Homework 2
CS 321
Due Date: 10/16/09, 2 PM

Note: The homeworks should be your own work. You can discuss the homeworks orally with your peers, however. You should not use any web sources for this assignment. All questions carry equal weight. Please see the TA and the instructor during the office hours to get more help.

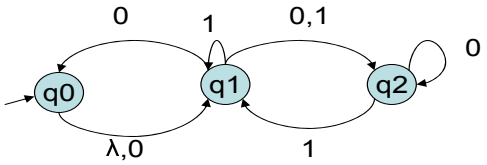
1. Give a DFA for the following problems. Assume the alphabet is $\{a, b\}$.
   (a) All strings over with at least one a and exactly two b's.
   (b) $L = \{w : n_a(w) + 2n_b(w) \bmod 3 < 2\}$.
   (c) All strings of length 4 or greater in which the leftmost 3 symbols are the same, but different from the rightmost symbol.

2. Let L be the language accepted by the automaton of Figure 2.2. Find a DFA that accepts L^2.

3. Design an NFA with no more than 5 states for the set $\{abab^n : n \geq 0\} \bigcup \{aba^n : n \geq 0\}$.

4. Use Definition 2.5 to show that for any NFA,
$$\delta^*(q, wv) = \bigcup_{p \in \delta*(q,w)} \delta^*(p, v), \tag{1}$$
for all $q \in Q$ and all $w, v \in \Sigma^*$.

5. Convert the following NFA into an equivalent DFA.



6. Prove that all finite languages are regular, by giving a general schema to construct an NFA for any finite language.

7. Let L be a regular language that does not contain λ. Show that there exists an NFA without λ-transitions and with a single final state that accepts L.
   Hint: Carefully study the solution to Problem 7 of Section 2.3 which shows that there exists an NFA with a single final state that accepts any regular language. How do you modify this solution to eliminate λ-transitions?