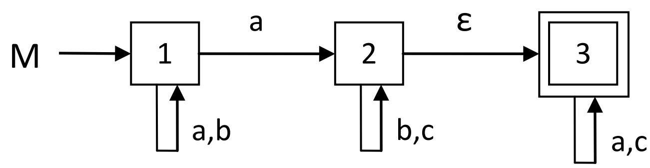
CS 475/575 Exam 1 **Spring 2012** **Name ___________________**

Your score on this exam is based on your best 5 of these 6 problems.

1. Let language L be the strings over alphabet {a,b,c} that do not contain two consecutive identical characters. That is, the following substrings are forbidden: aa, bb, cc. Draw a deterministic finite-state machine that accepts language L.

2. Let language L be as defined in problem 1, and let n be an arbitrary positive integer. Let X_n denote the number of strings in L that have length exactly n. Write a formula for X_n, and prove by mathematical induction that your formula is correct.

3. Consider the non-deterministic finite-state machine M shown below. Draw a deterministic finite-state machine M' that is equivalent to M, and label each state of M' with its corresponding set of states from M.



4. Let machines M and M' be same as in problem 3. For each of M and M', write all the accepting computation sequences for the input string abaca. [If you omitted problem 3, note that you can still obtain a computation sequence for M' by determining all possible states for M after M processes each prefix of the input string.]

5. Let language L be the strings over alphabet {a,b,c} such that the character in the third-rightmost position also appears somewhere earlier in the string. For example, in the string S = aca<u>b</u>ca<u>b</u>ac, the character b appears both in the third-rightmost position and also earlier in S. Draw a <u>non-deterministic</u> finite-state machine that accepts language L.

6. Draw a deterministic finite-state machine that models a memory that holds one value. The initial value is 0. The input alphabet {i,d,s} corresponds to these unary operations: increment, double, square. Each operation is performed using mod 7 arithmetic. The machine should accept a string iff the corresponding sequence of operations yields a prime number (2, 3, 5). For example, the string “idsid” yields the value 3, so it is accepted. But the string “disidis” yields the value 4, so it is rejected.