

HW2

Q1

The following grammar is not suitable for a top-down predictive parser. Identify the problem and correct it by rewriting the grammar. Show that your new grammar satisfies the LL(1) condition.

ORIGINAL GRAMMAR

$$\begin{array}{lcl} L & \rightarrow & Ra \\ & | & Qba \\ R & \rightarrow & aba \\ & | & caba \\ & | & Rbc \\ Q & \rightarrow & bbc \\ & | & bc \end{array}$$

ISSUE

The rule $R \rightarrow Rbc$ is an example of left recursion. There are two choices in the rule $Q \rightarrow bbc|bc$ if the parser is presented with a b .

NEW GRAMMAR

$$\begin{array}{lcl} L & \rightarrow & Ra \\ & | & Qba \\ R & \rightarrow & abaS \\ & | & cabaS \\ S & \rightarrow & bcS \\ & | & \varepsilon \\ Q & \rightarrow & bT \\ T & \rightarrow & bc \\ & | & c \end{array}$$

LEFT RECURSION

No longer present

FIRST TERMINAL SETS

$\text{First}(L) = \{a, b, c\}$ $\text{First}(R) = \{a, c\}$ $\text{First}(S) = \{a, b\}$ $\text{First}(Q) = \{b\}$ $\text{First}(T) = \{b, c\}$
 $\text{First}(R) \cap \text{First}(Q) = \emptyset$

Q2

$$\begin{array}{lll}
 1 & A & \rightarrow Ba \\
 2 & B & \rightarrow dab \\
 3 & & | Cb \\
 4 & C & \rightarrow cB \\
 5 & & | Ac
 \end{array}$$

LEFT RECURSION

Yes, this grammar has left recursion. (Rules 1, 3 and 5 applied one after the other is circular. In other words $A \Rightarrow^+ A\beta$ for $b \in N \cup T$.)

REWRITTEN GRAMMAR

Step 1: Eliminate C

$$\begin{array}{lll}
 A & \rightarrow & Ba \\
 B & \rightarrow & dab \\
 & | & cBb \\
 & | & Acb
 \end{array}$$

Step 2: Remove circular left recursion

$$\begin{array}{lll}
 A & \rightarrow & Ba \\
 B & \rightarrow & dab \\
 & | & cBb \\
 & | & Bacb
 \end{array}$$

Step 3: Remove left recursion

$$\begin{array}{lll}
 A & \rightarrow & Ba \\
 B & \rightarrow & dabC \\
 & | & cBbC \\
 C & \rightarrow & acbC \\
 & | & \varepsilon
 \end{array}$$

LL(1)

No, since the grammar has left recursion, it is not LL(1).

Q3

$$\begin{array}{lll}
 A & \rightarrow & 0 \\
 & | & 1B00 \\
 B & \rightarrow & 0B \\
 & | & 1B \\
 & | & \varepsilon
 \end{array}$$