

BU CS320 Assignment 5: Context Free Grammars

October 30, 2023

1. Given the following grammar where $\langle expr \rangle$ is the starting symbol

$\begin{aligned}\langle digit \rangle &::= 0 \mid 1 \mid 2 \mid 3 \mid 4 \mid 5 \mid 6 \mid 7 \mid 8 \mid 9 \\ \langle nat \rangle &::= \langle digit \rangle \mid \langle digit \rangle \langle nat \rangle \\ \langle int \rangle &::= \langle nat \rangle \mid -\langle nat \rangle \\ \langle expr \rangle &::= \langle int \rangle \\ &\quad \mid (\langle expr \rangle) \\ &\quad \mid \langle expr \rangle + \langle expr \rangle \\ &\quad \mid \langle expr \rangle * \langle expr \rangle\end{aligned}$

Derive the sentence using *rightmost derivation*.

$12 + 2 * -07$

$\langle expr \rangle$
 $\langle expr \rangle + \langle expr \rangle$
 $\langle expr \rangle + \langle expr \rangle * \langle expr \rangle$
 $\langle expr \rangle + \langle expr \rangle * \langle int \rangle$
 $\langle expr \rangle + \langle expr \rangle * -\langle nat \rangle$
 $\langle expr \rangle + \langle expr \rangle * -\langle digit \rangle \langle nat \rangle$
 $\langle expr \rangle + \langle expr \rangle * -\langle digit \rangle \langle digit \rangle$
 $\langle expr \rangle + \langle expr \rangle * -\langle digit \rangle 7$
 $\langle expr \rangle + \langle expr \rangle * -07$
 $\langle expr \rangle + \langle int \rangle * -07$
 $\langle expr \rangle + \langle nat \rangle * -07$
 $\langle expr \rangle + \langle digit \rangle * -07$
 $\langle expr \rangle + 2 * -07$
 $\langle int \rangle + 2 * -07$
 $\langle nat \rangle + 2 * -07$
 $\langle digit \rangle \langle nat \rangle + 2 * -07$
 $\langle digit \rangle \langle digit \rangle + 2 * -07$
 $\langle digit \rangle 2 + 2 * -07$
 $12 + 2 * -07$

2. Given the following grammar where $\langle stmt \rangle$ is the starting symbol.

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 $\langle digit \rangle ::= 0 \mid 1 \mid 2 \mid 3 \mid 4 \mid 5 \mid 6 \mid 7 \mid 8 \mid 9$ 

 $\langle letter \rangle ::= a \mid b \mid c \mid \dots \mid z$ 

 $\langle nat \rangle ::= \langle digit \rangle \mid \langle digit \rangle \langle nat \rangle$ 

 $\langle int \rangle ::= \langle nat \rangle \mid -\langle nat \rangle$ 

 $\langle expr \rangle ::= \langle int \rangle$ 
              $\mid (\langle expr \rangle)$ 
              $\mid \langle expr \rangle + \langle expr \rangle$ 
              $\mid \langle expr \rangle * \langle expr \rangle$ 

 $\langle id \rangle ::= \langle letter \rangle \mid \langle letter \rangle \langle id \rangle$ 

 $\langle stmt \rangle ::= \langle id \rangle = \langle expr \rangle$ 
              $\mid \text{for } \langle id \rangle = \langle expr \rangle \text{ to } \langle expr \rangle \text{ do } \langle stmt \rangle$ 
              $\mid \{ \langle stmts \rangle \}$ 
              $\mid \text{pass}$ 

 $\langle stmts \rangle ::= \langle stmt \rangle \mid \langle stmt \rangle ; \langle stmts \rangle$ 

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Derive the sentence using *leftmost derivation*.

```
for x = -12 to 10 do { y = 0; pass }
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```

<stmt>
for <id> = <expr> to <expr> do <stmt>
for <letter> = <expr> to <expr> do <stmt>
for x = <expr> to <expr> do <stmt>
for x = <int> to <expr> do <stmt>
for x = -<nat> to <expr> do <stmt>
for x = -<digit><nat> to <expr> do <stmt>
for x = -1<nat> to <expr> do <stmt>
for x = -1<digit> to <expr> do <stmt>
for x = -12 to <expr> do <stmt>
for x = -12 to <int> do <stmt>
for x = -12 to <nat> do <stmt>
for x = -12 to <digit><nat> do <stmt>
for x = -12 to 1<nat> do <stmt>
for x = -12 to 1<digit> do <stmt>
for x = -12 to 10 do <stmt>
for x = -12 to 10 do { <stmts> }
for x = -12 to 10 do { <stmt>; <stmts> }
for x = -12 to 10 do { <id> = <expr>; <stmts> }
for x = -12 to 10 do { <letter> = <expr>; <stmts> }
for x = -12 to 10 do { y = <expr>; <stmts> }
for x = -12 to 10 do { y = <int>; <stmts> }
for x = -12 to 10 do { y = <nat>; <stmts> }
for x = -12 to 10 do { y = <digit>; <stmts> }
for x = -12 to 10 do { y = 0; <stmts> }
for x = -12 to 10 do { y = 0; <stmt> }
for x = -12 to 10 do { y = 0; pass }

```