

CSc 473

Exam 1

Fall 2006

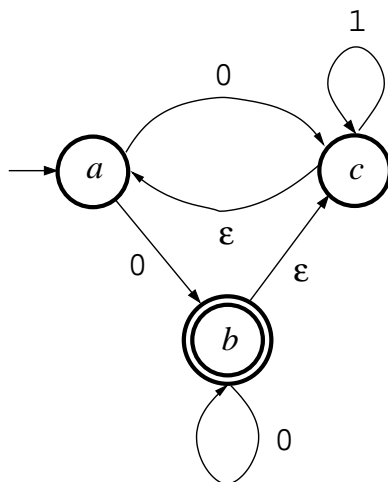
Name _____

Instructions This exam consists of six problems worth a total of 100 points. You have 75 minutes. The exam is closed book, closed notes, and closed calculator. Good luck!

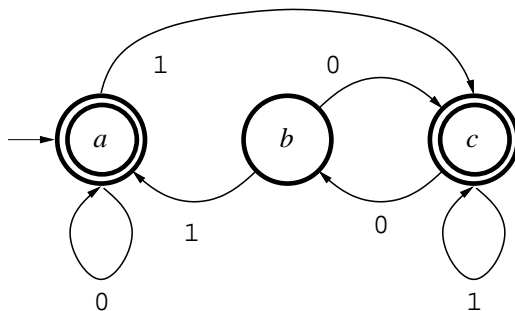
- (1) (**Constructing automata**) (10 points) Construct a *DFA* that recognizes the following language.

$$\left\{ w \in \{0, 1\}^* : w \text{ does not contain substring } 011 \right\}$$

- (2) **(Removing nondeterminism)** (15 points) Convert the following NFA over alphabet $\{0, 1\}$ to an equivalent DFA.



- (3) **(Converting automata to regular expressions)** (15 points) Convert the following DFA over alphabet $\{0, 1\}$ to an equivalent regular expression. Remove the states in the order c , then b , then a .



- (4) **(Converting regular expressions to automata)** (10 points) Convert the following regular expression to an equivalent NFA, by proceeding bottom-up over the expression tree.

$$(01)^* 0 (1 + 0)^*$$

- (5) **(Closure properties of regular languages)** (25 points) For a language L over alphabet Σ , define

$$\text{Leap}(L) := \{xz : xyz \in L, \text{ where } x, y, z \in \Sigma^*\}.$$

Prove that if L is regular, then $\text{Leap}(L)$ is regular, by giving a construction.

- (6) **(Proving nonregularity)** (25 points) Prove that the following language L is nonregular, using the Pumping Lemma.

$$L := \left\{ w \in \{\mathbf{a}, \mathbf{b}, \mathbf{c}\}^* : \left(\begin{array}{l} \text{in } w, \text{ the number of occurrences of substring } \mathbf{abc} \text{ is} \\ \text{at most the number of occurrences of substring } \mathbf{bac} \end{array} \right) \right\}$$