

## TDT4205 PS 2

Øyvind Skaaden (oyvindps)

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### Problem 1.

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- 1.1) As discussed in Piazza, it is not possible to rewrite the following grammar in table 1 into LL(1) just by using left factoring and/or left recursion elimination.

Table 1: Original grammar, supplied in PS2 description.

$$\begin{aligned} S &\rightarrow wXYZ \\ X &\rightarrow MB|MBeX \\ Y &\rightarrow eB|\epsilon \\ M &\rightarrow m \\ B &\rightarrow b \end{aligned}$$

We can already see a problem when for instance we have the input sequences ending in **ebz** and **embz**. By just looking at **e** we can't determine that the **e** is part of the  $X$  tree or  $Y$  tree, without looking at the next symbol **b** or **m**.

The solution is to rewrite the grammar so that there is only one type of tree,  $X$ . The  $X$  tree always start with  $MB$ , and can be followed by an arbitrary number of  $eMB$  and then an optional  $eB$ .

This can be done by rewriting the  $X$  to  $X \rightarrow MBX'$ , where  $X' \rightarrow eX''|\epsilon$  and  $X'' \rightarrow X|B$ . Then the  $Y$  is unused and we can remove that and the  $Y$  from  $S$ . The new  $S$  is therefore  $S \rightarrow wXz$ .

We can not set  $B \rightarrow b|\epsilon$  because then we could have an  $eB$  block in the middle, which is not allowed by the FORTRAN language.

The new grammar is written down in table 2.

Table 2: Rewritten grammar to comply with LL(1).

$$\begin{aligned} S &\rightarrow wXz \\ X &\rightarrow MBX' \\ X' &\rightarrow eX''|\epsilon \\ X'' &\rightarrow X|B \\ M &\rightarrow m \\ B &\rightarrow b \end{aligned}$$

1.2) The FIRST and FOLLOW sets are described in table 3.

Table 3: FIRST and FOLLOW sets.

NT	FIRST	FOLLOW	$\rightarrow \epsilon?$
$S$	w	-	no
$X$	m	z	no
$X'$	e	z	yes
$X''$	m, b	z	no
$M$	m	b	no
$B$	b	e, z	no

The predictive parsing table is shown in table 4.

Table 4: Predictive parsing table for the new grammar.

	w	m	e	b	z
$S$	$S \rightarrow wXz$				
$X$		$X \rightarrow MBX'$			
$X'$			$X' \rightarrow eX''$		$X' \rightarrow \epsilon$
$X''$		$X'' \rightarrow X$		$X'' \rightarrow B$	
$M$		$M \rightarrow m$			
$B$				$B \rightarrow b$	