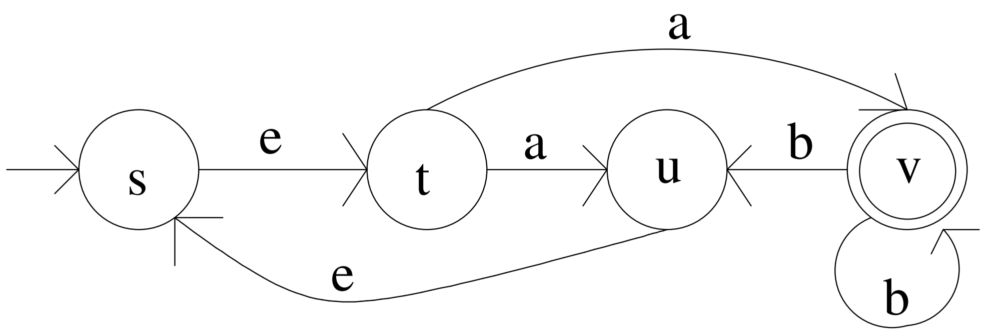
# CSC 320 Midterm Exam

## June 19, 1998

1. [20 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 | | | Next state |
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Start state: ________________________________

Final states: ________________________________

A picture of your final DFA:

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

(a) [5 marks] The set $\{L : L \text{ is a regular language over } \Sigma = \{a, b, c\}\}$ is countable.

True False

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

True False

(c) [5 marks] Regular languages are closed under difference.

True False

3. [20 marks] Define $L_1 = \{w \in \{0, 1\}^* : w \text{ ends with } 0\}$.
Define $L_2 = \{w \in \{0, 1\}^* : \text{the number of } 1's \text{ in } w \text{ is not divisible by } 3\}$.
Design a **DFA** for the strings in $L_1 \cup L_2$.

4. [20 marks] Give a context-free grammar for $L = \{a^n b^m c^{n+m} : n, m \geq 0\}$.

5.(a) [10 marks] State precisely the pumping lemma for regular languages.

(b) [15 marks] Apply the pumping lemma to $w = a^k b c^{k^2}$. to prove that $L = \{a^n b c^p : n \leq p \leq n^3\}$ is not accepted by a DFA with $k$ states.