1. Let $M$ be the non-deterministic finite automaton $< Q, \Sigma, \delta, q_0, F >$ where:

$$Q = \{q_0, q_1, q_2, q_3, q_4\}$$

$$\Sigma = \{a, b\}$$

$$F = \{q_1, q_4\}$$

$$\delta(q_0, a) = q_1$$

$$\delta(q_0, a) = q_3$$

$$\delta(q_1, a) = q_2$$

$$\delta(q_2, b) = q_3$$

$$\delta(q_3, b) = q_1$$

(a) Draw the transition diagram for $M$.

(b) Construct a deterministic finite automaton $M'$ which simulates $M$ and draw the transition diagram for $M'$. (Label the states of $M'$ with subsets of the states of $M$.)

(c) Give the sequence of configurations and moves which causes $M$ to accept $aabbabba$.

(d) Let $\tilde{L}$ be the language of strings $w \in \{a, b\}^*$ where $w$ is not accepted by $M$. Construct a deterministic finite automaton which accepts $\tilde{L}$. (Be sure to put in a dead state before forming the complement.)

2. Construct a finite automata (possibly non-deterministic with $\Lambda$ transitions) which accepts the languages generated by the following regular expressions:

(a) $(ac^*ba)^*(a + \Lambda)$.

(b) $((a^* + ab)^*cb)^*$.

(c) $(ca^*)(c(b + c) + \Lambda)(c^*b + a^*)$.

3. Prove using the pumping lemma that the following languages are not regular:

(a) $\{a^ib^i : i \geq 17 \}$.

(b) $\{ w \in \{a, b, c\}^* : \text{the number of } a's \text{ is greater than the number of } b's \text{ which is greater than the number of } c's \text{ in } w \}$.

(c) $\{ a^ib^j : \text{integer } i \text{ is a multiple of integer } j \text{ and } i, j \geq 2 \}$.

(The grader will only grade a subset of these problems.)