
The answers 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. Any other source must be specified clearly.

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

$$\begin{aligned} S &\rightarrow AB \mid CB \\ A &\rightarrow aaAbb \mid aaaAbbb \mid Ae \mid e \\ B &\rightarrow Bd \mid d \\ C &\rightarrow Cee \mid Cff \mid gg \end{aligned}$$

a. Construct a grammar G' that contains no left-recursive rules and is equivalent to G .

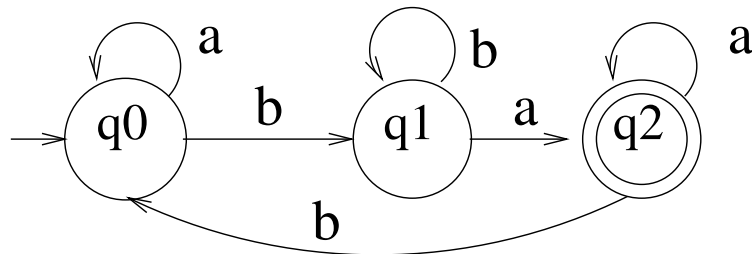
b. Give a leftmost derivation on the string $aaebbbe ddd$ in grammar G .

c. Give a leftmost derivation on the string $aaebbbe ddd$ 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. (10 points) Give a formal description (in the form of a 5-tuple) of the DFA shown below.



4. (30 points) Build a DFA that accepts the described language. Explain how you construct the machine.

Part a. The set of strings over $\{a, b, c\}$ in which all the a 's precede the b 's, which in turn precede the c 's. It is possible to have no a 's, b 's, or c 's.

Part b. The empty set (over $\{a, b\}$).

Part c. The empty string (over $\{a, b\}$).