Midterm Exam II
CIS 341: Introduction to Logic and Automata — Spring 1998
Prof. Marvin K. Nakayama

Print Name (last name first): _____

Student Number: _____

- This exam will be 1 hour and 25 minutes in length.
- This is an open-book, open-note exam.
- For all problems, follow these instructions:
  1. Show your work and give reasons (except for question 1).
  2. Give only your answers in the spaces provided. Only what you put in the answer space will be graded, and points will be deducted for any scratch work in the answer space. Use the scratch-work area to work out your answers before filling in the answer space.
  3. FA stands for finite automaton; TG stands for transition graph.
  4. For any proofs, be sure to provide a detailed, step-by-step argument, with justifications (e.g., cite a theorem or definition in the textbook) for each step. You may assume that any theorems and results in the textbook hold; i.e., you do not have to reprove the results in the textbook for which proofs are already given. When using a theorem, definition, or result from the textbook, make sure you refer to it by number or page number (e.g., Theorem 3).

Problem	1	2	3	4	Total
Points					

1. **[30 points]** For each of the following, circle TRUE if the statement is correct. Otherwise, circle FALSE

(a) TRUE FALSE — There is an equivalent Mealy machine for each Moore machine.

(b) TRUE FALSE — Context-free grammars can generate some regular languages.

(c) TRUE FALSE — Context-free grammars can generate some nonregular languages.

(d) TRUE FALSE — If L_1 and L_2 are regular languages, then $L_1 + L_2$ is a nonregular language.

(e) TRUE FALSE — All nonregular languages have finitely many words.

(f) TRUE FALSE — All nonregular languages have infinitely many words.

(g) TRUE FALSE — If L is a nonregular language, then L' is a nonregular language.

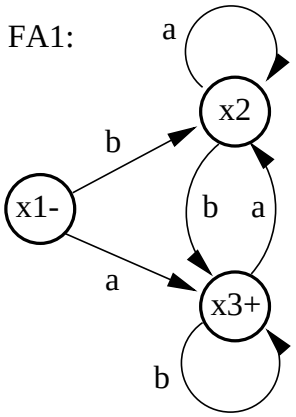
(h) TRUE FALSE — If L_1 is a nonregular language and L_2 is a regular language, then L_1L_2 is a nonregular language.

(i) TRUE FALSE — If L_1 is a nonregular language and L_2 is a regular language, then L_1L_2 is a regular language.

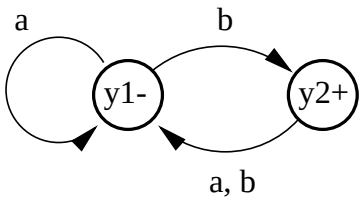
(j) TRUE FALSE — There is no way to tell if two finite automata accept the same language.

2. **[25 points]** Let L_1 and L_2 be the languages accepted by the following finite automata:

FA1:



FA2:



Build an FA that will accept exactly the language L_1L_2.

Draw finite automaton here:

Scratch-work area

3. **[20 points]**

Let L be a regular language. Suppose your friend suggests the following method to show that L' is a regular language. Take a transition graph T for L, and then switch all of the final and non-final states. In other words, change all of the final states into non-final states, and vice versa. Keep all of the same arcs. Your friend claims that the new transition graph accepts L', and so Kleene's Theorem then implies that L' is a regular language. Is your friend's argument correct?

YES NO (Circle one)

If your answer is YES, explain why it is correct. If your answer is NO, give a counterexample. Explain your answer.

4. **[25 points]** Consider the language $L = \{ww : w \in \Sigma^*\}$ over the alphabet $\Sigma = \{a, b\}$. Use the pumping lemma to prove that L is a nonregular language.