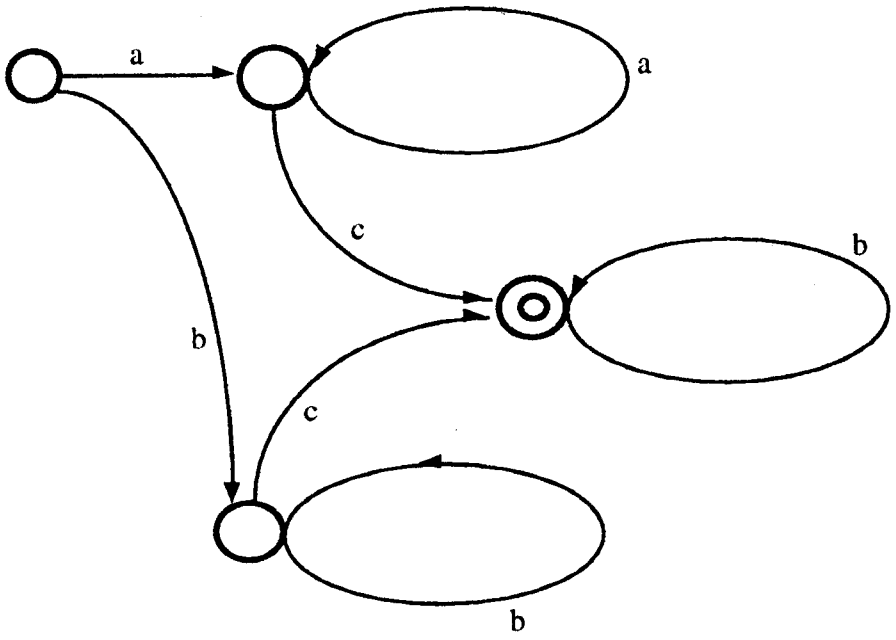
(i)



(ii)



(iii)



(50/100)

2. (a) For the context-free grammar given by

S -> AA
A -> AAA
A -> a
A -> bA
A -> Ab

give a derivation for the string b^2aba^2ba

(20/100)

(b) Give a context-free grammar for each of the following context-free languages:

(i) $\{a^m b^n \mid m \geq n\}$

(ii) $\{w \in \{a,b\}^* \mid w$ has twice as many a's as b's$\}$

(iii) $\{a^m b^n \mid n \leq m \leq 2n\}$

(20/100)

(c) Find pushdown automaton accepting $\{a^n b^n \mid n \geq 0\}$

(20/100)

(d) Let G be the context-free grammar whose rules are

S -> aSa
S -> bSb
S -> c

(i) What language L(G) is generated by this grammar G?

(ii) Construct a pushdown automaton accepting L(G).

(20/100)

(e) Let G be the context-free grammar whose rules are

S -> AB
A -> aA
A -> a
B -> bB
B -> b

Construct a derivation/parse tree of the string aabbb

(20/100)

3. (a) Construct a Turing machine that scans a string $\{a,b\}^*$ on the tape from left to right, replacing all occurances of b by c. The Turing mashine should start with the read/write head on the first (leftmost) symbol of the string and end with its read/write head on the trailing blank, that follows the rightmost a or c of the transformed string.

(30/100)

(b) Give the algebraic representation of the function defined by the following primitive recursive scheme:

$f_1 = \lambda x[x]$

$f_2 = \lambda x[x+1]$

$f_3 = \lambda x_1 x_2 x_3[x_2]$

$f_4 = f_2\, f_3$

(30/100)

(c) Prove (give a primitive recursive scheme) that $f(x,y) = xy$ is the primitive recursive function.

(20/100)

(d) Prove (give a primitive resursive scheme) that $f(x,y) = x^y$ is the primitive recursive function.

(20/100)

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