Midterm Exam I
CIS 341: Introduction to Logic and Automata — Fall 1995
Prof. Marvin K. Nakayama

Print Name: _____

Student Number: _____

- This exam will be two hours 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 your answers in the spaces provided. I will only grade what you put 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, and TG stands for transition graph.

Problem	Points
1	
2	
3	
4	
5	
6	
Total	

1. **[20 points]** For each of the following, circle TRUE if the statement is correct. Otherwise, circle FALSE

(a) TRUE FALSE — Every finite automaton is also a transition graph.

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

(c) TRUE FALSE — Every regular language is also a nonregular language.

(d) TRUE FALSE — Any string processed on a Moore machine either will be accepted or will be rejected.

(e) TRUE FALSE — Every nondeterministic finite automaton can be transformed into an equivalent (deterministic) finite automaton.

(f) TRUE FALSE — Every nonregular language has a finite automaton which accepts it.

(g) TRUE FALSE — Every transition graph is also a finite automaton.

(h) TRUE FALSE — Any string processed on a finite automaton will either be accepted or rejected.

(i) 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 regular language.

(j) TRUE FALSE — There may be more than one way to process a particular string on a transition graph.

2. **[30 points]** For each of the following languages L over the alphabet $\Sigma = \{a, b\}$, give a regular expression for L and a finite automaton that accepts exactly L:

   (a) **[15 points]** L consists of exactly all words that begin with b and have exactly three a's.

   Regular Expression: _____

   Draw finite automaton here:

Scratch-work area

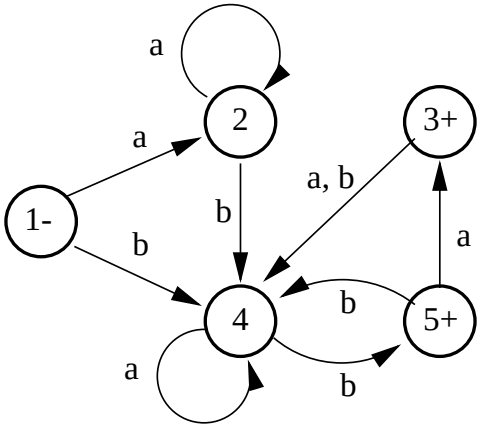
(b) **[15 points]** L consists of exactly all words for which the first two letters are different or the last two letters are different (or both).

Regular Expression: _____

Draw finite automaton here:

Scratch-work area

3. **[10 points]** Let L be the language accepted by the following finite automaton:

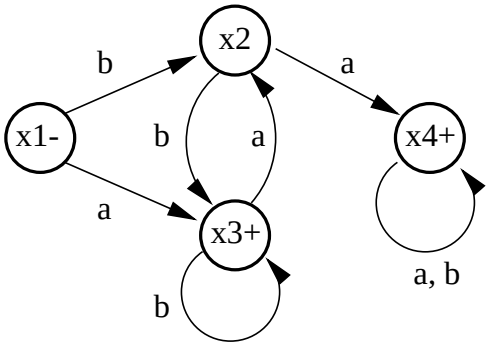


Find a regular expression for the language L.

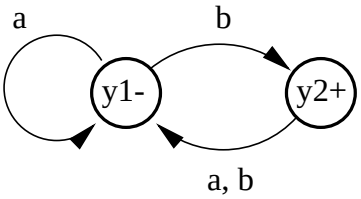
Regular Expression: _____

4. **[10 points]** Let L_1 and L_2 be the languages accepted by the following finite automata:

FA1:



FA2:

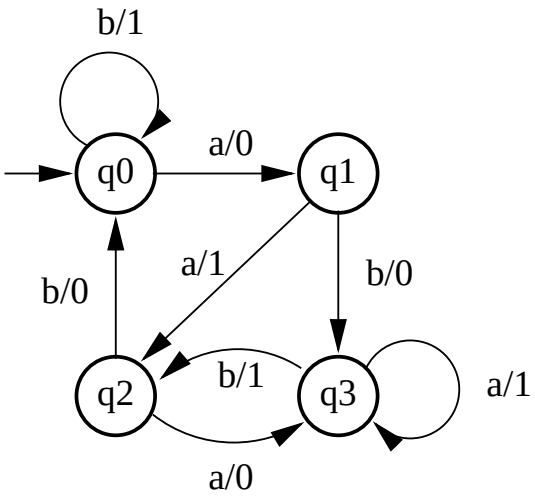


Build an FA that will accept exactly the language $L_1 \cap L_2$.

Draw finite automaton here:

Scratch-work area

5. **[20 points]** Consider the following Mealy machine with input alphabet $\Sigma = \{a, b\}$ and output alphabet $\Gamma = \{0, 1\}$:



(a) **[10 points]** Convert the Mealy machine into an equivalent Moore machine.

Draw Moore machine here:

Scratch-work area

(b) **[5 points]** What is the output when the input string *abaabab* is run on the original Mealy machine?

Output: _____

(c) **[5 points]** What is the output when the input string *baaaabb* is run on your Moore machine from part a?

Output: _____

6. **[10 points]** Prove that any nonregular language must have infinitely many words.