

Exp  $\rightarrow$  Num | Ide | Exp Op Exp | ...

Dec  $\rightarrow$  Type Ide = Exp ;  
 Type Ide ;

Com  $\rightarrow$  Ide = Exp ; |  
 if (Exp) Com else Com |  
 if (Exp) Com |  
 while (Exp) Com |  
 Block

Block  $\rightarrow$  { Declist Comlist }

Declist  $\rightarrow$  Dec | Dec Declist

Comlist  $\rightarrow$  Com | Com Comlist

$$\text{Exp} \rightarrow \text{Num} \mid \text{Id} \mid \text{Exp Op Exp}$$

$$\text{Sem}_e: \text{Exp} \rightarrow P \rightarrow M \rightarrow \text{Val}_I$$

$$\text{Sem}_e [m] \rho \mu = \underbrace{\text{val } m}_{\in \mathbb{Z}}$$

$\swarrow \in \text{Num}$

x	l <sub>1</sub>
z	l <sub>2</sub>

l <sub>1</sub>	7
l <sub>2</sub>	4

y	l <sub>1</sub>
x	l <sub>0</sub>

l <sub>1</sub>	-10
l <sub>0</sub>	5

ambiguity

memory

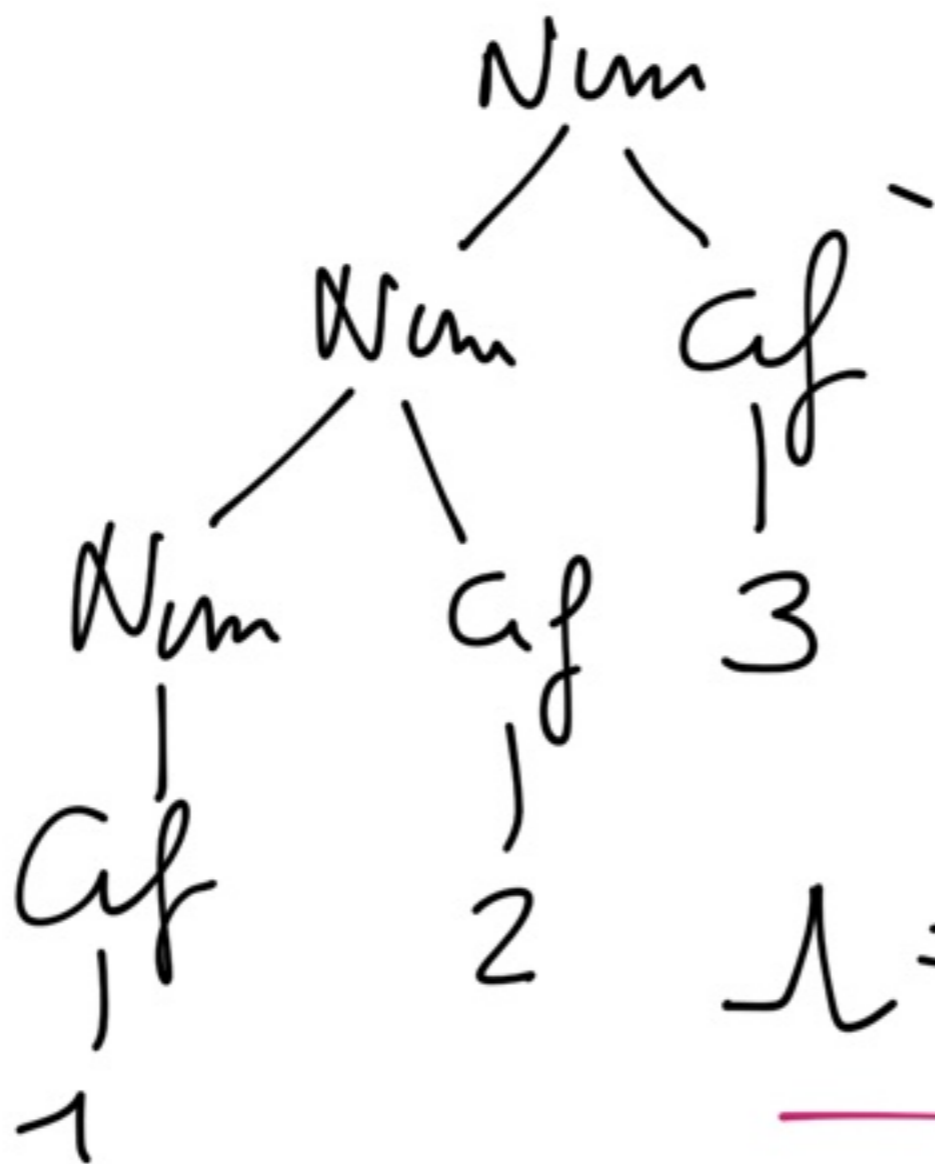
$val : Num \rightarrow IN$

$Num \rightarrow Num \text{ Cf } | \text{ Cf}$

$Cf \rightarrow \emptyset | 1 | \dots | 9$

123

$\in Num$



$\mathcal{N} = \{\emptyset, 1, \dots, 9\}$

$$1, 2, \dots, 9 \in \mathcal{A}_f$$

$$\underline{1}, \underline{2}, \dots, \underline{9} \in \mathbb{N}$$

$$\text{val } \emptyset = \emptyset$$

$$\text{val } 1 = \underline{1}$$

$$\vdots$$
$$\text{val } 9 = \underline{9}$$

$$\text{val } \textcircled{mc} = (\text{val } m) \cdot \underline{10} + (\text{val } c)$$

$$\in \mathbb{N}_m \quad \in \mathcal{A}_f$$



val 123  
         
    m   c

= { def val, 10<sup>0</sup> case, m = 12, c = 3 }

(val 12) · 10 + (val 3)

= { def val, 10<sup>1</sup> case, c = 3 }

(val 12) · 10 + 3

= { def val, 10<sup>1</sup> c., m = 1, c = 2 }

((val 1) · 10 + (val 2)) · 10 + 3

= { def val, 2<sup>0</sup> case, m = 1, c = 2 } -

$$\begin{aligned}
 & \left( \left( \underline{1} \cdot \underline{10} \right) + \underline{2} \right) \cdot \underline{10} + \underline{3} \\
 & = \{ \text{calc} \} \\
 & \left( \underline{10} + \underline{2} \right) \cdot \underline{10} + \underline{3} \\
 & = \{ \text{calc} \} \\
 & \underline{120} + \underline{3} \\
 & = \{ \text{calc} \} \\
 & \underline{123} \in \mathbb{N}
 \end{aligned}$$

$$Sem_e [l_1 \ 0 \ l_2] \rho \mu =$$

$(\text{valop } 0)$   $(Sem_e [l_1] \rho \mu)$  } valore di  $l_1$

$(Sem_e [l_2] \rho \mu)$

} funzione corrispondente all'operatore 0

} valore di  $l_2$

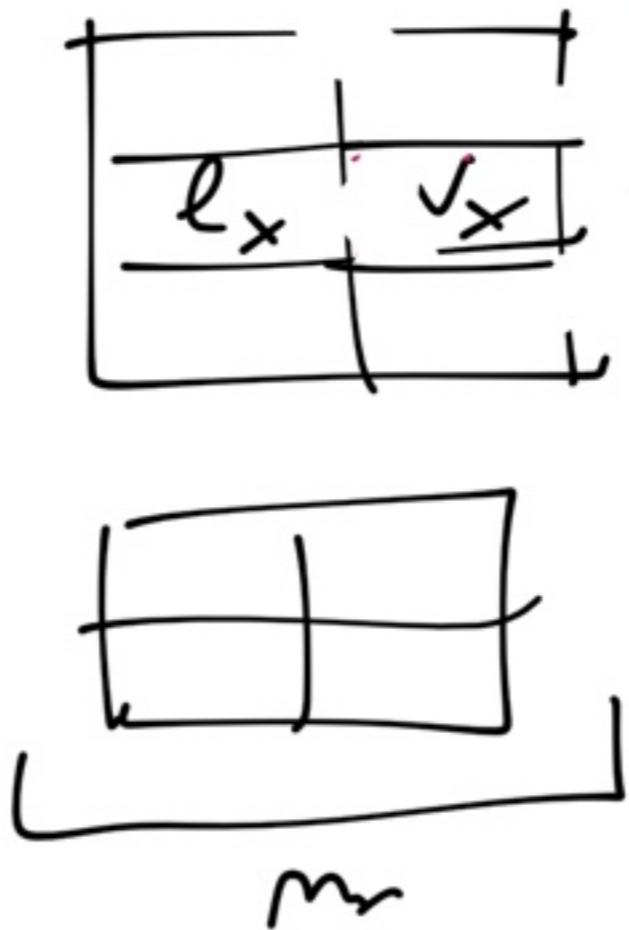
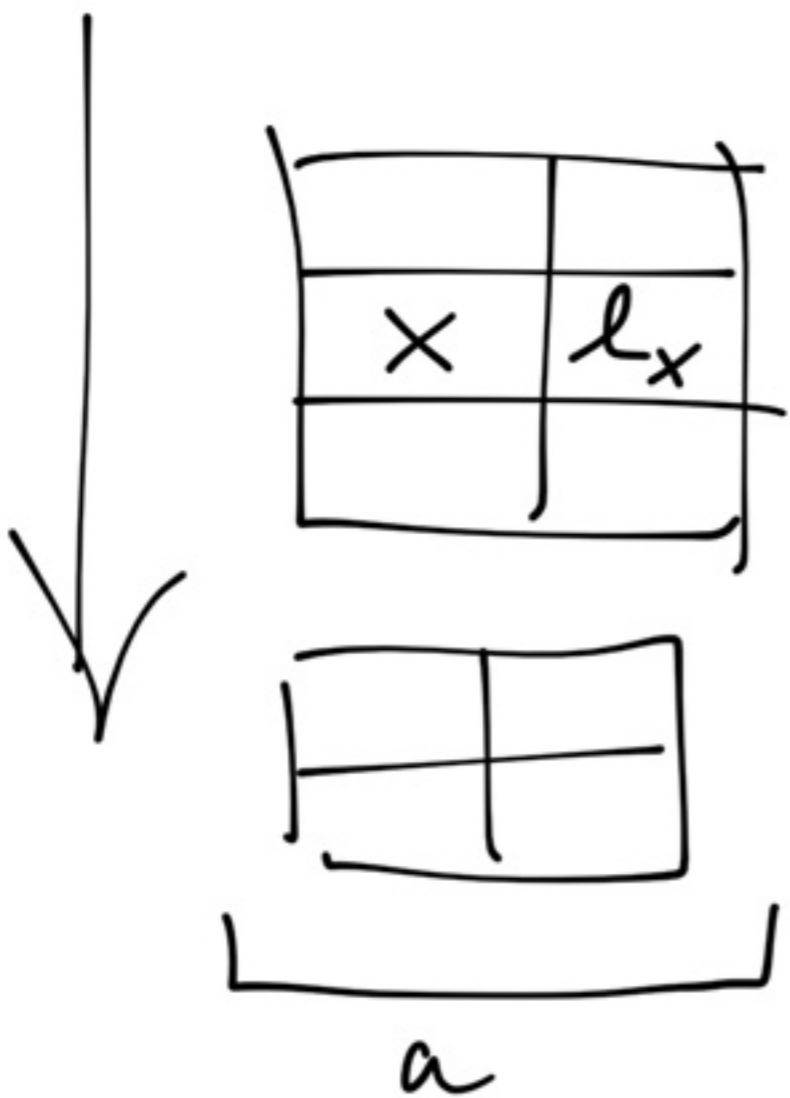


$$\text{Sem}_1 [x] \rho \mu = \mu(\rho x)$$

← Idel



loc anotate  
 $\frac{a \times m \rho}{l_x}$

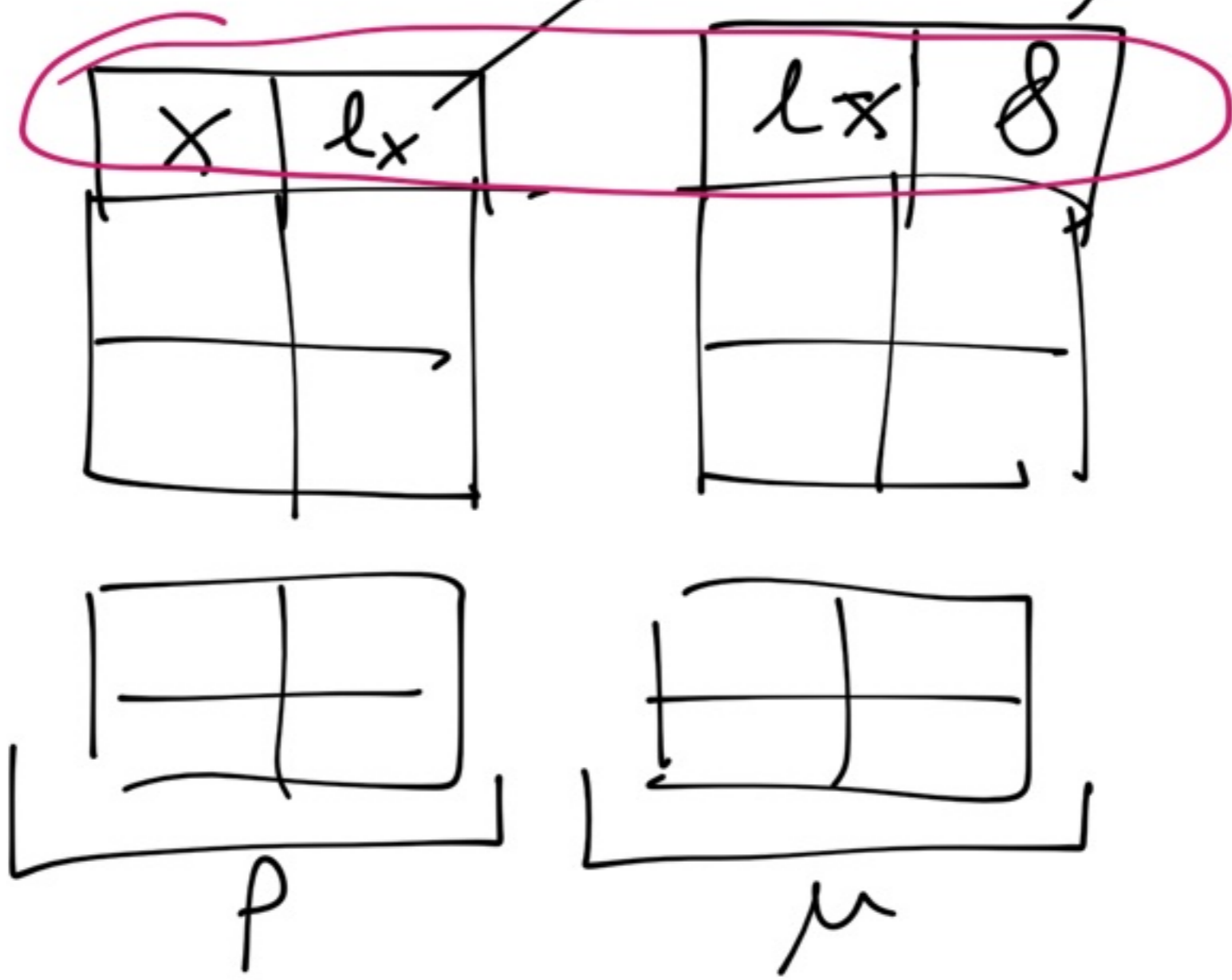


$$\mu(l_x) = v_x$$

Dec  $\rightarrow$  Type Id  $= \text{Exp} ; | \text{Type Id}$

$mut\ x = 6 + 2\ j$

mu  $\sqrt{q}$   
 locetwme  
 $\mu(lx) = 1$   
 $\uparrow$



$\text{succloc} : M \rightarrow \text{Loc}$

$\text{succloc}(\mu) = \mu \text{ where } \text{loc} \text{ is } \mu$   
located in  $\mu$

$\text{succloc}(\mu) = l$

$\Rightarrow \mu(l) = \perp$

$$\text{Sem}_d: \text{Dec} \rightarrow P \rightarrow M$$

$$\rightarrow P \times M$$

$$\text{Dec} \rightarrow \text{Type} \quad \text{Id}_d = \text{Exp};$$

$$\text{Type} \quad \text{Id}_e;$$

$$\text{Sem}_d [T \ x = e;] \rho \mu =$$

$$\left( \rho \left[ \frac{l}{x} \right]^{\text{old}}, \mu \left[ \frac{v}{e} \right]^{\text{old}} \right)$$

do ve

$$l = \text{succ loc } \mu$$

$$v = \text{Sem}_e [e] \rho \mu$$



Send  $[T \times i] \rho \mu =$

$(\rho [l/x]^{add}, \mu [?/l]^{abol})$

done

$l = succ\ loc\ \mu$

Declist  $\rightarrow$  Dec | Dec Declist

Sem<sub>de</sub> : Declist  $\rightarrow$  P  $\rightarrow$  M

$\rightarrow$  P  $\times$  M

---

Sem<sub>de</sub> [d] p  $\mu$  = Sem<sub>d</sub> [d] p  $\mu$

Sem<sub>de</sub> [d dl] p  $\mu$  = Sem<sub>de</sub> [dl] p'  $\mu'$

dove

(p',  $\mu'$ ) = Sem<sub>d</sub> [d] p  $\mu$

# Sementce dei Comandi

Non  
modifca  
l'ambiente

$$p \ x = l_0$$

$$x = (x + 1)$$

calcolo il  
valore della

exp.

z	l3
x	l2

l3	10
l2	-4

$\mu \begin{bmatrix} v \\ l_0 \end{bmatrix}$

y	l1
x	l0

p

l1	3
l0	-2

-1

$\mu$

$$\text{Sem}_c : \text{Com} \rightarrow \mathcal{P} \rightarrow M \rightarrow M$$

$$\text{Sem}_c [x = e;] \rho \mu =$$

$$\mu \left[ \checkmark \right]_{\rho^x} \text{mod}$$

dove

$$v = \text{Sem}_e [e] \rho \mu$$

$$\text{Sem}_c [f(e) \text{ or } c_1 \text{ else } c_2] \rho \mu = \mu'$$

do ve

$$\text{true} = \text{Sem}_c [e] \rho \mu$$

$$\mu' = \text{Sem}_c [c_1] \rho \mu$$


---

$$\text{Sem}_c [f(e) \text{ or } c_1 \text{ else } c_2] \rho \mu = \mu'$$

do ve

$$\text{false} = \text{Sem}_c [e] \rho \mu$$

$$\mu' = \text{Sem}_c [c_2] \rho \mu$$



$$\text{Sem}_c [f(x) c] \rho \mu = \mu'$$

done

$$\text{true} = \text{Sem}_e [e] \rho \mu$$

$$\mu' = \text{Sem}_c [c] \rho \mu$$

---

$$\text{Sem}_c [f(x) c] \rho \mu = \mu$$

done

$$\text{false} = \text{Sem}_e [e] \rho \mu$$

$$\text{Sem}_c [\text{while } (e) c] p \mu = \mu$$

dove

$$\text{false} = \text{Sem}_e [e] p \mu$$


---

$$\text{Sem}_c [\text{while } (e) c] p \mu = \mu''$$

dove

$$\text{true} = \text{Sem}_e [e] p \mu$$

$$\mu' = \text{Sem}_c [c] p \mu$$

$$\mu'' = \text{Sem}_c [\text{while } (e) c] p \mu'$$

$$\left\{ \begin{array}{l} \text{int } x = 5; \text{ int } z = 6; x = x + 1; \\ \left\{ \begin{array}{l} \text{int } y = 3; \text{ int } x = 7; \\ z = x + 2; x = y + 2; \end{array} \right\} \\ x = x + z; \end{array} \right\}$$

← sum

- quando si entra in un blocco viene aggiunto un frame vuoto su ambiente e memoria.
- quando si esce da un blocco si cancella il primo frame da ambiente e memoria.

$\{ \text{int } x = 5; \text{ int } z = 6; x = x + 1; \}$   
 $\{ \text{int } y = 3; \text{ int } x = 7; \}$   
 $\{ z = x + 2; x = y + 2; \}$   
 $\{ x = x + z; \}$

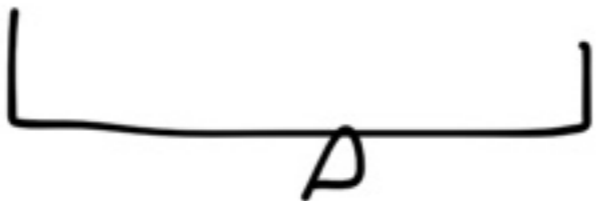
<del>x</del>	<del>l3</del>
<del>y</del>	<del>l2</del>

<del>l3</del>	<del>7</del>
<del>l2</del>	<del>3</del>

<del>z</del>	<del>l1</del>
<del>x</del>	<del>l0</del>

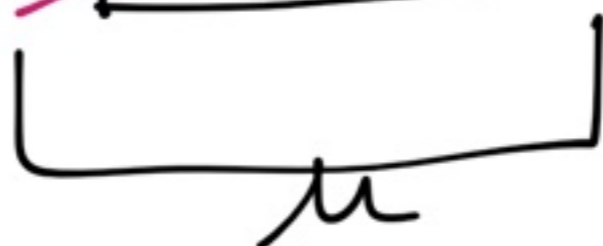
<del>l1</del>	<del>6</del>
<del>l0</del>	<del>5</del>

$\omega$



5

9  
~~6~~  
 $\omega$  15





$$S_{em_c} [\{dl \ d\}] \rho \mu = \mu''$$

done

$$(\varphi, \rho', v, \mu') = S_{em_{dl}} [dl] (\omega, \rho) (\omega, \mu)$$

$$v, \mu'' = S_{em_{ce}} [ce] (\varphi, \rho') (v, \mu')$$