CSE 2001 First test
Summer 2007
June 18, 2007
Instructor: S. Datta

Name (LAST, FIRST): _____

Student number: _____

**Instructions:**

1. If you have not done so, put away all books, papers, cell phones and pagers. Write your name and student number NOW!
2. Check that this examination has 8 pages. There should be 5 questions together worth 60 points plus 6 extra credit points.
3. You have 75 minutes to complete the exam. Use your time judiciously.
4. Show all your work. Partial credit is possible for an answer, but only if you show the intermediate steps in obtaining the answer.
5. If you need to make an assumption to answer a question, please state the assumption clearly.
6. Points will be deducted for **vague and ambiguous** answers.
7. Your answers MUST be LEGIBLE.

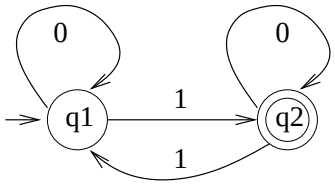
Answer the questions in the spaces provided on the question sheets. If you run out of room for an answer, continue on the back of the page.

DO NOT WRITE ANYTHING ON THIS PAGE.

| Q | part a | part b | part c | TOTAL |
|---|---|---|---|---|
| 1 | | | | |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | |
| 5 | | | | |
| 6 | | | | |

Aggregate score =

1. (a) (6 points) Suppose $\sum = \{0, 1\}$. Describe using concise English or Mathematics the language recognized by the following automaton over this alphabet:




(b) (6 points) Suppose $\sum = \{0, 1\}$. Describe a 2-state NFA over this alphabet for accepting the language $\sum^* - \{\epsilon\}$.

2. (a) (6 points) Design a DFA over $\sum = \{0, 1\}$ that recognizes the set of all binary strings having a substring 00 and ending with 01.

(b) (6 points) Describe a DFA for accepting the language $L \subseteq \{a, b\}^*$ consisting of strings that start with $b$ and have at most one $a$.

3. (a) (6 points) Describe a DFA over $\sum = \{0, 1\}$ that accepts all strings that contain 00101 as a substring.

(b) (6 points) Suppose $A, B$ are regular languages over an alphabet $\sum$. Is the language $\{x | x \in A \text{ and } x^R \in B\}$ regular? Prove your answer.

4. (a) (6 points) Prove the following identity for regular expressions:

$$a^*(a+b)^* = (a+ba^*)^* = (a+b)^*.$$

(b) (6 points) Prove that the following set is not regular: $\{w | w \in \{0,1\}^*, w \text{ is not a palindrome}\}$.

5. (a) (6 points) Let $\sum = \{0, 1\}$ and

$$D = \{w | w \text{ contains an equal number of substrings 01 and 10}\}.$$

Prove that $D$ is a regular language.

(b) (6 points) Prove that the following language over $\sum = \{0, 1\}$ is not regular: $\{0^m 1^n | m \neq n, m = 0, 1, 2, ldots, n = 0, 1, 2, \ldots\}$.

6. (6 points) [EXTRA CREDIT QUESTION] Let $C = \{1^k y | y \in \{0,1\}^*$ and $y$ contains at most $k$ 1's, for $k \geq 1\}$. Show that $C$ is not a regular language.