Midterm Exam II
CIS 341: Introduction to Logic and Automata — **Fall 2003, evening**
Prof. Marvin K. Nakayama

Print family (or last) name: ____________________________________

Print given (or first) name: ____________________________________

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

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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 a closed-book, closed-note exam.
- For all problems, follow these instructions:
    1. Give only your answers in the spaces provided. I will only grade what you put in the answer space, and I will take off points for any scratch work in the answer space. Use the scratch-work area or the backs of the sheets to work out your answers before filling in the answer space.
    2. FA stands for finite automaton; TG stands for transition graph.
    3. For any proofs, be sure to provide a step-by-step argument, with justifications for every step.

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 — Some nonregular languages are finite.

(b) TRUE FALSE — There is an effective procedure to determine if a transition graph accepts an infinite language.

(c) TRUE FALSE — The language $L = \{a^i b^j : i \geq 0, j \geq 0\}$ is a regular language.

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

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

(f) TRUE FALSE — If a language L is accepted by a nondeterministic finite automaton, then there is a regular expression for L'.

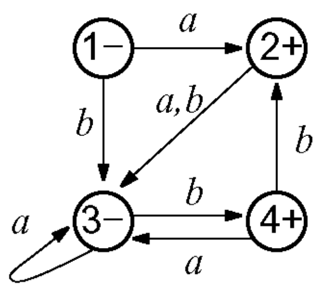
(g) TRUE FALSE — If L is the language Palindrome over $\Sigma = \{a, b\}$, then L^* has regular expression $(\mathbf{a} + \mathbf{b}^*)^*$.

(h) TRUE FALSE — If L is accepted by a transition graph T, the language L' is accepted by the transition T' formed by swapping all final and non-final states of T, and using the same transitions and initial states.

(i) TRUE FALSE — Some regular languages are infinite.

(j) TRUE FALSE — It is impossible to determine if a regular expression generates an infinite language.

2. **[30 points]** Give a regular expression for the language L of the transition graph below.



Regular expression: ______________________________

Scratch-work area

3. **[25 points]** For each of the following parts, provide an example satisfying the given conditions. Give a brief explanation for each of your examples.

   (a) Give an example of a nonregular language L_1 and a regular language L_2 such that $L_1 \subset L_2$.

   (b) Give an example of nonregular languages L_1 and L_2 such that $L_1 \cap L_2$ is regular.

   (c) Give an example of infinitely many regular languages $L_1, L_2, L_3, \ldots$ such that $L_1 + L_2 + L_3 + \cdots$ is nonregular.

4. [**15 points**] Prove that if we remove a finite set of words from a regular language, the result is a regular language. (For this question, you may assume that all theorems from the book and the notes hold; i.e., you do not have to reprove any of those theorems.)