CS 421 — LL Grammar Problems

Question 1: What advantage does it give the programmer if a grammar turns out to be LL?

Question 2: What are the two conditions that will cause a grammar to **not** be LL?

Question 3: Consider the following grammar.

$$\begin{array}{rl} S \rightarrow & x\ E\ a \\ | & y\ E\ z \\ E \rightarrow & x\ F \\ | & x\ E\ q \\ F \rightarrow & q \\ | & F\ z \end{array}$$

This grammar is not LL. There are two reasons for that. What are they?

Question 4: Convert the following grammar into an equivalent LL grammar.

$$\begin{array}{rl} S \rightarrow & x\ E\ a \\ | & y\ E\ z \\ E \rightarrow & x\ F \\ | & x\ E\ q \\ F \rightarrow & q \\ | & F\ z \end{array}$$

Question 5: Convert the following non-LL grammar into an equivalent LL grammar.

$$\begin{array}{rl} S \rightarrow & S\ x \\ | & a\ E \\ E \rightarrow & y\ a\ y \\ | & y\ a\ z \end{array}$$

Question 6: Convert the following non-LL grammar into an equivalent LL grammar.

$$\begin{array}{rl} S \rightarrow & y\ y \\ | & y\ E \\ E \rightarrow & E\ x \\ | & x\ a \end{array}$$

Question 7: Convert the following non-LL grammar into an equivalent LL grammar.

$$\begin{array}{rl} S \rightarrow & S\ x \\ | & a\ E \\ E \rightarrow & x\ y \\ | & x\ z \end{array}$$

Question 8: Convert the following non-LL grammar into an equivalent LL grammar.

$$\begin{array}{rl} S \rightarrow & S\ x \\ | & x\ E \\ E \rightarrow & y\ y \\ | & y\ z \end{array}$$

Question 9: Convert the following non-LL grammar into an equivalent LL grammar.

$$\begin{array}{rl} S \rightarrow & y\ E \\ | & y\ z \\ E \rightarrow & E\ z\ z \\ | & x\ a\ a \end{array}$$

Question 10: Convert the following non-LL grammar into an equivalent LL grammar.

$$\begin{array}{rl} S \rightarrow & S\ x \\ | & a\ E \\ E \rightarrow & z\ b\ b \\ | & z\ b\ z \end{array}$$

1 Solutions to exercises

Solution 1 If the grammar is LL, then we can write a parser for it very simply using recursive descent.

Solution 2

1. two rules for the same symbol that have overlapping first sets (The "common prefix" problem.)

2. a left recursive rule

Solution 3 The E productions share a common prefix, x; and one of the F rules is left recursive.

Solution 4

$$\begin{array}{rl} S \rightarrow & x\ E\ a \\ | & y\ E\ z \\ E \rightarrow & x\ E' \\ E' \rightarrow & F \\ | & E\ q \\ F \rightarrow & q\ F' \\ F' \rightarrow & z\ F' \\ | & \epsilon \end{array}$$

Solution 5

$$\begin{array}{rl} S \rightarrow & a\ E\ S' \\ S' \rightarrow & x\ S' \\ | & \epsilon \\ E \rightarrow & y\ a\ E' \\ E' \rightarrow & y \\ | & z \end{array}$$

Solution 6

$$\begin{array}{rl} S \rightarrow & y\ S' \\ S' \rightarrow & y \\ | & E \\ E \rightarrow & x\ a\ E' \\ E' \rightarrow & x\ E' \\ | & \epsilon \end{array}$$

Solution 7

$$\begin{array}{rl} S \rightarrow & a\ E\ S' \\ S' \rightarrow & x\ S' \\ | & \epsilon \\ E \rightarrow & x\ E' \\ E' \rightarrow & y \\ | & z \end{array}$$

Solution 8

$$\begin{array}{rl} S \rightarrow & x\ E\ S' \\ S' \rightarrow & x\ S' \\ | & \epsilon \\ E \rightarrow & y\ E' \\ E' \rightarrow & y \\ | & z \end{array}$$

Solution 9

$$\begin{array}{rl} S \rightarrow & y\ S' \\ S' \rightarrow & z \\ | & E \\ E \rightarrow & x\ a\ a\ E' \\ E' \rightarrow & z\ z\ E' \\ | & \epsilon \end{array}$$

Solution 10

$$\begin{array}{rl} S \rightarrow & a\ E\ S' \\ S' \rightarrow & x\ S' \\ | & \epsilon \\ E \rightarrow & z\ b\ E' \\ E' \rightarrow & b \\ | & z \end{array}$$