CS 150, Spring 2006 Quiz 1/A

Name (first last) .....

SSN .....

- This exam is **closed book, closed notes** and is designed to take 45 minutes
- Please turn off you cell phones
- Write legibly. What can't be read will not be graded
- Good luck!

1		/16
2		/16
3		/16
4		/18
5		/18
6		/16
Total		/100

1. (16 points: 2 points if correct, 1 point if unanswered, 0 points if wrong.)

   Mark by true or false each of the following (no need to prove)

Given a string $u \in \Sigma^+$ we can always find another string $v \in \Sigma^*$, $v \neq u$, such that $uv = vu$	☐ True	☐ False
There exists at least one language L accepted by a NFA for which we cannot produce a DFA that accepts it	☐ True	☐ False
Given a DFA $(Q, \Sigma, \delta, q_0, F)$, we have that for all $a \in \Sigma$, $\delta^*(q, a) = \delta(q, a)$	☐ True	☐ False
The number of incoming arcs to a state of a DFA is always equal to $\|\Sigma\|$	☐ True	☐ False
The number of outgoing arcs from a state of a NFA is always less than or equal to $\|\Sigma\| + 1$	☐ True	☐ False
All finite languages are regular	☐ True	☐ False
If L is a regular language, then L^R may not be a regular language	☐ True	☐ False
If L is a regular language, then L^2 is also a regular language	☐ True	☐ False

2. (16 points)

Write the formal definition of a language accepted by a NFA.

Write the formal definition of a regular language.

3. (16 points)

Given the following languages over $\Sigma = \{a, b\}$

$$\begin{aligned} L_1 &= \{b^n | n \geq 1\} \\ L_2 &= \{ba^n | n \geq 0\} \\ L_3 &= \{b^n a^n | n \geq 0\} \\ L_4 &= \{(ba)^n | n \geq 1\} \end{aligned}$$

describe the new languages below using the simplest mathematical notation

(a) $L_1 \cap \Sigma^* = \{$ $\}$

(b) $L_2 \cap L_3 = \{$ $\}$

(c) $L_4^2 = \{$ $\}$

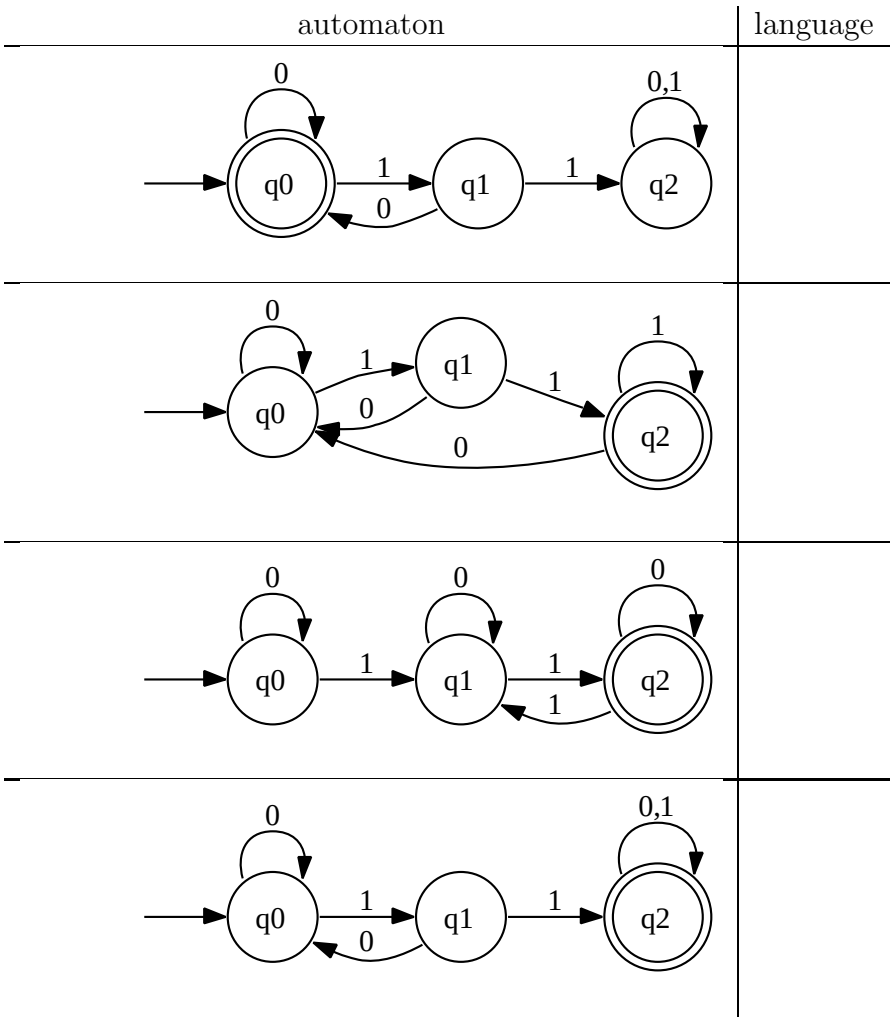
(d) $L_3 L_3^R = \{$ $\}$

4. (18 points)

Let $L_1, L_2, \ldots, L_7$ be the following languages over $\Sigma = \{0, 1\}$

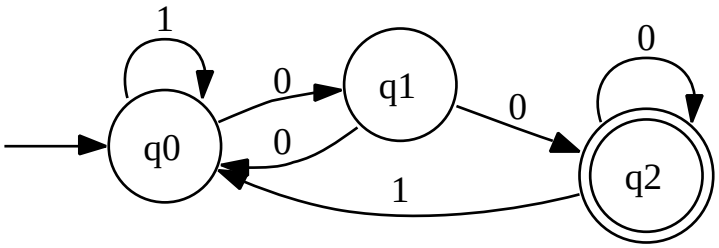
$$
\begin{aligned}
L_1 &= \{w \in \Sigma^* | \, w \text{ ends with } 11\} \\
L_2 &= \{w \in \Sigma^* | \, w \text{ starts with } 11\} \\
L_3 &= \{w \in \Sigma^* | \, w \text{ ends with } 10\} \\
L_4 &= \{w \in \Sigma^* | \, w \text{ contain the substring } 11\} \\
L_5 &= \{w \in \Sigma^* | \, \text{each 1 in } w \text{ is immediately followed by a 0 }\} \\
L_6 &= \{w \in \Sigma^* | \, w \text{ contains an even number of 1's}\} \\
L_7 &= \{w \in \Sigma^+ | \, w \text{ contains an even number of 1's }\}
\end{aligned}
$$

For each DFA shown below, tell which of the languages above it accepts (write NONE if none of the above matches the language accepted by the DFA)



5. (18 points)

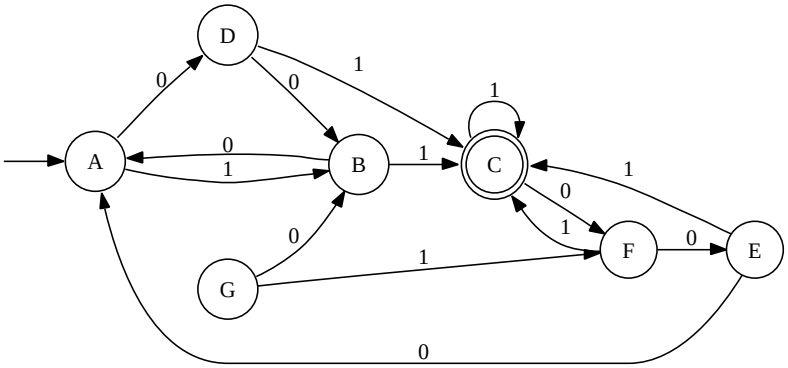
Let A be the following NFA



Draw the DFA equivalent to A.

6. (16 points)

Let A be the following DFA



and let

B	?				
C	x	x			
D	x	?	x		
E	x		x	x	
F	x	x	x		x
	A	B	C	D	E

be an intermediate table of distinguished states produced by the algorithm MINIMIZE_DFA(A) described in class.

- Complete the table by checking whether the pairs of states marked with `?` are distinguishable (write `x`) or not (draw a circle around the `?`)
- Draw the graph for the minimal DFA $\hat{A}$.