NATIONAL UNIVERSITY OF SINGAPORE

University Scholars Programme

SEMESTER II (2000-01)
EXAMINATION FOR

CCST01: Computer Science and Information Technology Revolution

April 2001 Time Allowed: 2 Hours

INSTRUCTIONS TO CANDIDATES

1. This examination paper consists of **FIVE (5)** questions and **THREE (3)** printed pages.
2. Answer all questions.
3. This is an **OPEN BOOK** examination.

Question 1: (15 marks)

Give a circuit and truth table corresponding to the following logical formula:

$$((A \wedge B) \vee (\neg(C \wedge B)))$$

Question 2: (10 marks)

Professor Newton makes the following two claims:

(i) He has developed an algorithm which solves the travelling salesman problem in polynomial time (in the length of the input) on a super computer.
(ii) No algorithm can solve the travelling salesman problem on a Turing Machine in polynomial time (in the length of the input).

Based on what you have studied in class, answer the following three questions in True/False. Justify your answer.

(i) It is possible that both claims of Professor Newton are correct.
(ii) It is possible that both claims of Professor Newton are wrong.
(iii) Exactly one claim of Professor Newton is correct, but we do not yet know which one.

Question 3: (25 marks)

Recall the problem of finding patterns in a text that we did in the tutorials. This question is a similar problem except that pattern may contain a special symbol *. The question being asked now is whether the pattern occurs in the text, if we replace all occurrences of * by the same, but arbitrary, letter from the alphabet. For example the pattern "a*b*" appears in the text "baabab" as well as in the text "babbba" (in the first case by replacing * by "a" and in the second case by replacing * by "b"). However "a*b*" does not occur in the text "aabb" (note that one is not allowed to replace different *s by different letters).

Write an algorithm to find whether a pattern containing *s occurs in a text. More formally your algorithm solves the following question. Fix a finite alphabet set Σ, and a special symbol * not in Σ.

Input to the algorithm:

(i) a text $T_1T_2\ldots T_n$

(ii) a pattern $P_1P_2\ldots P_m$

where each T_i is a letter from the alphabet Σ, and each P_j is either a * or a letter from the alphabet Σ.

Output of the algorithm is the answer to the question:

Is there a letter α in Σ and an i, where $1 \leq i \leq n-m+1$, such that

for every j satisfying $1 \leq j \leq m$,

Either $T_{i+j-1}=P_j$, or ($T_{i+j-1}=\alpha$ and $P_j =*$).

You may use the pattern finding algorithm done in tutorial as a subroutine/procedure to solve this question.

Question 4: (25 marks)

Consider the idea of implementing a virtual database on the web using information from various sites to respond to queries.

(a) Explain why this is a virtual rather than real database, according to standard computing ideas of databases.

(b) Discuss in what way such a database is different from simple search engines.

(c) Briefly discuss how the user interface for such a database would process typical queries; as the steps depend on particular implementation, you may have to explain some assumed technical details that affect your query processing.

Question 5: (25 marks)

Imagine that a web-based PC seller wants to use a simulated customer program to test its site's customer responses and try out different selling strategies.

(a) “Customers are intelligent”; explain in what way a decision to buy a PC requires intelligence rather than mere capability (execution of algorithm);

(b) Discuss the part of customer variables that the customer simulation program must capture in order to perform such site tests; (i.e., a brief systems analysis);

(c) Briefly outline a typical simulation run using a number of such customer programs pretending to be customers accessing the selling site over the web and the data collection the site would do in order to achieve the objective of the simulation exercise.

END OF QUESTIONS