1. Let $b(n)$ denote the binary representation of n without leading 0s (e.g., $b(10) = 1010$). Let $b(n)^R$ denote the reversal of such a string.

   Show that $A = \{b(n)^R\#b(n+1) \mid n \geq 1\}$ is not a regular language. Provide two proofs of this fact, one using the Myhill-Nerode theorem and one using the Pumping Lemma.

2. Consider the DFA $D = (\{1, \ldots, 8\}, \{a, b\}, \delta, 1, \{1, 8\})$ with δ described by the following table:

q	$\delta(q, a)$	$\delta(q, b)$
1	4	5
2	5	1
3	4	8
4	5	8
5	1	2
6	8	3
7	1	4
8	2	7

   Using the algorithm described in class:

   (a) Determine which states of the machine are equivalent. Show your work. That is, produce one or more tables of the form

1							
	2						
		3					
			4				
				5			
					6		
						7	
							8

   with increasingly many $\neq$s marking pairs of states that are known to be non-equivalent and show those tables in your solution.

   (b) Draw the state diagram for the equivalent **minimal** DFA for L(D).

3. Complete exercise 2.13 from Sipser (as modified below):

   Let $G = (V, \Sigma, R, S)$ be the following grammar. $V = \{S, T, U\}; \Sigma = \{0, \#\}$; and R is the set of rules:

   $S \rightarrow TT \mid U$
   $T \rightarrow 0T \mid T0 \mid \#$
   $U \rightarrow 0U00 \mid \#$

   a. Describe $L(G)$ in English. (Note: A mix of English and extended regular expression notation may be more effective.)

b. Prove that $L(G)$ is not regular using the Myhill-Nerode Theorem.

4. Let $b(n)$ denote the binary representation of n without leading 0s (e.g., $b(10) = 1010$). Let $b(n)^R$ denote the reversal of such a string. Give a context-free grammar for $A = \{b(n)^R \# b(n+1) \mid n \geq 1\}$.