Midterm Exam II
CIS 341: Introduction to Logic and Automata — Spring 2000
Prof. Marvin K. Nakayama

Print Name (last name first): _____

Student Number: _____

I have read and understand all of the instructions below, and I will obey the Academic Honor Code.

_____
Signature and Date

- This exam has 5 pages in total, numbered 1 to 5. Make sure your exam has all the pages.
- This exam will be 1 hour and 25 minutes in length.
- This is an closed-book, closed-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 for each step. You may assume that any theorems in the textbook hold; i.e., you do not have to reprove the theorems in the textbook. If you use a theorem, definition, or result from the textbook in your proofs, be sure to give enough details so that I know what you are referring to; e.g., say something like "Using the theorem that states that $S^{**} = S^*$, we have that ...".

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 — If L is a nonregular language, then there must be a nondeterministic finite automaton that accepts L.

(b) TRUE FALSE — If L is a finite language, then L^* must be a regular language.

(c) TRUE FALSE — If $L_1, L_2, L_3, \ldots$ is an infinite collection of regular languages, then $L_1 + L_2 + L_3 + \cdots$ must be a regular language.

(d) TRUE FALSE — A decision procedure to test if a finite automaton accepts an infinite language is to test all words on the FA and see if infinitely many are accepted.

(e) TRUE FALSE — If L_1 is a nonregular language and L_2 is a regular language, then $L_1 \cap L_2$ must be nonregular.

(f) TRUE FALSE — If L_1 is a nonregular language and L_2 is a regular language, then $L_1 \cap L_2$ must be regular.

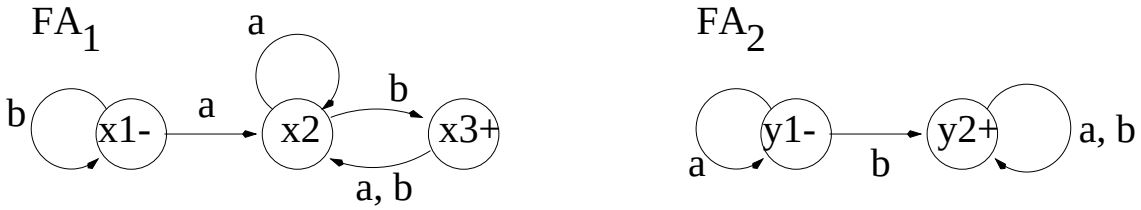
(g) TRUE FALSE — If L_1 is a nonregular language and L_2 is a regular language, then $L_1 + L_2$ must be nonregular.

(h) TRUE FALSE — If L_1 is a nonregular language and L_2 is a regular language, then $L_1 + L_2$ must be regular.

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

(j) TRUE FALSE — If L_1 is a nonregular language and L_2 is a regular language, then $L_1 L_2$ must be regular.

2. **[20 points]** Suppose L_1 is accepted by finite automaton FA_1 and L_2 is accepted by finite automaton FA_2.



Give an FA that will accept exactly the language L_1L_2.

Draw finite automaton here:

Scratch-work area

3. **[25 points]** Suppose that language L_1 is accepted by finite automaton F_1, and suppose that language L_2 is accepted by finite automaton F_2. Give a effective procedure for the problem of deciding if $L_1 \subset L_2$. Be sure to provide all of the details of your method. Also, explain why your method works and why it is an effective procedure. **Hint:** Appropriately modify the algorithm we went over in class to decide if two FA's accept the same language.

4. **[25 points]** Prove that if L is a nonregular language, then L' is nonregular.