expr → expr + term

expr → expr − term

expr → term

term → 0

term → 1

⋮

term → 9

term → (expr)

INFIX NOTATION

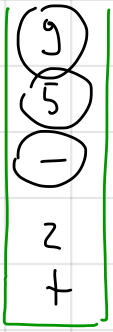
$[9-5]+2$ ⟼ $95-2+$

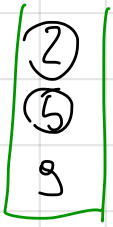
$9-(5+2)$ ⟼ $952+-$

POSTFIX NOTATION

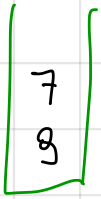
95

$9-5=4$



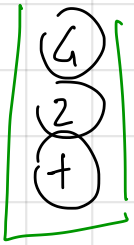


$+$ $5+2=7$ →



$-$ $4,2+$

$4+2=6$



$9-7=2$

6

$$T : \mathcal{E}_{expr} \longrightarrow Post\,\mathcal{E}_{expr}$$

$$\begin{cases} T[\![n]\!] = n & \text{(base case)} \\ T[\![e_1 \ op \ e_2]\!] = T[\![e_1]\!] \cdot T[\![e_2]\!] \cdot \text{'op'} \\ T[\![(e)]\!] = T[\![e]\!] \end{cases}$$

We use the same recursion to define an SDD that is S-attributed

We add to the grammar an attribute code of type String for the non-terminal symbols expr and term. The attribute is synthesized. The resulting S-attributed SDD is the following

SDD

$expr \longrightarrow expr_1 + term \quad \{ expr.code = expr_2.code \,||\, term.code \,||\, '+' \}$

$expr \longrightarrow expr_2 - term \quad \{ expr.code = expr_2.code \,||\, term.code \,||\, '-' \}$

$expr \longrightarrow term \quad \{ expr.code = term.code \}$

$term \longrightarrow 0 \quad \{ term.code = '0' \}$

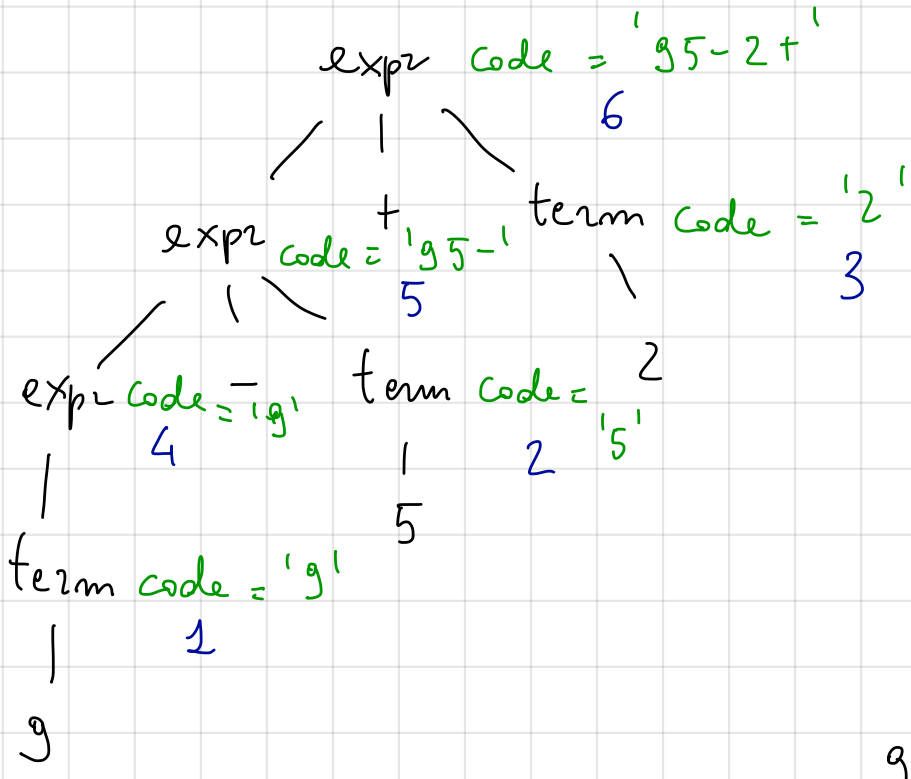
...

$term \longrightarrow 9 \quad \{ term.code = '9' \}$

$term \longrightarrow (expr) \quad \{ term.code = expr.code \}$

ANNOTATED PARSE TREE

9-5+2



BOTTOM-UP TRAVERSING

⇓

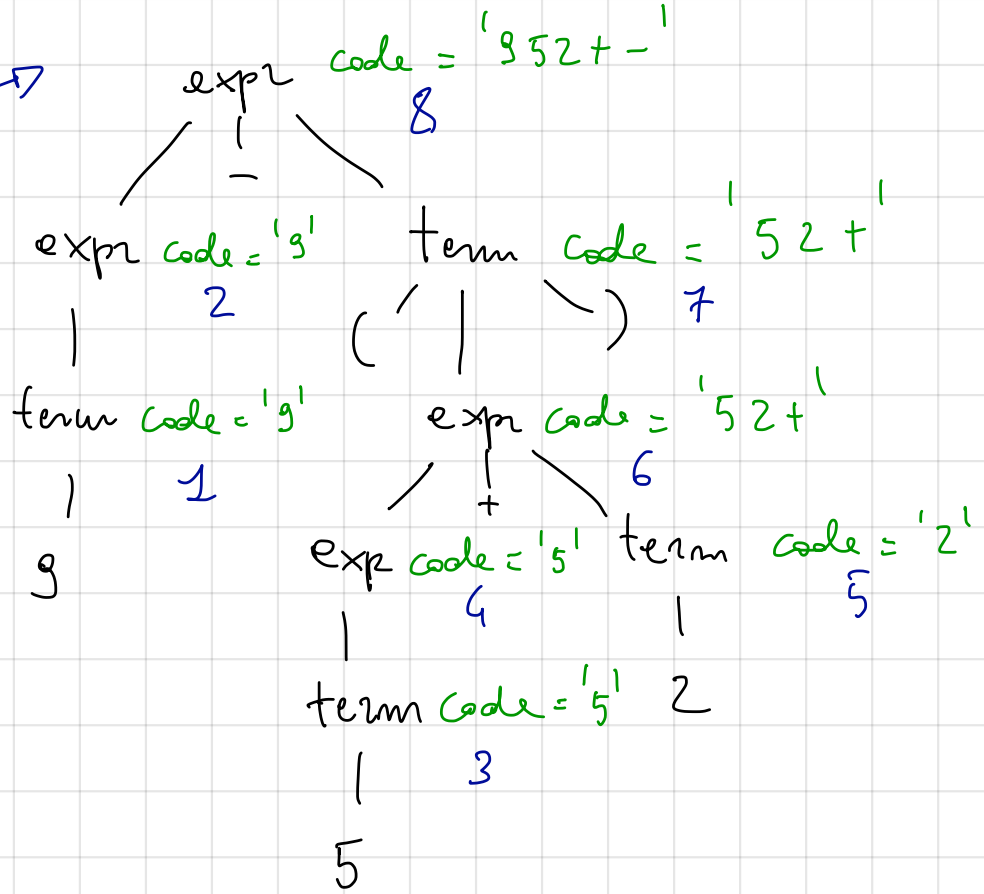
ORDER OF EXECUTION OF THE RULES

9 - (5+2)

TOP-DOWN TRAVERSING

⇓

ORDER OF EXECUTION OF RULES



$T \to F\,T'$

$T' \to *\,F\,T'$

$T' \to \varepsilon$

$F \to \underline{num}$

LL(1)

From

$T \to T * F \mid F$

$F \to \underline{num}$

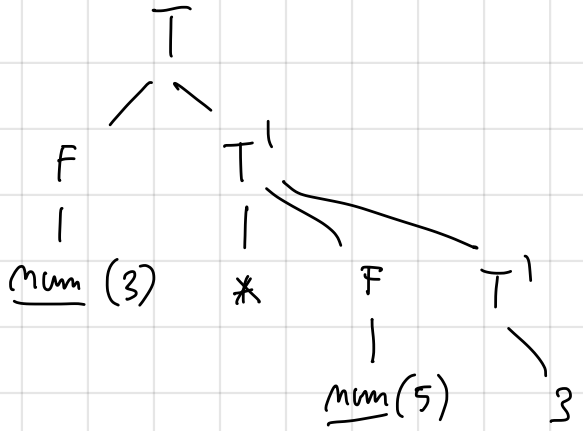
by eliminating left-recursion

NOT LL(1)

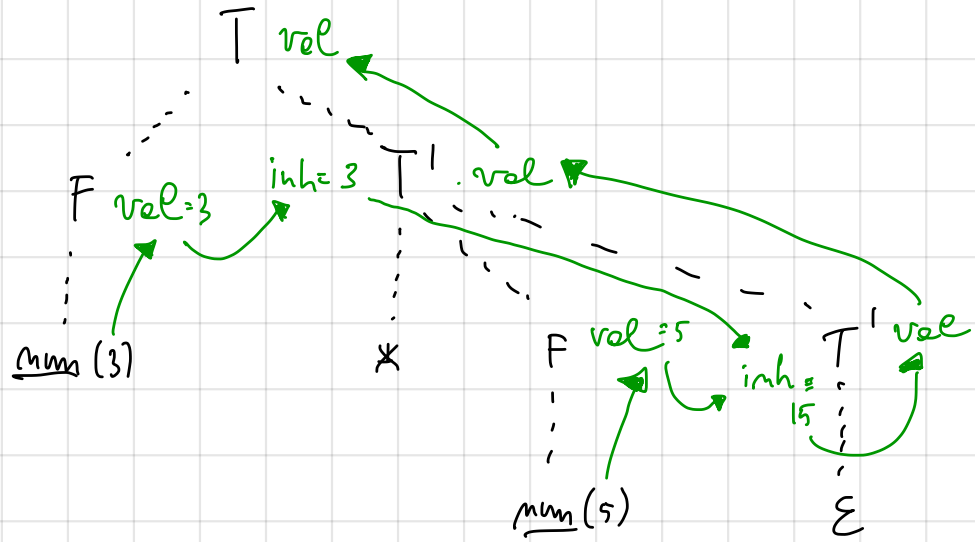
Val : $T \to \mathbb{N}$

3 * 5

PARSE TREE



DEPENDENCY GRAPH



We add an attribute "value" of type int to symbols T, F, T' which is synthesized

We add an attribute "inh" of type int to the symbol T' which is inherited

SDD L-attributed

$T \to F\ T'$ { $T'.inh = F.val$; $T.val = T'.val$ }

$T' \to *\ F\ T'_1$ { $T'_1.inh = T'.inh * F.val$; $T'.val = T'_1.val$ }

$T' \to \varepsilon$ { $T'.val = T'.inh$ }

$F \to \underline{num}$ { $F.val = \underline{num}.lexval$ }

$[3 * 5] * 2$