1.3

- Values: 1 ✓ 2 X 3 X 4 X

  5 X 6 ✓ 7 X 8 X

- "is-val" relation : " e val "

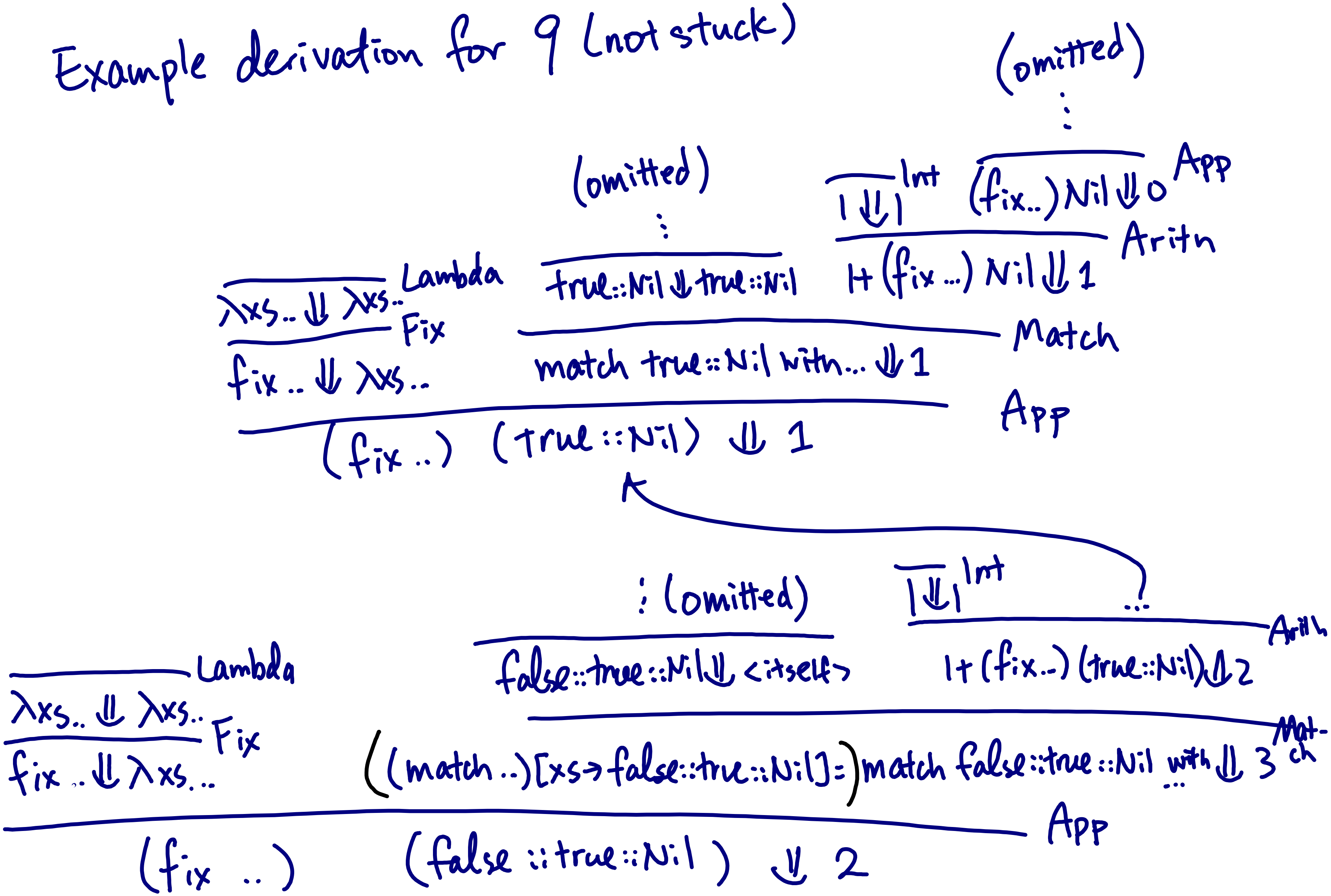
  Rules :

$$\frac{}{i \ \text{val}}\ \text{V-Int} \qquad \frac{}{(\lambda x. e) \ \text{val}}\ \text{V-Lambda}$$

$$\frac{}{\text{Nil} \ \text{val}}\ \text{V-Nil} \qquad \frac{e_1 \ \text{val} \quad e_2 \ \text{val}}{(e_1 :: e_2) \ \text{val}}\ \text{V-Cons}$$

e ⇓ v : Check v using the CSIL reference interpreter

Example derivation for 9 (not stuck)



(omitted)
(omitted)
1 ⇓ 1 Int
(fix..) Nil ⇓ 0 App
λxs.. ⇓ λxs.. Lambda
true::Nil ⇓ true::Nil
1+(fix...) Nil ⇓ 1 Arith
fix.. ⇓ λxs.. Fix
match true::Nil with... ⇓ 1 Match
(fix..) (true::Nil) ⇓ 1 App
(omitted)
1 ⇓ 1 Int
...
λxs.. ⇓ λxs.. Lambda
false::true::Nil ⇓ <itself>
1+(fix..) (true::Nil) ⇓ 2 Arith
fix.. ⇓ λxs... Fix
((match..)[xs→false::true::Nil]=)match false::true::Nil with... ⇓ 3 Mat-ch
(fix ..) (false::true::Nil) ⇓ 2 App

11:

$$
\dfrac{
\dfrac{(\lambda n.n-1)[recur \rightarrow fix..] = \lambda n.n-1 \quad \dfrac{}{\lambda n.n-1 \Downarrow \lambda n.n-1}\text{Lambda}}{fix\ recur\ is\ \lambda n.n-1 \Downarrow \lambda n.n-1}\text{Fix}
\quad \dfrac{}{10 \Downarrow 10}\text{Int}
\quad (n-1)[n \rightarrow 10] = \dfrac{\dfrac{}{10 \Downarrow 10}\text{Int} \quad \dfrac{}{1 \Downarrow 1}\text{Int} \quad 9=10-1}{10-1 \Downarrow 9}\text{Arith}
}{(fix\ recur\ is\ \lambda n.\ n-1)\ 10}\text{Apt}
$$

what-if:

App-Alt 1: "$(\lambda x.\ \lambda y.\ x+y)\ 3\ \ 2$" gets stuck

App-Alt 2: "$(\lambda x.\ 0)\ \ (1+\text{true})$" will not get stuck

"$(\lambda x.\ x+x)\ \ (1+2)$" will have a larger tree.

Let-Alt:
- "let $x = 1+\text{true}$ in 0" gets stuck with $\Downarrow$ but not $\Downarrow_1$.
- If e gets stuck with $\Downarrow_1$, e will also get stuck with $\Downarrow$.
- let $x = 2*3$ in $x+x$"

MatchCons-Alt:

$$\frac{e_1 \Downarrow h::t \quad \overbrace{(h \Downarrow v_1)\,(t \Downarrow v_2)}^{\text{optional}} \quad e_3\overbrace{[x \mapsto v_1][y \mapsto v_2]}^{\text{or } [x \to h][y \to t]} \Downarrow v}{\text{match } e_1 \text{ with Nil} \to e_2 \mid x::y \to e_3 \text{ end} \Downarrow v}$$

$$\frac{}{e_1 :: e_2 \quad \text{val}} \ \text{V-ConsAlt}$$