

Parsing

Homework 5 (LL(1)), due 31 May 2021

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Question 1 (LL(1) grammar)

Consider a CFG with $N = \{S, A, B, C\}$, $T = \{a, b, c\}$, start symbol S and the following productions: $S \rightarrow AB \mid BB, A \rightarrow aA \mid \varepsilon, B \rightarrow bB \mid \varepsilon$.

1. Compute the First sets for all non-terminals.
2. Compute the Follow sets of all non-terminals.
3. Compute the First sets for all righthand sides of productions in the grammar.
4. Give the LL(1) parse table for this grammar.
5. Is this grammar LL(1)? Explain your answer.

Solution:

1. $First(A) = \{\varepsilon, a\}$, $First(B) = \{\varepsilon, b\}$, $First(S) = \{a, b, \varepsilon\}$.
2. $Follow(S) = \{\$\}$, $Follow(A) = \{b, \$\}$, $Follow(B) = \{b, \$\}$.
3. $First(AB) = \{a, b, \varepsilon\}$, $First(BB) = \{b, \varepsilon\}$, $First(aA) = \{a\}$, $First(\varepsilon) = \{\varepsilon\}$, $First(bB) = \{b\}$.

	S	A	B
a	$S \rightarrow AB$	$A \rightarrow aA$	-
4. b	$S \rightarrow AB, S \rightarrow BB$	$A \rightarrow \varepsilon$	$B \rightarrow bB, B \rightarrow \varepsilon$
c	-	-	-
\$	$S \rightarrow AB, S \rightarrow BB$	$A \rightarrow \varepsilon$	$B \rightarrow \varepsilon$

5. The grammar is not LL(1) since some of the fields in the parse table contain more than one entry.

Question 2 (LL(1) grammar, transformations)

Now consider a CFG with $N = \{S, A, B\}$, $T = \{a, b\}$, start symbol S and the following productions: $S \rightarrow AB \mid BB, A \rightarrow aA \mid \varepsilon, B \rightarrow b$, and do the following transformations:

1. Remove ε -productions.
2. Do left factoring on the result. (Note that this will again introduce ε -productions but that is fine.)

Give the grammars you obtain. Compute then the resulting LL(1) parse table.

Solution

1. New productions:

$$S \rightarrow AB \mid BB \mid B, A \rightarrow aA \mid a, B \rightarrow b$$

2. New productions:

$$S \rightarrow AB \mid BX, X \rightarrow B \mid \varepsilon, A \rightarrow aY, Y \rightarrow A \mid \varepsilon, B \rightarrow b$$

Resulting parse table:

	S	A	B	X	Y
a	$S \rightarrow AB$	$A \rightarrow aY$			$Y \rightarrow A$
b	$S \rightarrow BX$		$B \rightarrow b$	$X \rightarrow B$	$Y \rightarrow \varepsilon$
\$				$X \rightarrow \varepsilon$	