CS 5900 Compiler **Final** **Spring 2020**

Family Name (Print): **ID: 700-**

Given Name: **Score:** **/100**

Please provide complete work to get full credit.

1. (10 pts) Write a regular expression that generates the same language as the following grammar:

   $S \rightarrow \boldsymbol{a}SA \mid B$

   $A \rightarrow \boldsymbol{c}$

   $B \rightarrow B\boldsymbol{b} \mid \boldsymbol{b}$

   Solution:

2. (10 pts) Write a context-free grammar that generates the same language as the following regular expression:

   $(\boldsymbol{a} \mid \boldsymbol{b})(\boldsymbol{a} \mid \boldsymbol{cb})^{+}(\mathbf{c} \mid \varepsilon)$

   Solution:

3. (10 pts) Remove the left recursion:

   exp → *exp addop term* | *term*

   Solution:

4. (10 pts) Left factor the grammar:

   lexp → *atom list* | *atom term1 term2*

   Solution:

5. (10 pts) Given CF grammar $S \rightarrow \boldsymbol{a}SS \mid \varepsilon$.
   1) Provide a left-most derivation for string ***aa***.
   2) Show the grammar is ambiguous.

   Solution:

   1)

   2)

6. (15 pts) Show the LL(1) parsing action table, according to the LL(1) parsing table shown below, to recognize the string ***( )( )***.

M[N, T]	***(***	***)***	***$***
S	S ⟶ (S)S	S ⟶ ε	S ⟶ ε

Solution:

	Parsing Stack	Input	Action
1	$	$	
2	$	$	
3	$	$	
4	$	$	
5	$	$	
6	$	$	
7	$	$	
8	$	$	
9	$	$	
10	$	$	
11	$	$	
12	$	$	
13	$	$	
14	$	$	
15	$	$	
16	$	$	

7. (10 pts) Given grammar:

$T \rightarrow A\ \boldsymbol{a} \mid \boldsymbol{b}$

$A \rightarrow A\ \boldsymbol{c} \mid T\ \boldsymbol{d} \mid \varepsilon$

Remove left recursion.

Solution:

8. This question is on SLR(1) paring (shift-reduce). Given the context-free grammar:

$S \rightarrow \boldsymbol{(}\ AS\ \boldsymbol{)} \mid \varepsilon$

$A \rightarrow S \mid \varepsilon$

1) (10 pts) Convert the given grammar to a augmented grammar with new start symbol and list all LR(0) items.

Solution:

Augmented grammar:

LR(0) items:

2) (15 pts) Construct the NFA of LR(0) items for the grammar.
Solution:

3) (15 pts) Construct the DFA from the above NFA.
Solution:

4) (15 pts) Show the parsing stack and the action of an SLR(1) parser for the input ***(( )( ))***.
Solution: (You may use R for "Reduce" and S for "Shift".)

	Parsing Stack	Input	Action
1	$	$	
2	$	$	
3	$	$	
4	$	$	
5	$	$	
6	$	$	
7	$	$	
8	$	$	
9	$	$	
10	$	$	
11	$	$	
12	$	$	
13	$	$	
14	$	$	
15	$	$	
16	$	$	
17	$	$	
18	$	$	
19	$	$	
20	$	$	
21	$	$	

The End