Name: ______________________________

ID Number: ___________________________

CSC 320 Midterm Exam

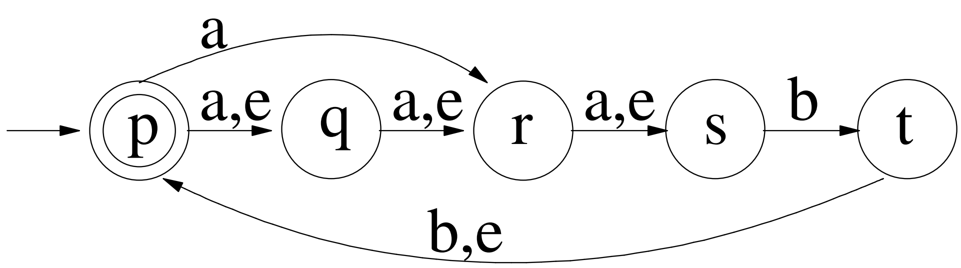
June 13, 2003

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	20	
3	20	
4	30	
Total	**100**	

1.(a) [20] 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		Next state

Start state: ______________________________

Final states: ______________________________

(b) [5] A picture of your final DFA:

(c) [5] Give a regular expression for the language that M accepts.

2. Circle **True** or **False** and justify your answer. **No marks will be given unless there is a correct justification.**

   (a) [5] $\phi = \{e\}$.

   True False

   (b) [5] The class of languages accepted by DFA's is closed under complement but the class of languages accepted by NDFA's is not.

   True False

   (c) [5] Every subset of a regular language is regular.

   True False

   (d) [5] It is possible to have a language which contains only the empty set.

   True False

3. Prove that the languages in parts (a) and (b) are regular by providing either a regular expression that generates the language or a DFA which accepts the language.

(a) [10] $L_1 = \{w \in \{a, b\}^* : w$ does not contain $abaabb\}$

(b) [10] $L_2 = \{w \in \{0, 1\}^* :$ the number of *0*'s in w is $2\,r + 1$ and the number of 1's is $3\,s + 2$ for some integers r and $s\}$.

4.(a) [5] State precisely the pumping lemma for regular languages.

(b) [10] Let $w = a^s\, b\, a^{s^4}$. Describe all possible ways of choosing x, y, z such that $w = xyz$, and $y \neq \varepsilon$.

(c) [10] Apply the pumping lemma to $w = a^s\, b\, a^{s^4}$ to prove that $L = \{a^n\, b\, a^r : n^2 \le r \le n^4\}$ is not regular. All you may assume is that s is chosen so that $s^4 + s + 1 \ \ge\ k$ (and possibly we have equality).

(d) [5] 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)?

Use this page if you need more space.
Clearly indicate the question you are answering.