CSC 320 Midterm Exam

June 20, 2008

Instructions:

- 1. Put your name on every page of the exam.
- 2. No calculators or other aids. Closed book.
- 3. Read through the entire exam before beginning. You should have 7 pages including this header page.

Question	Value	Mark
1	30	
2	25	
3	25	
4	20	
Total	100	

Name: ______

ID Number: _____

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1.(a) [10 marks] Prove that the language

 $L = \{w \in \{0, 1\}^* : w \text{ has } 01 \text{ as a prefix and } 10 \text{ as a suffix } \}$ is regular by designing a DFA which accepts *L*.

(b) [10 marks] Prove that the language
L = {w ∈ {a, b}* : w contains both a a b and a b a as substrings } is regular by giving a regular expression which generates L.

(c) [10 marks] Design a nondeterministic finite automaton which accepts $L = (01 \cup 011 \cup 00)^* 011$ 2. [25 marks] Use the construction described in class (which is the same as the one in the text) to convert this NDFA to an equivalent DFA:

State	Symbol	Q	Next state

Start state: _____

Final states:

A picture of your final DFA:

3.(a) [5 marks] State the pumping lemma for regular languages.

(b) [5 marks] Let $w = a^r b a^{3r}$. Describe all possible ways of choosing x, y, z such that w = x y z, and $y \neq \varepsilon$.

(c) [10 marks] Apply the pumping lemma to $w = a^r b a^{3r}$ to prove that $L = \{a^n b a^m : n \le m \le 3n\}$ is not accepted by a DFA with 4r + 1 states.

(d) [5 marks] A more judicious choice for *w* would have made the argument for (c) much simpler. Suggest a better choice for *w*. How does this simplify the argument you gave for (c)?

- 4. Circle **True** or **False** and justify your answer. No marks will be given unless there is a correct justification.
- (a) [5 marks] If $x \notin L_1$ and $y \notin L_2$ then $xy \notin L_1L_2$. True False

 (b) [5 marks] A regular language can contain a subset which is not a regular language. True False

(c) [5 marks] The set ϕ^* does not contain any strings. True False

(d) [5 marks] The language L = {u u^R v : u, v ∈ {a, b}⁺} is regular because for any string w of length at least four, w can be factored as xyz where |xy| is at most four and xyⁿz is in L for all n ≥ 0. True False Use this page if you need more space.

Clearly indicate the question you are answering.