

Midterm Exam I
CIS 341: Introduction to Logic and Automata — Fall 1999
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	5	Total
Points						

1. [20 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 it has a regular expression.
- (b) TRUE FALSE — If L is a finite language, then L^* must be infinite.
- (c) TRUE FALSE — All transitions graphs are non-deterministic.
- (d) TRUE FALSE — A finite automaton may have more than one initial state.
- (e) TRUE FALSE — A finite automaton may have more than one final state.
- (f) TRUE FALSE — If L is an infinite language, then L^* must be infinite.
- (g) TRUE FALSE — If L is any language, then $L^* = L^+$.
- (h) TRUE FALSE — If L is any language, then $L^{++} = L^+$.
- (i) TRUE FALSE — The regular expression $\mathbf{b^*(aa)^*b^*}$ generates the language over the alphabet $\{a, b\}$ consisting of all words having an even number of a 's.
- (j) TRUE FALSE — A finite automaton may have no final states.

2. [20 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 a and end with ba .

Regular Expression: _____

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

Regular Expression: _____

Scratch-work area

3. [20 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 have an even number of a 's and an odd number of b 's.

Draw finite automaton here:

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

Draw finite automaton here:

Scratch-work area

4. **[20 points]** In class we discussed the language PALINDROME over the alphabet $\Sigma = \{a, b\}$.
- (a) Give a definition of the language PALINDROME. Don't just list out the words.

 - (b) List all words in PALINDROME having length 3.

 - (c) List all words in PALINDROME having length 4.

 - (d) How many words in PALINDROME have length exactly n ? Be sure to give an explanation.

Scratch-work area

5. [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.