# Automata Theory

Midterm Exam : 23 October 2008

1. Find a DFA that is equivalent to the following NFA.

2. Find a regular grammar for $\Sigma = \{0, 1\}$ that generates the set of all strings with at least one 1.

3. Prove or disprove that $L = \{a^n : n = 3 + 4k, k = 0, 1, 2, \ldots\}$ is regular.

4. Prove or disprove that $L = \{w \in \{a, b\}^* : N_a(w) \neq N_b(w)\}$ is regular.

5. Let $G$ be the following grammar.

$$S \rightarrow aSb \mid bSa \mid SS \mid \epsilon$$

Let $L_{ab} = \{w \in \{a, b\}^* : N_a(w) = N_b(w)\}$. Prove that $L(G) = L_{ab}$.

6. Let $L = \{0^n 1^n : n \geq 0\}$. Describe $L^2$ by using the set notation. Find a context-free grammar for $L^2$.