CARLETON UNIVERSITY
SCHOOL OF COMPUTER SCIENCE
WINTER 2015
COMP. 3803
INTRODUCTION TO THEORY OF COMPUTATION
ASSIGNMENT II
DUE: FRIDAY FEB. 13, 2015 (11:30 AM)

Assignment Policy: Late assignments will **not** be accepted. You are expected to work on the assignments on your own. Past experience has shown conclusively that those who do not put adequate effort into the assignments do not learn the material and have a probability near 1 of doing poorly on the exams.

Important note: When writing your solutions, you must follow the guidelines below.

- Please write your name and student number clearly. Your last name must be in Upper Case.
- The answers should be concise, clear and neat. Make sure that your TA can read your solutions.
- Please submit the solutions *in the order of the problems*, the solution to Problem 1, then to Problem 2 and so on.
- When presenting proofs, every step should be justified so as to get partial credit.
- Assignments should be stapled (or in an unsealed envelope) *with your name and student number*.

Substantial departures from the above guidelines will not be graded.

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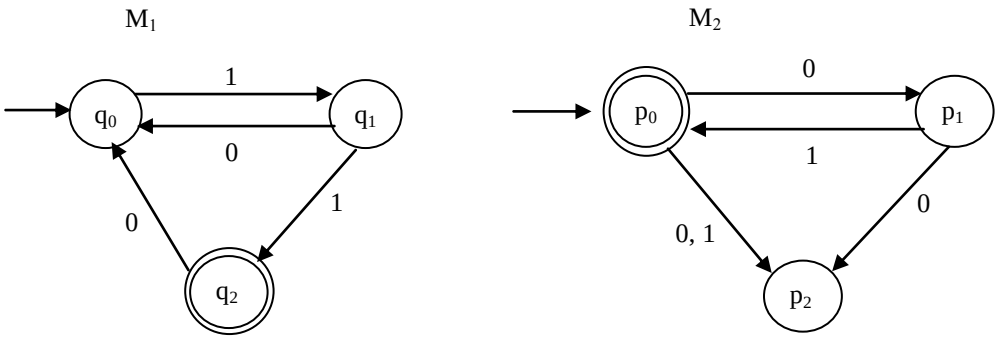
1. Let $\Sigma = \{a, b\}$. Write a regular expression for the set of all strings in Σ^* that start with an odd number of a's, and contain at least two b's.

2. For each of the following languages, construct a **DFA** that accepts the language. In all cases, the alphabet is {0, 1}.
   a. { W| W contains at least three 1s}
   b. { W| W contains an odd number of 1s or more than two 0s}
   c. { W| W every odd position in W is 1}

3. For the following NFA, answer the following questions with some reasonable justification:
   a. Construct an NFA for $L(M_1) \cup L(M_2)$.
   b. Construct an NFA for $L(M_1)L(M_2)$.
   c. Construct NFA for $(L(M_1))^*$ and $(L(M_2))^*$.
   d. What is a regular expression that describes $L(M_1)$?



4. Convert both the NFA of Question 3 into equivalent **DFA**.

5. For each of the following languages, construct an **NFA**, with the specified number of states, that accepts the language. In all cases, the alphabet is {0, 1}.
    a. The language {W| W ends with 101}. The NFA must have four states.
    b. The language {W| W contains the substring 10001}. The NFA must have six states.
    c. The language {W| W contains an odd number of 1's or exactly two 0's}. The NFA must have six states.

6. Give regular expressions describing the following languages in which the alphabet Σ is {0,1}.
    a. {W| W has length at least 3, and its second symbol is 1}
    b. {W| Every odd position of W is a 0}

7. Develop the NFA (recognizer) for each of the following regular languages:
    a. $(0 \cup 1)^*10(01)^*$
    b. $((01)^*10 \cup (00))^*$

8. What is the regular expression accepted by the following DFA?