

BU CS320 Assignment 5: Context Free Grammars

October 30, 2023

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

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

Derive the sentence using *rightmost derivation*.

$12 + 2 * -07$

1. $\langle expr \rangle$
2. $\langle expr \rangle + \langle expr \rangle$
3. $\langle expr \rangle + \langle expr \rangle * \langle expr \rangle$
4. $\langle expr \rangle + \langle expr \rangle * -\langle nat \rangle$
5. $\langle expr \rangle + \langle expr \rangle * -\langle digit \rangle \langle nat \rangle$
6. $\langle expr \rangle + \langle expr \rangle * -0 \langle digit \rangle$
7. $\langle expr \rangle + \langle expr \rangle * -07$
8. $\langle expr \rangle + \langle nat \rangle * -07$
9. $\langle expr \rangle + \langle digit \rangle \langle nat \rangle * -07$
10. $\langle expr \rangle + 2 * -07$
11. $\langle nat \rangle + 2 * -07$
12. $\langle digit \rangle \langle nat \rangle + 2 * -07$
13. $1 \langle nat \rangle + 2 * -07$
14. $12 + 2 * -07$

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*.

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for x = -12 to 10 do { y = 0; pass }
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1. $\langle stmt \rangle$
2. for $\langle id \rangle = \langle expr \rangle$ to $\langle expr \rangle$ do $\{ \langle stmts \rangle \}$
3. for $x = \langle expr \rangle$ to $\langle expr \rangle$ do $\{ \langle stmts \rangle \}$
4. for $x = \langle int \rangle$ to $\langle expr \rangle$ do $\{ \langle stmts \rangle \}$
5. for $x = -\langle nat \rangle$ to $\langle expr \rangle$ do $\{ \langle stmts \rangle \}$.
6. for $x = -\langle digit \rangle \langle nat \rangle$ to $\langle expr \rangle$ do $\{ \langle stmts \rangle \}$.
7. for $x = -1 \langle nat \rangle$ to $\langle expr \rangle$ do $\{ \langle stmts \rangle \}$.
8. for $x = -12$ to $\langle expr \rangle$ do $\{ \langle stmts \rangle \}$.
9. for $x = -12$ to $\langle nat \rangle$ do $\{ \langle stmts \rangle \}$.
10. for $x = -12$ to $\langle digit \rangle \langle nat \rangle$ do $\{ \langle stmts \rangle \}$.
11. for $x = -12$ to $1 \langle nat \rangle$ do $\{ \langle stmts \rangle \}$.
12. for $x = -12$ to 10 do $\{ \langle stmts \rangle \}$.
13. for $x = -12$ to 10 do $\{ \langle stmt \rangle ; \langle stmts \rangle \}$.
14. for $x = -12$ to 10 do $\{ \langle id \rangle = \langle expr \rangle ; \langle stmts \rangle \}$.
15. for $x = -12$ to 10 do $\{ y = \langle expr \rangle ; \langle stmts \rangle \}$.
16. for $x = -12$ to 10 do $\{ y = \langle int \rangle ; \langle stmts \rangle \}$.
17. for $x = -12$ to 10 do $\{ y = \langle nat \rangle ; \langle stmts \rangle \}$.
18. for $x = -12$ to 10 do $\{ y = \langle digit \rangle ; \langle stmts \rangle \}$.

19. for $x = -12$ to 10 do { $y = 0$; <stmts> }.

20. for $x = -12$ to 10 do { $y = 0$; <stmt> }.

21. for $x = -12$ to 10 do { $y = 0$; pass }.