On homework, you may discuss with other students in the course about how to solve a problem, but the write-up should be your own. You must include the names of any students you consulted with. Give credit where credit is due.

You may use jeLLRap for this assignment. It is a instructional tool for building LL and LR parse tables. With jeLLRap, after the parse table is constructed you can see the parsing of strings animating the stack, the parse tree and the derivation.

1. (8 pts) Construct the LR parse table for the following grammar by a) calculate FIRST and FOLLOW sets for the variables, b) construct the corresponding transition diagram, and c) construct the LR parse table. A new start symbol $S'$ and production have already been added to the grammar.

$$
0) S' \rightarrow S
1) S \rightarrow SaA
2) S \rightarrow c
3) A \rightarrow Bb
4) A \rightarrow \lambda
5) B \rightarrow \lambda
$$

2. (8 pts) Construct the LR parse table for the following grammar by a) calculate FIRST and FOLLOW sets for the variables, b) construct the corresponding transition diagram, and c) construct the LR parse table. A new start symbol $S'$ and production have already been added to the grammar.

NOTE the grammar is not LR(1), so you will have at least one conflict in the table.

$$
0) S' \rightarrow S
1) S \rightarrow CBa
2) B \rightarrow bBS
3) B \rightarrow b
4) C \rightarrow a
5) C \rightarrow \lambda
$$

3. (6 pts) Consider the following grammar:

$$
S \rightarrow ABD \\
A \rightarrow Bc \mid aa \\
B \rightarrow bB \mid \lambda \\
D \rightarrow dDA \mid \lambda
$$

(a) Compute FIRST and FOLLOW for all the variables in the grammar.

(b) Compute the LL(1) parse table.
4. (4 pts) Consider the following grammar:

\[
S \rightarrow aAa \mid aBc \\
A \rightarrow Bf \mid bba \mid be \\
B \rightarrow bbbd \mid b
\]

(a) The grammar is LL(k) for what value of k?
(b) Give an example of a string in which k lookaheads are needed to parse the string and explain why fewer than k lookaheads will not work (where k is the value you choose in part (a)).

5. Comment on the tool jeLLRap by considering the following questions.

(a) Did you use jeLLRap?
(b) If so, did you find it helpful? In what way?
(c) What improvement to the tool can you suggest so that they will be easier to use?
(d) What features should not be changed?