CSC 320 Midterm Exam

Oct 23, 2009

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: ______________________________

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

$L = \{w \in \{0, 1\}^* : w \text{ has } 0\,1\,1 \text{ as a prefix and } 1\,1\,0 \text{ as a suffix } \}$

is regular by designing a DFA which accepts L.

(b) [10 marks] Prove that the language

$L = \{w \in \{a, b\}^* : w \text{ contains both } b\,b\,a \text{ and } b\,a\,b \text{ as substrings } \}$

is regular by giving a regular expression which generates L.

(c) [10 marks] Design a nondeterministic finite automaton which accepts

$L = (1\,0 \cup 0\,1\,1 \cup 1\,0\,0)^*\,1\,0\,1$

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 $w = a^r\, b\, a^{2r}$. 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 $w = a^r\, b\, a^{2r}$ to prove that $L = \{a^n\, b\, a^m : n \le m \le 2n\}$ is not accepted by a DFA with $3r + 1$ 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 $xy \notin L_1 L_2$.

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 $L = \{u\, u^R\, v \ :\ u, v \in \{a, b\}^+\}$ 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 $xy^n z$ is in L for all $n \geq 0$.

True False

Use this page if you need more space.

Clearly indicate the question you are answering.