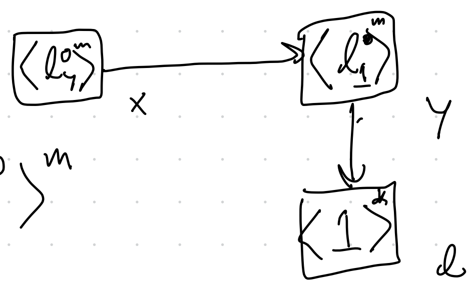
FR Semantics (II)

- **Location**: abstract entity w/ id. ℓ_x named, ℓ_5 unnamed
- **Values**: unit (ε), integer (i32), reference ℓ_i° borrowed, $\ell_i^{\bullet}$ owned
- **Partial Value**: value or none ($\perp$)
- **Slot Value**: Par. Val. + lifetime, $\langle v \rangle^m$
- **Store**: map from loc. to slot value

global lifetime

$$\{\ell_x \mapsto \langle \ell_y^{\circ} \rangle^m,\ \ell_y \mapsto \langle \ell_1^{\bullet} \rangle^m,\ \ell_1 \mapsto \langle 1 \rangle^{*}\}$$

S :



let mut y = box 1;

let mut x = &y;

$$S(\ell_x) = \langle \ell_y^{\circ} \rangle^m$$

$$loc(S, *x) = \ell_1$$

Store Interface:

$loc(S, \underbrace{w}_{\text{lval}})$: locate lval

$read(S, w)$:

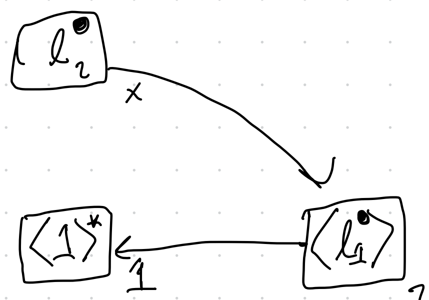
$write(S, \underbrace{w}_{\text{lval}}, \underbrace{v}_{\text{partial}})$

$drop(S, \underbrace{\psi}_{\text{list of partial value}})$

Drop:

ex.

let mut x = Box::new(Box::new(1))



Def:

(i) $\mathrm{drop}(S, \emptyset) = S$

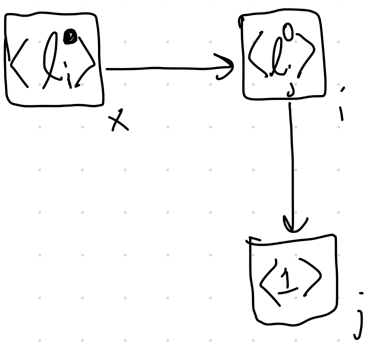
owned

(ii) $\mathrm{drop}(S, \psi \cup \{v^{\perp}\}) = \mathrm{drop}(S, \psi)$ if $v^{\perp} \neq \ell_x^{\bullet}$

(iii) $\mathrm{drop}(S, \psi \cup \{\ell^{\bullet}\}) =$

$$\mathrm{drop}(S \setminus \{\ell \mapsto \langle v^{\perp}\rangle^{?}\}, \psi \cup \{v^{\perp}\}) \text{ where}$$

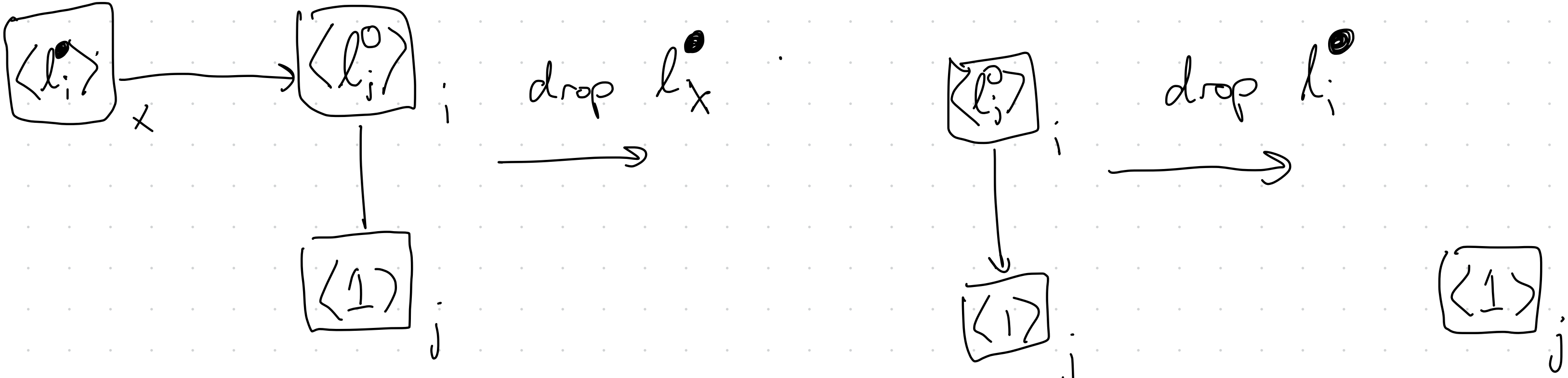
$$S(\ell) = \langle v^{\perp}\rangle^{?}$$



$$\mathrm{drop}(S, \{\ell_x^{\bullet}\}) = \mathrm{drop}(\overbrace{S \setminus \{\ell_x \mapsto \langle \ell_i^{\bullet}\rangle}^{S'}, \{\ell_i^{\bullet}\})$$

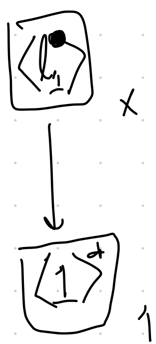
$$= \mathrm{drop}(S' \setminus \{\ell_i \mapsto \langle \ell_j^{0}\rangle\}, \{\ell_j^{0}\})$$

$$= S' \setminus \{\ell_i \mapsto \ell_j^{0}\}$$




```
let mut x = Box::new(1);
```

S



$$\mathrm{drop}(S, \{ l_x^{\bullet} \}) =$$

$$\mathrm{drop}(S \setminus \{ l_x \mapsto \langle l_{\underline{1}}^{\circledcirc} \rangle \}, \{ l_1^{\circledcirc} \})$$

$$S \setminus \{ l_x \mapsto \langle l_{\underline{1}} \rangle, \; l_1 \mapsto \langle 1 \rangle^{*} \}$$

$$\frac{S_2 = \mathrm{drop}(S_1, \{v\})}{\langle S_1 \triangleright v ; \vec{t} \longrightarrow S_2 \triangleright \vec{t} \rangle^{\ell}} \;(\text{R-SEQ})$$

$$\frac{\langle S_1 \triangleright t_1 \longrightarrow S_2 \triangleright t_2 \rangle^{\ell}}{\langle S_1 \triangleright t_1 ; \vec{t} \longrightarrow S_2 \triangleright t_2 ; \vec{t} \rangle^{\ell}} \;(\text{R-SUB})$$

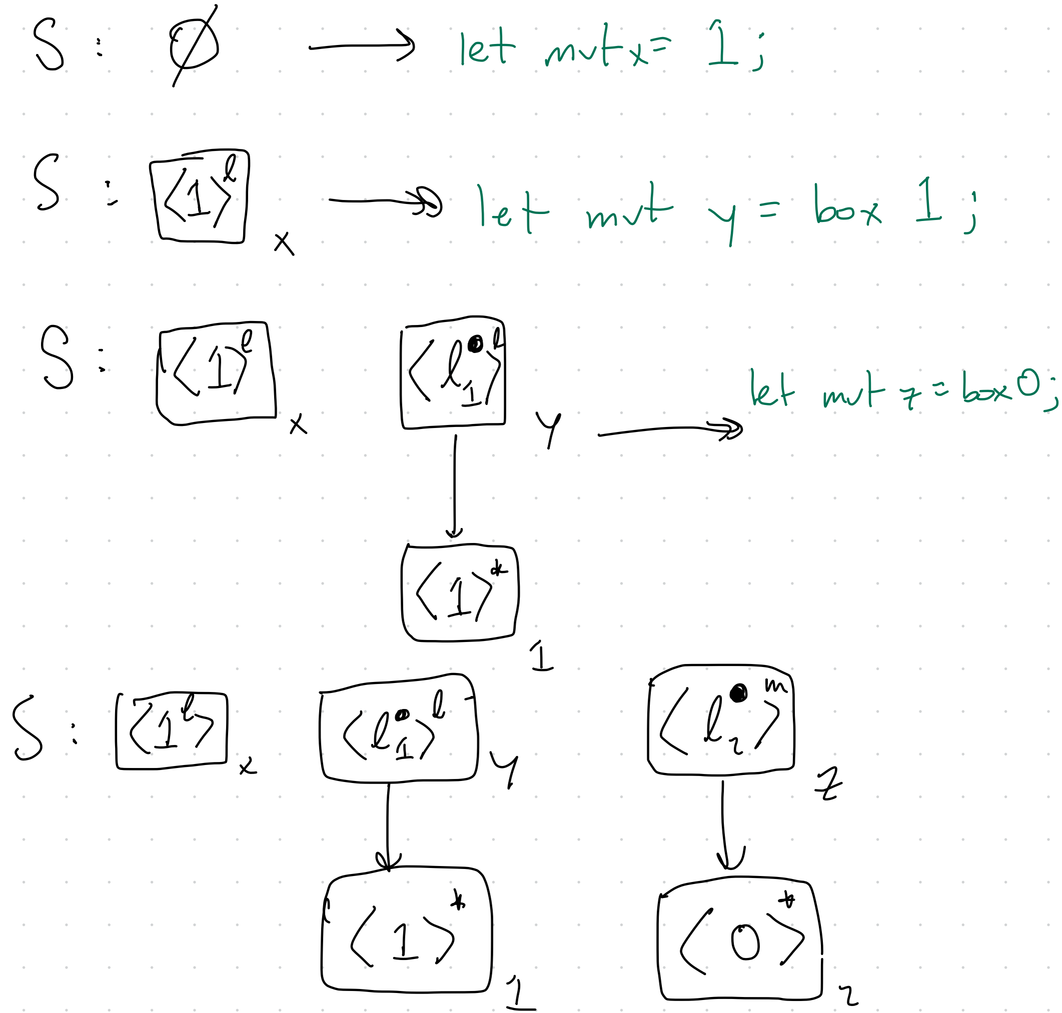
$$\frac{\langle S_1 \triangleright \vec{t}_1 \longrightarrow S_2 \triangleright \vec{t}_2 \rangle^{m}}{\langle S_1 \triangleright \{\vec{t}_1\}^{m} \longrightarrow S_2 \triangleright \{\vec{t}_2\}^{m} \rangle^{\ell}} \;(\text{R-BLOCK A})$$

$$\frac{drop(S_{\underline{1}}, m)}{\langle S_{\underline{1}} \triangleright \{v\}^m \longrightarrow S_2 \triangleright v \rangle}$$

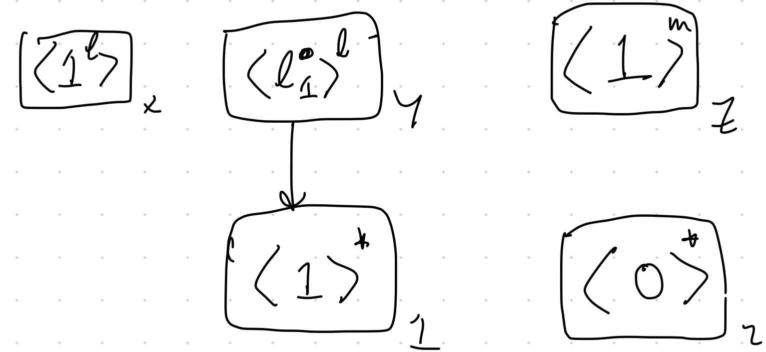
$drop(S_{\underline{1}}, \{v : \exists\, l, S(l) = \langle v \rangle^m\})$

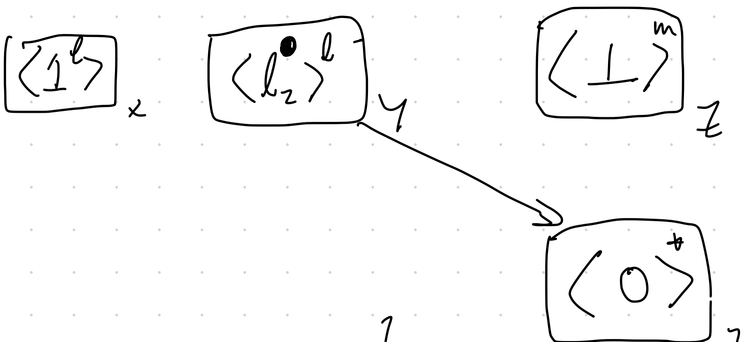
Example

```
let mut x = 1;
let mut y = box x̂ ;
{
    let mut z = box 0;
    y = z;
    *y
}^m
;
```



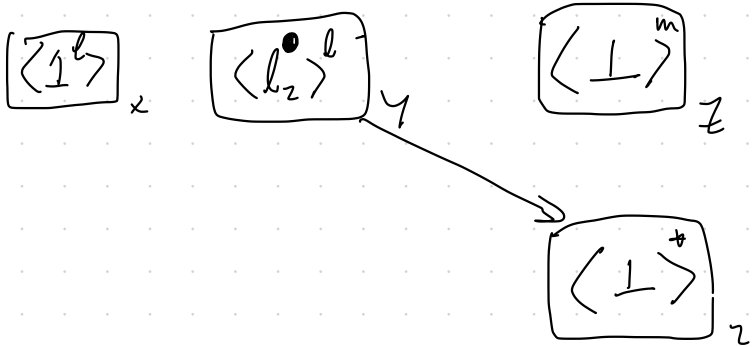
$$y = z \longrightarrow y = \ell_2^{\bullet}$$





$\longrightarrow$ let $y = \ell_2^{\bullet}$;

$^{\dagger}y \to 0$



end block $\longrightarrow$