Midterm Exam I
CIS 341: Introduction to Logic and Automata — Fall 1996
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.

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 more than one start state.

(b) TRUE FALSE — A finite automaton may have no final states.

(c) TRUE FALSE — A transition graph may have more than one start state.

(d) TRUE FALSE — A transition graph may have no final states.

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

(f) TRUE FALSE — There may be more than one way to process a particular string on a finite automaton.

(g) TRUE FALSE — The string *bbabab* can be generated by the regular expression $(\mathbf{a} + \Lambda + \mathbf{baa})\mathbf{b}^*(\mathbf{ab})^*(\mathbf{b} + \Lambda)$.

(h) TRUE FALSE — Λ is in the language $\emptyset$.

(i) TRUE FALSE — If a finite automaton accepts Λ, then some start state must also be a final state.

(j) TRUE FALSE — If a transition graph accepts Λ, then some start state must also be a 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 begin with either ab or ba.

   Regular Expression: _____

   (b) L exactly consists of all words that have an odd number of b's.

   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 end with b.

   Draw finite automaton here:

   (b) L exactly consists of all words that have at least two b's and end with aa.

   Draw finite automaton here:

Scratch-work area

4. **[20 points]** Let S be any set of strings. Prove that $S^+ = (S^+)^+$.