Midterm Exam II
CIS 341: Introduction to Logic and Automata — Fall 1997
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 — If L is accepted by some nondeterministic finite automaton, then L is a nonregular language.

(b) TRUE FALSE — If L has infinitely many words, then L is a nonregular language.

(c) TRUE FALSE — Mealy machines accept only regular languages.

(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 a nonregular language.

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

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

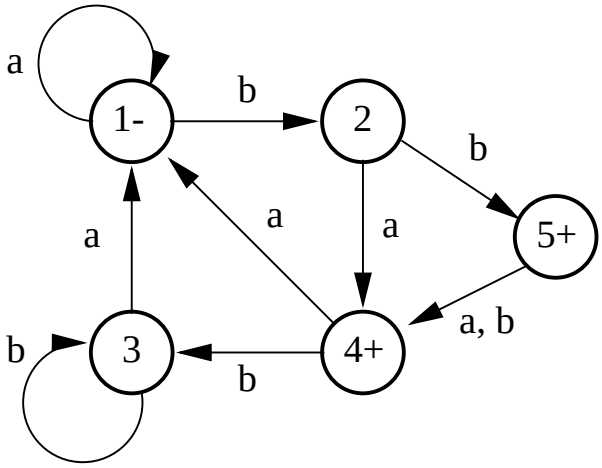
(g) TRUE FALSE — There is an effective procedure to determine if two regular expressions generate the same language.

(h) TRUE FALSE — A subset of a nonregular language is always a nonregular language.

(i) TRUE FALSE — A subset of a regular language is always a regular language.

(j) TRUE FALSE — A Moore machine may crash when processing an input string.

2. **[30 points]** Let L be the language exactly accepted by the following finite automaton:



Give a regular expression for L.

Regular Expression: _____

_____

Scratch-work area

3. **[20 points]** Suppose that L_1 is a regular language and L_2 is any language. Is it necessarily the case that $L_1 - L_2$ is a regular language?

YES NO (Circle one)

If your answer is YES, give a proof. If your answer is NO, give a counterexample. Explain your answer.

4. **[20 points]** Consider the language $L = \{\text{words with more } a\text{'s than } b\text{'s}\}$ over the alphabet $\Sigma = \{a, b\}$. Prove that L is a nonregular language.