Midterm Exam I
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 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 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 — If L is a finite language, then L^* must be finite.

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

(c) TRUE FALSE — If L is an infinite language, then L^* must be infinite.

(d) TRUE FALSE — A finite automaton may accept infinitely many different words.

(e) TRUE FALSE — A finite automaton may accept only finitely many different words.

(f) TRUE FALSE — All finite automata are transition graphs.

(g) TRUE FALSE — All transition graphs are finite automata

(h) TRUE FALSE — A finite automata may have more than one initial state.

(i) TRUE FALSE — A transition graph may be deterministic.

(j) TRUE FALSE — A finite automaton may have more than one final state.

2. **[25 points]** For each of the following languages L over the alphabet $\Sigma = \{a, b\}$, give a regular expression for L.

   (a) L exactly consists of all words that do not contain the substring ab.

   Regular Expression: _____

   (b) L exactly consists of all words in which the substring aa occurs exactly once.

   Regular Expression: _____

Scratch-work area

3. **[25 points]** For each of the following languages L over the alphabet $\Sigma = \{a, b\}$, give a finite automaton that accepts exactly L.

   (a) L exactly consists of all words that do not contain the substring ab.

   Draw finite automaton here:

   (b) L exactly consists of all words whose second-to-last letter is an a.

   Draw finite automaton here:

Scratch-work area

4. **[20 points]** Let S and T be any arbitrary sets of strings. If $S^* = T^*$, is it always the case that $S = T$?

   YES NO (Circle one)

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