

CS 310T-31 - TPCS: Theory of Computation

Midterm 1

October 15, 2003

1. Use mathematical induction to show that, for all integers $n \geq 4$, $2^n > n^2$.

2. Draw state diagrams for nondeterministic finite automata that accepts the following language:

$$(ab \cup aab \cup aba)^*$$

3. What language is represented by the regular expression $(c^*(a \cup (bc^*)))^*$?

4. Construct deterministic finite automata accepting each of the following languages

(a) $\{ w \in \{a, b\}^* : \text{each } b \text{ is immediately preceded by an } a \}$

(b) $\{ w \in \{a, b\}^* : w \text{ has an even number of } a\text{'s and an odd number of } b\text{'s} \}$

5. Prove that $\{a^1ba^2ba^3b\dots ba^kb : k \geq 1\}$ is not regular

6. Construct deterministic finite automaton equivalent to the nondeterministic automaton shown below

7. Give some examples of strings in, and not in, these sets where $\Sigma = \{a, b\}$.

(i) $\{w : \text{for some } u \in \Sigma\Sigma, w = uu^R u\}$

(ii) $\{w : \text{for some } u \in \Sigma^*, w w w = u u\}$

8. Obtain a regular expression from the following finite automata. Simplify the regular expression as much as you can: