

HOMEWORK #2 [25 points].

1. [5 points] Problem #3, p.157.

Solution. $\langle \text{assign} \rangle \rightarrow \langle \text{id} \rangle = \langle \text{expr} \rangle$ $\langle \text{id} \rangle \rightarrow A \mid B \mid C$ $\langle \text{expr} \rangle \rightarrow \langle \text{expr} \rangle * \langle \text{term} \rangle$ $\mid \langle \text{term} \rangle$ $\langle \text{term} \rangle \rightarrow \langle \text{factor} \rangle + \langle \text{term} \rangle$ $\mid \langle \text{factor} \rangle$ $\langle \text{factor} \rangle \rightarrow (\langle \text{expr} \rangle)$ $\mid \langle \text{id} \rangle$

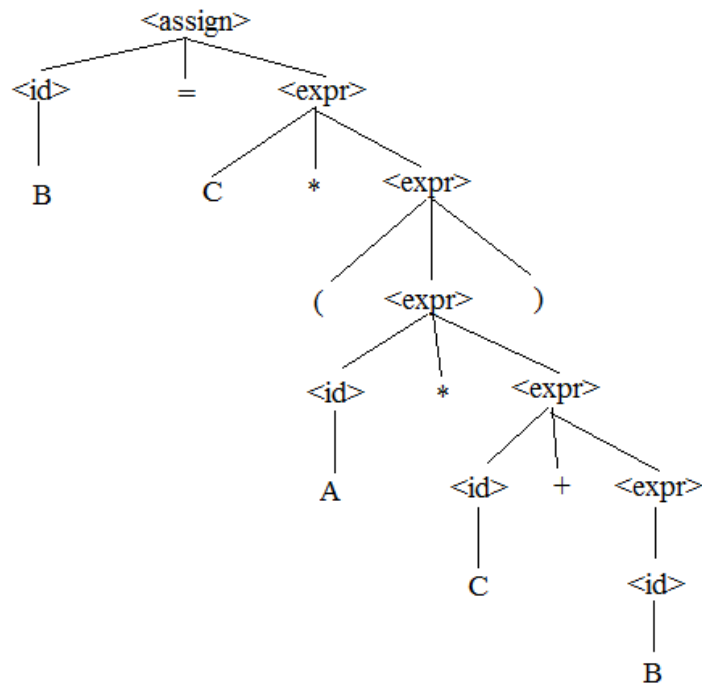
2. [4 points] Problem #6 (part b), p.157.

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

Leftmost derivation:

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

Parse tree:



Note that for this grammar precedence of + and * operators is not always correct.

3. [6 points] Problem #7 (parts a and b), p.158.

Solution.

$$(a) A = (A + B) * C$$

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

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

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

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

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

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

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

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

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

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

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

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

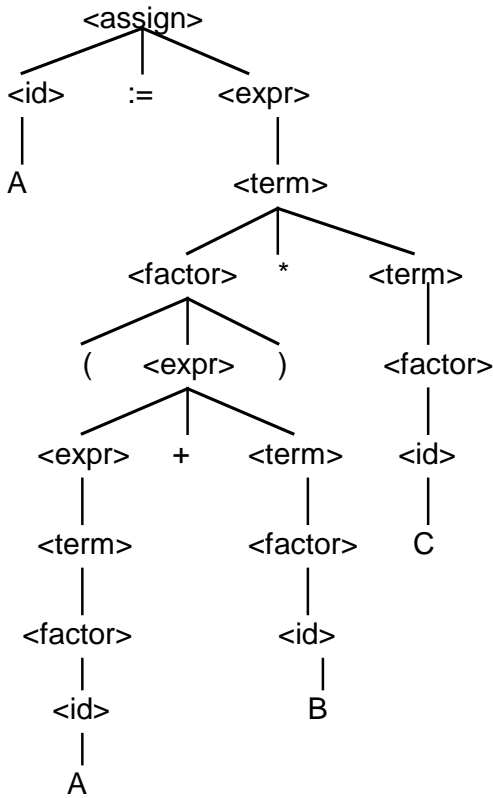
$$\Rightarrow A = (A + B) * \langle \text{term} \rangle$$

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

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

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

Parse tree:



(b) $A = B + C + A$

Solution.

Leftmost derivation:

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

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

$\Rightarrow A = \langle \text{expr} \rangle + \langle \text{term} \rangle$

$\Rightarrow A = \langle \text{expr} \rangle + \langle \text{term} \rangle + \langle \text{term} \rangle$

$\Rightarrow A = \langle \text{term} \rangle + \langle \text{term} \rangle + \langle \text{term} \rangle$

$\Rightarrow A = \langle \text{factor} \rangle + \langle \text{term} \rangle + \langle \text{term} \rangle$

$\Rightarrow A = \langle \text{id} \rangle + \langle \text{term} \rangle + \langle \text{term} \rangle$

$\Rightarrow A = B + \langle \text{term} \rangle + \langle \text{term} \rangle$

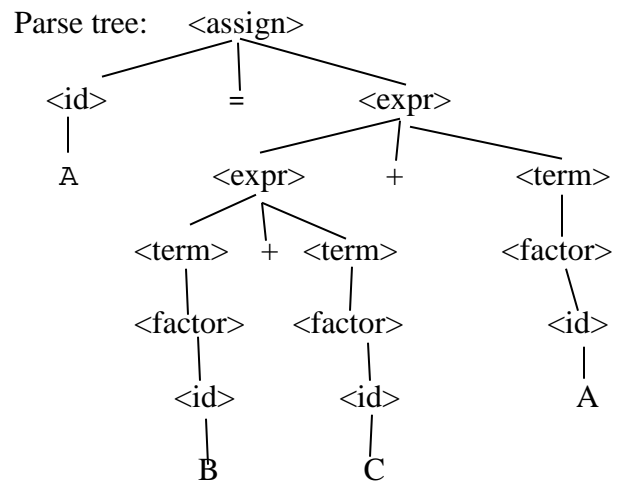
$\Rightarrow A = B + \langle \text{factor} \rangle + \langle \text{term} \rangle$

$\Rightarrow A = B + \langle \text{id} \rangle + \langle \text{term} \rangle$

$\Rightarrow A = B + C + \langle \text{term} \rangle$

$\Rightarrow A = B + C + \langle \text{id} \rangle$

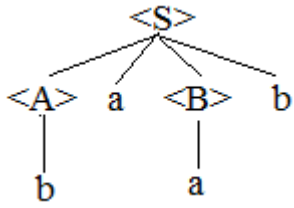
$\Rightarrow A = B + C + A$



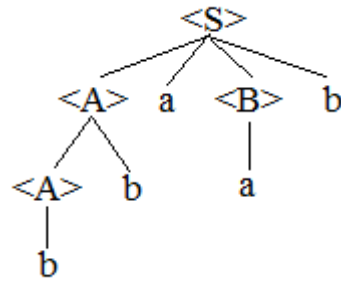
4. [4 points] Problem #11, p.158.

Solution. Note that parse trees are not required.

(a)



(d)



5. [3 points] Problem #15, p.159.

Solution.

<program> -> **begin** <stmt_list> **end**

<stmt_list> -> <stmt> {; <stmt_list>}

<var> -> A | B | C

<expression> -> <var> { (+ | -) <var> }

6. [3 points] Problem #17, p.159.

Solution.

S -> A

| A <list>

A -> aA

| abA

<list> -> ba

| ba <list>