CS 390 Final Exam

April 2011

1. Prove by *Structural Induction* that $L_(1)^* \cup L_2^* \subseteq (L_(1) \cup L_2)^*$ [12]

2. Construct NFA-Λ for $(a*+(ba)*)b*$ following Kleene Theorem (Part) 1 faithfully. Do not simplify your answer. [12]

3 Prove that $\{ww^r \mid w \in \{a, b\}*\}$ is nonregular, where w^r is the reversal of w. [12]

4. Given the following grammar, answer the questions below: [8 each]

$$S \rightarrow aT \mid bT$$
$$T \rightarrow Sa \mid Sb \mid \Lambda$$

(a) Generate a string of length 3 using the grammar.

(b) Using the grammar generate a string of length 5 which starts with a and ends in b.

(c) Describe briefly in English the language generated by the grammar.

5. For the following Turing machine answer the questions below: [8 each]

q	σ	$\delta(q,\sigma)$	q	σ	$\delta(q,\sigma)$
q_0	Δ	(q_0,Δ,R)	q_2	I	(q_2,I,R)
q_0	I	(q_0,I,R)	q_2	Δ	(q_3,Δ,L)
q_0	$*$	$(q_1,*,R)$	q_3	I	(q_4,Δ,L)
q_1	I	(q_1,I,L)	q_4	I	(q_4,I,L)
q_1	$*$	(q_2,I,R)	q_4	Δ	(h,Δ,S)
q_1	Δ	(q_5,Δ,L)	q_5	$*$	(q_4,Δ,L)

(a) Describe the operation of the Turing machine using configurations when the input $\Delta I * II\Delta$ is given. [8]

(b) What does the Turing machine do in general ? [8]

6. (a) Give a brief description of a Turing machine which accepts the language L_Y of "yes" instances of the Halting Problem (No need to give a transition diagram or table). [8]

(b) What will happen when a "no" instance of the Halting Problem is given to yoour Turig machine of (a) ? [8]

(c) Is it possible to modify yoour Turing machine of (a) so that it decides L_Y ? Why ? [8]