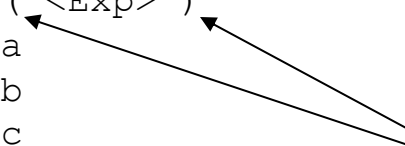


# Grammars in Action

Example: A simple programming language grammar.

$G: \langle \text{Exp} \rangle^* ::= \langle \text{Exp} \rangle + \langle \text{Exp} \rangle$   
                  |  $\langle \text{Exp} \rangle * \langle \text{Exp} \rangle$   
                  |  $( \langle \text{Exp} \rangle )$   
                  |  $a$   
                  |  $b$   
                  |  $c$



Terminal symbols!!!

$S = a$   
 **$S = a + b$**   
 $S = a + b * c$   
 **$S = (a + b) * c$**   
 **$S = ((a + b))$**   
 **$S = c(a + b)$**   
 $S = (c) + (b)$   
 $S = b++$

}  $S \in L(G)?$

2, 4, 5, 6

# Grammars in Action

- The empty symbol:  $\langle \text{empty} \rangle$
- You can think of  $\langle \text{empty} \rangle$  being defined by the implicit rule:  
$$\langle \text{empty} \rangle ::= ""$$
- That is the  $\langle \text{empty} \rangle$  symbol derives nothing.

# <empty>

- Consider the grammar:

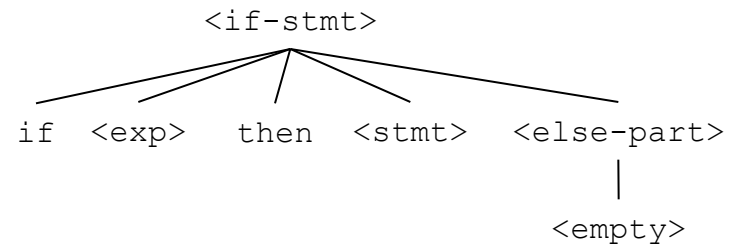
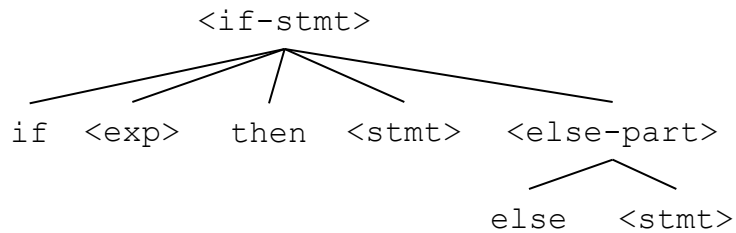
$G:$      $\langle A \rangle^* ::= a \langle B \rangle \mid a$   
          $\langle B \rangle ::= b \langle B \rangle \mid b$

$G':$      $\langle A \rangle^* ::= a \langle B \rangle$   
          $\langle B \rangle ::= b \langle B \rangle \mid \langle \text{empty} \rangle$

# Grammars in Action

Consider the following grammar fragment:

```
<if-stmt> ::= if <exp> then <stmt> <else-part>
<else-part> ::= else <stmt> | <empty>
<exp> ::= ...
<stmt> ::= ...
```



# Grammars in Action

- 2.1 a) Let  $L(G)$  be the language of all string consisting of zero or more  $a$ 's.
- 2.1 i) Let  $L(G)$  be the set of strings consisting of one or more  $a$ 's with a comma between each  $a$  and the next.
- 2.1 d) Let  $L(G)$  be the set of all strings consisting of one or more digits  $0 - 9$ .