Norges teknisk–naturvitenskapelige universitet
Department of Computer Science

TDT4205 Kompilatorteknikk Vår 2022

Problem Set 2

1 **a)** Initial grammar:

$$S \to wXYz$$
$$X \to MB|MBeX$$
$$Y \to eB|\epsilon$$
$$M \to m$$
$$B \to b$$

First notice that $M \to m$ and $B \to b$ are the only productions for M and B. This means we can substitute M with terminal m and B with terminal b:

$$S \to wXYz$$
$$X \to mb|mbeX$$
$$Y \to eb|\epsilon$$

Now notice that if we have token m we will be unable to choose between $X \to mb$ and $X \to mbeX$. We can solve this by using left factoring:

$$S \to wXYz$$
$$X \to mbX'$$
$$X' \to eX|\epsilon$$
$$Y \to eb|\epsilon$$

There is another issue. Notice that if input is $wmbebz$ we will get to wmb but then not know if we should choose $X' \to eX$, or $X' \to \epsilon$ and $Y \to eb$. If we use left factoring we can rewrite to

$$S \to wXYz$$
$$X \to mb$$
$$Y \to eY'|\epsilon$$
$$Y' \to XY|b$$

This allows us to postpone that choice to a later time.

b)

$$FIRST(S) = \{w\}$$
$$FIRST(X) = \{m\}$$
$$FIRST(Y) = \{e\}$$
$$FIRST(Y') = \{m, b\}$$

We see that only Y is nullable.

$$FOLLOW(S) = \{\$\}$$
$$FOLLOW(X) = \{e, z\}$$
$$FOLLOW(Y) = \{z\}$$
$$FOLLOW(Y') = \{z\}$$

	w	e	m	b	z
S	$S \to wXYz$				
X			$X \to mb$		
Y		$Y \to eY'$			$Y \to \epsilon$
Y'			$Y' \to XY$	$Y' \to b$	

Tabell 1: Parsing table