

1. **A = A + (B * C)**

A) Leftmost Derivation

<assign> → <id> = <expr>

 → A = <expr>

 → A = <expr> + <term>

 → A = <term> + <term>

 → A = <factor> + <term>

 → A = <id> + <term>

 → A = A + <term>

 → A = A + <factor>

 → A = A + (<expr>)

 → A = A + (<term>)

 → A = A + (<term> * <factor>)

 → A = A + (<factor> * <factor>)

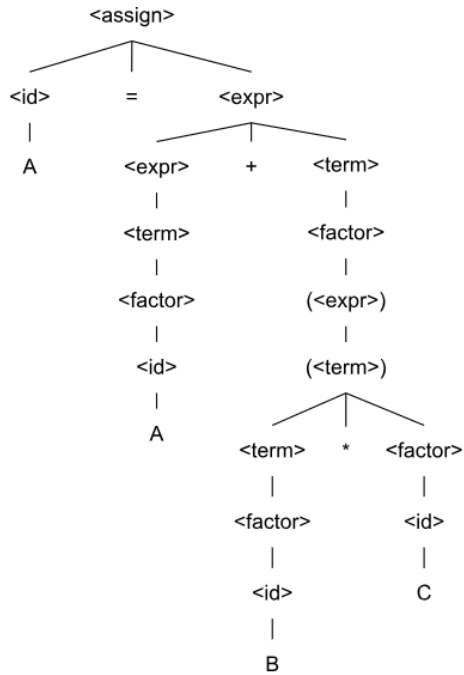
 → A = A + (<id> * <factor>)

 → A = A + (B * <factor>)

 → A = A + (B * <id>)

 → A = A + (B * C)

B) Parse Tree



2. **B = (A * C) + B**

A) **Leftmost Derivation**

<assign> → <id> = <expr>

 → B = <expr>

 → B = <expr> + <term>

 → B = <term> + <term>

 → B = <factor> + <term>

 → B = (<expr>) + <term>

 → B = (<term>) + <term>

 → B = (<term> * <factor>) + <term>

 → B = (<factor> * <factor>) + <term>

 → B = (<id> * <factor>) + <term>

 → B = (A * <factor>) + <term>

 → B = (A * <id>) + <term>

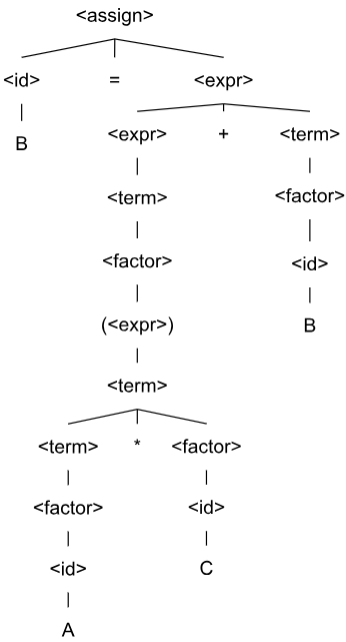
 → B = (A * C) + <term>

 → B = (A * C) + <factor>

 → B = (A * C) + <id>

 → B = (A * C) + B

B) **Parse Tree**



3. $A = ((C + A) * B) * C$

A) Leftmost Derivation

$\langle \text{assign} \rangle \rightarrow \langle \text{id} \rangle = \langle \text{expr} \rangle$

$\rightarrow A = \langle \text{expr} \rangle$

$\rightarrow A = \langle \text{term} \rangle * \langle \text{factor} \rangle$

$\rightarrow A = \langle \text{factor} \rangle * \langle \text{factor} \rangle$

$\rightarrow A = (\langle \text{expr} \rangle) * \langle \text{factor} \rangle$

$\rightarrow A = (\langle \text{term} \rangle) * \langle \text{factor} \rangle$

$\rightarrow A = (\langle \text{term} \rangle * \langle \text{factor} \rangle) * \langle \text{factor} \rangle$

$\rightarrow A = (\langle \text{factor} \rangle * \langle \text{factor} \rangle) * \langle \text{factor} \rangle$

$\rightarrow A = ((\langle \text{expr} \rangle) * \langle \text{factor} \rangle) * \langle \text{factor} \rangle$

$\rightarrow A = ((\langle \text{expr} \rangle + \langle \text{term} \rangle) * \langle \text{factor} \rangle) * \langle \text{factor} \rangle$

$\rightarrow A = ((\langle \text{term} \rangle + \langle \text{term} \rangle) * \langle \text{factor} \rangle) * \langle \text{factor} \rangle$

$\rightarrow A = ((\langle \text{factor} \rangle + \langle \text{term} \rangle) * \langle \text{factor} \rangle) * \langle \text{factor} \rangle$

$\rightarrow A = ((\langle \text{id} \rangle + \langle \text{term} \rangle) * \langle \text{factor} \rangle) * \langle \text{factor} \rangle$

$\rightarrow A = ((C + \langle \text{term} \rangle) * \langle \text{factor} \rangle) * \langle \text{factor} \rangle$

$\rightarrow A = ((C + \langle \text{factor} \rangle) * \langle \text{factor} \rangle) * \langle \text{factor} \rangle$

$\rightarrow A = ((C + \langle \text{id} \rangle) * \langle \text{factor} \rangle) * \langle \text{factor} \rangle$

$\rightarrow A = ((C + A) * \langle \text{factor} \rangle) * \langle \text{factor} \rangle$

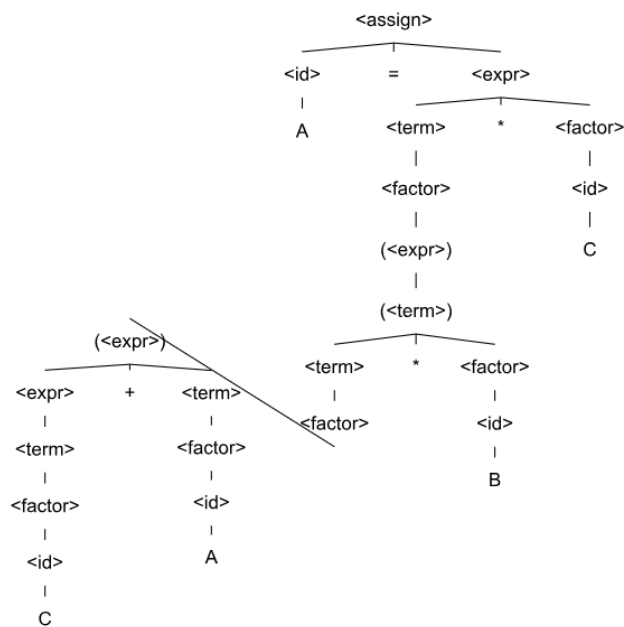
$\rightarrow A = ((C + A) * \langle \text{id} \rangle) * \langle \text{factor} \rangle$

$\rightarrow A = ((C + A) * B) * \langle \text{factor} \rangle$

$\rightarrow A = ((C + A) * B) * \langle \text{id} \rangle$

$\rightarrow A = ((C + A) * B) * C$

Parse Tree



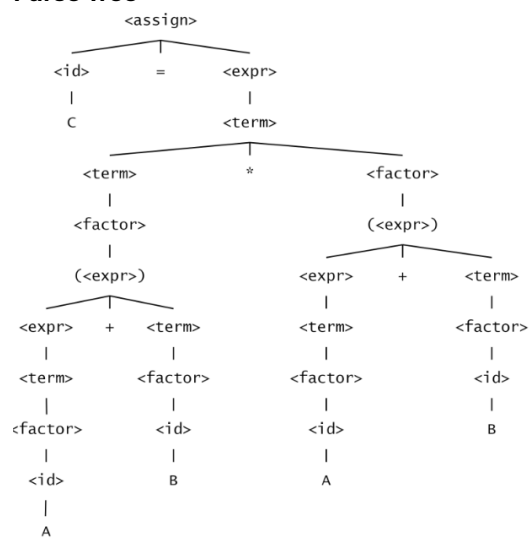
4. $C = (A + B) * (A + B)$

A) Leftmost Derivation

<assign>

- $\langle id \rangle = \langle expr \rangle$
- $C = \langle expr \rangle$
- $C = \langle term \rangle$
- $C = \langle term \rangle * \langle factor \rangle$
- $C = \langle factor \rangle * \langle factor \rangle$
- $C = (\langle expr \rangle) * \langle factor \rangle$
- $C = (\langle expr \rangle + \langle term \rangle) * \langle factor \rangle$
- $C = (\langle term \rangle + \langle term \rangle) * \langle factor \rangle$
- $C = (\langle factor \rangle + \langle term \rangle) * \langle factor \rangle$
- $C = (\langle id \rangle + \langle term \rangle) * \langle factor \rangle$
- $C = (A + \langle term \rangle) * \langle factor \rangle$
- $C = (A + \langle factor \rangle) * \langle factor \rangle$
- $C = (A + \langle id \rangle) * \langle factor \rangle$
- $C = (A + B) * \langle factor \rangle$
- $C = (A + B) * (\langle expr \rangle)$
- $C = (A + B) * (\langle expr \rangle + \langle term \rangle)$
- $C = (A + B) * (\langle term \rangle + \langle term \rangle)$
- $C = (A + B) * (\langle factor \rangle + \langle term \rangle)$
- $C = (A + B) * (\langle id \rangle + \langle term \rangle)$
- $C = (A + B) * (A + \langle term \rangle)$
- $C = (A + B) * (A + \langle factor \rangle)$
- $C = (A + B) * (A + \langle id \rangle)$
- $C = (A + B) * (A + B)$

B) Parse Tree



5. $A = A * (B + C)$

A) Leftmost Derivation

$\langle \text{assign} \rangle \rightarrow \langle \text{id} \rangle = \langle \text{expr} \rangle$

$\rightarrow A = \langle \text{expr} \rangle$

$\rightarrow A = \langle \text{term} \rangle$

$\rightarrow A = \langle \text{term} \rangle * \langle \text{factor} \rangle$

$\rightarrow A = \langle \text{factor} \rangle * \langle \text{factor} \rangle$

$\rightarrow A = \langle \text{id} \rangle * \langle \text{factor} \rangle$

$\rightarrow A = A * \langle \text{factor} \rangle$

$\rightarrow A = A * (\langle \text{expr} \rangle)$

$\rightarrow A = A * (\langle \text{expr} \rangle + \langle \text{term} \rangle)$

$\rightarrow A = A * (\langle \text{term} \rangle + \langle \text{term} \rangle)$

$\rightarrow A = A * (\langle \text{factor} \rangle + \langle \text{term} \rangle)$

$\rightarrow A = A * (\langle \text{id} \rangle + \langle \text{term} \rangle)$

$\rightarrow A = A * (B + \langle \text{term} \rangle)$

$\rightarrow A = A * (B + \langle \text{factor} \rangle)$

$\rightarrow A = A * (B + \langle \text{id} \rangle)$

$\rightarrow A = A * (B + C)$

B) Parse Tree

