

香港中文大學  
The Chinese University of Hong Kong

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Course Examination 1st Term, 2006 - 2007

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

Time allowed : 2 hours minutes

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

1. (20%) Consider the following grammar  $G$ :

$S \rightarrow AAS \mid A \mid \varepsilon$

$A \rightarrow 0A1 \mid 0B1$

$B \rightarrow B1 \mid \varepsilon$

- What is the language generated by  $G$ ?
- Remove  $\varepsilon$ -productions and unit productions from  $G$ .
- Write  $G$  in Chomsky normal form.

2. (20%) Is the family of regular languages closed under the following operations? Explain your answers.

- Intersection with context free languages?
- $\max(L) = \{w \mid w \in L \text{ and no non-empty } x \text{ such that } wx \in L\}$

3. (20%) Construct a Turing machine  $M$  that multiplies a binary number  $x > 0$  by two. For example:

Input:	Output:
...##101##...	...##1010##...
^	^
...##11##...	...##110##...
^	^

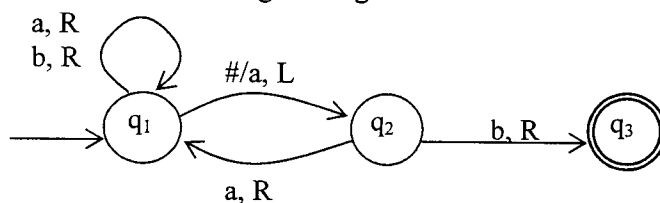
There is no leading zeros in the input  $x$  and the tape head must be pointing to the leftmost digit of the output when  $M$  halts. You can have at most 8 states in  $M$  and giving a solution with more than 8 states will receive zero mark for this question.

4. (20%) Consider the following problem  $P$ :

Given a TM  $T$ , determine if  $T$  will halt within ten moves for some string.

Is  $P$  solvable? Explain your answer. (Hint: What is the longest length of the input tape a Turing machine can read in ten moves?)

5. (20%) Consider the following Turing machine  $M$ :



- Construct an MPCP instance  $I = (A, B)$  such that  $I$  has a solution if and only if  $M$  accepts the input string "aa".
- Does  $I$  have a solution? If yes, give the sequence of indices used in the construction of the solution. Otherwise, explain why a solution does not exist.

-- End of Paper --  
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