

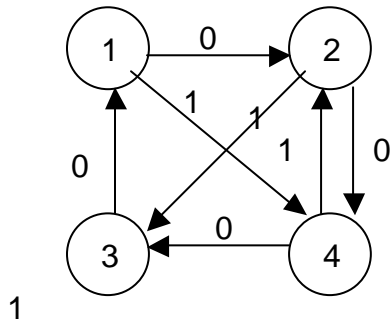
This is a 50 minute in class closed book exam. All questions are straight forward and you should have no trouble doing them. Please show all work and write legibly. Thank you.

1. Write a regular expression for the set of all strings of 0's and 1's such that the number of occurrences of the substring 01 is even. Zero occurrences is even.

Argue in English that your regular expression is correct.

2. Let R_{ij}^k be the regular expression denoting all strings that take a finite automaton from state i to state j without going through any state numbered higher than k .

(a) Give the formula for R_{ij}^k in terms of R_{ij}^l for $l < k$.



(b) What is the regular expression for R_{34}^2 for the above state diagram?

(c) What is the regular expression for R_{43}^2 for the above state diagram?

You do not need to use the formula in (a) to get your answer to parts (b) and (c).

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3. Let $M = (Q, \Sigma, \delta, q_0, F)$ be a deterministic finite automata. Let $K = \{x \mid x \in \Sigma^* \text{ and } \exists y \in L(M), |y| = |x|\}$.

(a) Describe in English the set K .

(b) Construct a nondeterministic finite automaton $M_2 = (Q_2, \Sigma, \delta_2, q_{02}, F_2)$ accepting the set K .

4. Let R be a regular set over the alphabet $\Sigma = \{a, b\}$. For each string in R replace the first occurrence of the substring baa by ba . Let \hat{R} be the resulting set of strings. Show by using homomorphisms, inverse homomorphisms and intersection with regular sets that \hat{R} is regular.