**Name: _____**

**ID Number: _____**

# CSC 320 Midterm Exam

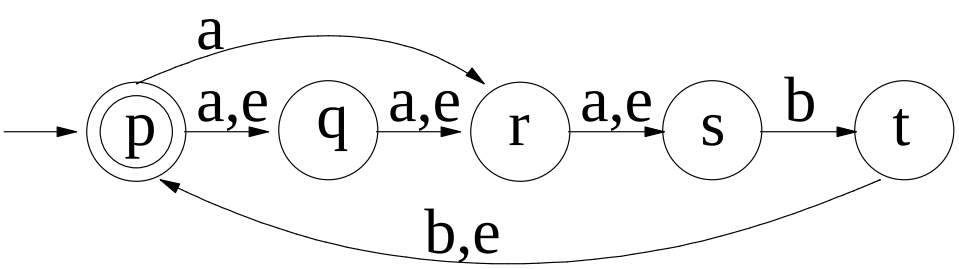
June 13, 2003

**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 |
|---|---|---|---|
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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] $L_1 = \{w \in \{a, b\}^* : w \text{ does not contain } abaabb\}$

(b) [10] $L_2 = \{w \in \{0, 1\}^* :$ the number of *0*'s in $w$ is $2r + 1$ and the number of 1's is $3s + 2$ 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 $L = \{a^n b a^r : n^2 \leq r \leq n^4\}$ is not regular. All you may assume is that $s$ is chosen so that $s^4 + s + 1 \geq k$ (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.