

$5 \in \mathbb{Z}_A$

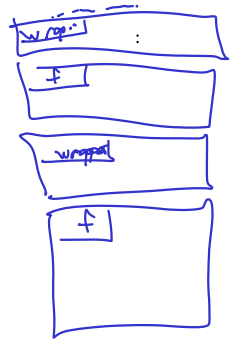
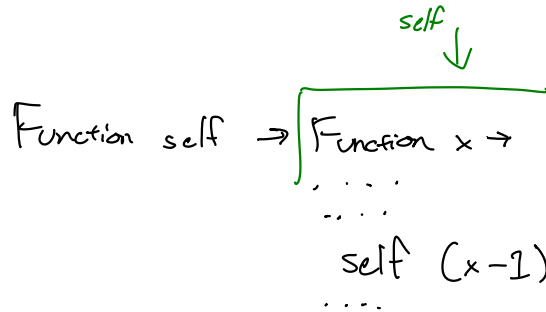
$$\frac{\text{Int}}{\emptyset \vdash 5 : \text{Int} \setminus \emptyset}$$

Plus

$$\frac{\frac{\{x:\text{Int}\} \vdash x : \text{Int} \setminus \emptyset \quad \{x:\text{Int}\} \vdash \text{True} : \text{Bool} \setminus \emptyset}{\{x:\text{Int}\} \vdash x + \text{True} : \text{Int} \setminus \{\text{Int} = \text{Int}, \text{Bool} = \text{Int}\}}}{\{x:\text{Int}\} \vdash x + \text{True} : \text{Int} \setminus \{\text{Int} = \text{Int}, \text{Bool} = \text{Int}\}}$$

$$\frac{\emptyset \vdash \text{Let } \underbrace{x}_{e_1} = \underbrace{5}_{e_2} \text{ In } \underbrace{x + \text{True}}_{e_2} : \text{Int} \setminus \{\text{Int} = \text{Int}, \text{Bool} = \text{Int}\}}{\emptyset \vdash \text{Let } x = 5 \text{ In } x + \text{True} : \text{Int} \setminus \{\text{Int} = \text{Int}, \text{Bool} = \text{Int}\}}$$

Y-combinator



Let $yc =$
Function $f \rightarrow$

Let $wrapper =$ Function $self \rightarrow$ Function $x \rightarrow f (self self) x$
In
wrapper wrapper

In
 $yc (Function self \rightarrow Function n \rightarrow \text{If } n=0 \text{ Then } 0 \text{ Else } n + (self (n-1)))$

Fb:

(Function $f \rightarrow$ Function $x \rightarrow f (f x)$)

λ -calculus

$\lambda f . \lambda x . f (f x)$

Object Encoding

* fields as record fields \leftarrow Ref

* methods as record fields \leftarrow functions

new = Function this \rightarrow

Let obj =

let private = { x = Ref 4;
y = Ref 5; }

In

{

!1 = Function this \rightarrow !private.x + !private.y

}

In
obj.

obj.!1 obj;

obj.x := 0

obj has no x field \smile

$\forall e. \exists v. e \Rightarrow v$ $Fb \Rightarrow$

input

output

$e ::= \dots \mid \text{Destroy}$

If $e \Rightarrow v$ and $e :: z$ then $v :: z$

input

input

output

$$\left. \begin{array}{l}
 \text{Let } a = \text{Ref } 4 \cdot I_n \\
 \text{Let } b = \text{Ref } 5 \cdot I_n \\
 \text{Let } c = a := !b \cdot I_n \\
 \text{(Function } d \mapsto !a + d)
 \end{array} \right\} \begin{array}{l} e_a \\ e_c \\ e_b \\ e_d \end{array} \Longrightarrow \underline{10}$$

$$\begin{array}{l}
 \overline{\langle \emptyset, 4 \rangle \Rightarrow \langle \emptyset, 4 \rangle \quad c_a \notin \emptyset} \\
 \text{Let } \langle \emptyset, \text{Ref } 4 \rangle \Rightarrow \langle \{c_a \mapsto 4\}, c_a \rangle \quad \langle \{c_a \mapsto 4\}, e_b [c_a/a] \rangle \Rightarrow \\
 \langle \emptyset, e_a \rangle \Rightarrow
 \end{array}$$