Midterm Exam I
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 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 — A finite automaton may have an arc labeled with Λ.

(b) TRUE FALSE — A finite automaton accepts Λ if and only if the initial state is also a final state.

(c) TRUE FALSE — A transition graph accepts Λ if and only if an initial state is also a final state.

(d) TRUE FALSE — If L is a language with finitely many words, then there is a regular expression for L.

(e) TRUE FALSE — A finite automaton may crash when processing a string.

(f) TRUE FALSE — There is no finite automaton that accepts the language $L = \emptyset$.

(g) TRUE FALSE — All transition graphs are non-deterministic.

(h) TRUE FALSE — Any regular expression that uses the Kleene star must generate an infinite language.

(i) TRUE FALSE — A finite automaton can have no final states.

(j) TRUE FALSE — A finite automaton can have no initial states.

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 contain either the substring bba or the substring aa (or both).

   Regular Expression: ______________________________

   (b) L exactly consists of all words that do not contain the substring aaa or that contain the substring aaa 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 whose third letter is b.

   Draw finite automaton here:

   (b) L exactly consists of all words that either start with aa or end with aa but not both.

   Draw finite automaton here:

Scratch-work area

4. **[20 points]** Prove that the following finite automaton accepts exactly the language $L = \{$ words not ending in $a\}$ over the alphabet $\Sigma = \{a, b\}$.