
The answers, comments, and programs (if any) must be the original work of the author. While discussion with others is permitted and encouraged, the final work should be done individually. You are not allowed to work in groups. You are allowed to build on the material supplied in the class. If you use any other source than the class notes and the textbook, specify it clearly.

1. (10+5+5 points) Consider the following grammar G :

$$\begin{aligned} S &\rightarrow AD \mid BD \\ A &\rightarrow aaB \mid Aab \mid Aba \\ B &\rightarrow Bb \mid c \\ D &\rightarrow d \end{aligned}$$

- Construct a grammar G' that contains no left-recursive rules and is equivalent to G .
- Give a leftmost derivation on the string $aa\ c\ bb\ ab\ ab\ d$ in grammar G .
- Give a leftmost derivation on the string $aa\ c\ bb\ ab\ ab\ d$ in grammar G' .

2. (40 points) Draw the graph of the following grammar. Give the lookahead sets for each variable and rule.

$$\begin{aligned} S &\rightarrow ABab \mid BAba \\ A &\rightarrow a \mid c \\ B &\rightarrow b \mid c \mid \lambda \end{aligned}$$

3. (40 points) Give the FIRST_1 and the FIRST_2 sets for each rule and variable of the following grammar. Show your work in following the steps of the algorithm.

$$\begin{aligned} S &\rightarrow AB\# \\ A &\rightarrow aAb \mid B \\ B &\rightarrow aBc \mid \lambda \end{aligned}$$