MIDTERM

1. [**30**] Prove the following two regular expressions are equivalent:

   (a) $(a \mid b)^*$

   (b) $(a^* \mid b^*)^*$

   Hint: Steps to prove two regular expressions are equivalent

   (1) [**10**] Construct nondeterministic finite automata (NFA) for the regular expressions using Thompson's construction algorithm.

   (2) [**10**] Convert NFA into deterministic finite automata (DFA) using the Subset Construction algorithm.

   (3) [**10**] Minimize the DFA states.

   (4) Show that the minimum-state DFA's are the same, except for the state names.

2. [**10**] Show that $\{(abc)^n \mid n \geq 0\}$ is a regular language.

3. [**10**] Eliminate left recursion of the following grammar.

   $S \rightarrow Aa \mid b$

   $A \rightarrow Ac \mid Sd \mid \epsilon$

4. [**20**] Consider the following grammar:

   $S \rightarrow cAt$

   $A \rightarrow a \mid \epsilon$

   (1) [**10**] Calculate FIRST and FOLLOW for the nonterminals S and A.

   (2) [**10**] Compute its LL(1) parsing table.

5. [**30**] Consider the following grammar G:

   $S \rightarrow aAd \mid bBd \mid aBe \mid bAe$

   $A \rightarrow c$

   $B \rightarrow c$

   (1) [**10**] Is G SLR(1)? If yes, give the parsing table. Otherwise, show why.

   (2) [**10**] Is G LR(1)? If yes, give the parsing table. Otherwise, show why.

   (3) [**10**] Is G LALR(1)? If yes, give the parsing table. Otherwise, show why.