Ph.D. Qualifying Exam (Fall 2005)
Automata and Formal Languages
Answer ALL questions

Closed Book Examination

Question 1. (35% + 30%)

Let $(Q, \Sigma, \delta, q_0, F)$ be a DFA.

Definitions:

- $L^R = \{w^R \mid w \in L\}$, where w^R denotes the reversal of w.
- A state q is *reachable* if $\exists w$ such that $\delta(q_0, w) = q$.
- A DFA is *reduced* if all states are reachable.
- $L_q = \{w \mid \delta(q, w) \in F\}$ where $q \in Q$.
- Two states p and q are *mergeable* if $L_p = L_q$.

(a) Given a reduced DFA for L^R, explain how to compute a reduced DFA A for L.

(b) With respect to the procedure in part (a), are there mergeable states in A? Justify your answer. If your answer is yes, you are required to provide an example.

Question 2 (35%)

A context-free language (CFL) L is called *deterministic* if there exists a deterministic pushdown automaton that accepts L.

It has been shown that deterministic CFL are closed under complementation.

Give a CFL that is not a deterministic CFL. Prove your claim.