Deferred Exam for Software Engineering 4I03 Michael Soltys

DAY CLASS
DURATION OF EXAMINATION: 3 Hours
MCMASTER UNIVERSITY FINAL EXAMINATION April 2002

THIS EXAMINATION PAPER INCLUDES 1 PAGE AND 10 QUESTIONS. YOU ARE RESPONSIBLE FOR ENSURING THAT YOUR COPY OF THE PAPER IS COMPLETE. BRING ANY DISCREPANCY TO THE ATTENTION OF YOUR INVIGILATOR.

No aids allowed.

1. What do we mean when we say that a language L is context-free?

2. What is the extended transition function in the context of finite automata?

3. Give a regular expression to describe all the strings over the alphabet $\{p, q, r\}$ of length exactly 6.

4. Define regular expressions over the alphabet $\{a, b\}$. Is there a <u>finite</u> set of strings over $\{a, b\}$ which cannot be described with a regular expression? That is, is there a set $L = \{s_1, s_2, \ldots, s_n\}$, where $s_i \in \{a, b\}^*$, for which there is no regular expression R such that $L = L(R)$? Explain your answer.

5. Give a Deterministic Finite Automaton (DFA) that accepts those strings over $\{0, 1\}$ which have at most 3 ones in them (for example, `011001` and `0100001` would be accepted, but `11111111` would be rejected).

6. Is it possible to design an ε-NFA (NFA = Non-deterministic Finite Automaton) N such that $L(N) =$ the set of strings over $\{a, b\}$ where:

$$\text{number of } a\text{'s} = 2^{\text{number of } b\text{'s}}$$

   (For example, $aba, aaaabb \in L$, but $ab \notin L$). Justify your answer.

7. What is the context-free grammar (CFG) that generates the language of all *non*-palindromes over $\{a, b\}$? Recall that a string is a palindrome if it reads the same way from the left as from the right (e.g., $abba, babbab$ are palindromes, and abb is not).

8. Suppose that L is a semi-decidable language over the alphabet $\{0, 1\}$. Suppose that L has an enumerator which enumerates the strings in L in a non-decreasing order of lengths (so, first all the strings of length 1 are listed, then all the strings of length 2 are listed, etc.). Show that in that case, L is also decidable.