

Jason Zhang

Assignment 7

Collaborators: Dan Qian

$$1. G_1 = \{ \langle a0, v \rangle, [a0 \leftarrow 5444] \}$$

local Run $\{ S \cup [x \leftarrow 'count(-)] \cup \langle x, v' \rangle \}$
 $v5444 \Rightarrow 'count(-)$



$$G_2 = \{ \langle x, v' \rangle, [x \leftarrow 'count(-)] \}$$

local Run $\{ S \cup [x \leftarrow 'count(-)] \}$
 $v' 'count(-) \Rightarrow v''$

Output: 2



$$G_3 = \{ \langle x, v'' \rangle, [x \leftarrow 'count(-)] \}$$

local Run $\{ S \cup [x \leftarrow 'count(-)] \}$
 $v'' 'count(-) \Rightarrow v'''$

Output: 1



$$G_4 = \{ \langle x, v''' \rangle, [x \leftarrow 'count(-)] \}$$

local Run $\{ S \}$
 $v''' 'count(-) \Rightarrow 0$

Output: 0



$$G_5 = \{ \langle x, v''' \rangle \}$$

S: Source of side effects during function run

V: Function during $\rightarrow \text{let } x = \text{create}(\text{internal_count_beh}, 2) \text{ in } x \leftarrow \text{count}(-)$

V': internal_count_beh (evaluated)

V'': internal_count_beh

V''': internal_count_beh



(data is subtracted by 1 with each state change)

3. a. If True Then 0 Else False

$$\frac{\frac{}{\vdash \text{True} : \text{Bool}} \quad \frac{}{\vdash 0 : \text{Int}} \quad \frac{}{\vdash \text{False} : \text{Bool}}}{\vdash \text{If True Then } 0 \text{ Else False} : \text{Bool}}$$

must be same type, no rule to match this

b.

$$\frac{\frac{\frac{}{x : \text{Int}} \vdash x : \text{Int}}{\vdash \text{True} : \text{Bool}} \quad \frac{\frac{}{x : \text{Int}} \vdash x + 1 : (\text{Int} \rightarrow \text{Int})} \quad \frac{\frac{}{x : \text{Int}} \vdash x : \text{Int}}{\vdash \text{False} : \text{Bool}}}{\vdash (\text{If True Then } (\text{Fun } x : \text{Int} \rightarrow x + 1) \text{ Else } (\text{Fun } x : \text{Int} \rightarrow x)) : (\text{Int} \rightarrow \text{Int})} \quad \frac{}{\vdash 0 : \text{Int}}$$

$$\vdash (\text{If True Then } (\text{Fun } x : \text{Int} \rightarrow x + 1) \text{ Else } (\text{Fun } x : \text{Int} \rightarrow x)) 0$$

c.

$$\frac{\frac{}{x : (\text{Int} \rightarrow \text{Int})} \vdash x : (\text{Int} \rightarrow \text{Int}) \quad \frac{}{x : (\text{Int} \rightarrow \text{Int})} \vdash \text{False} : \text{Bool}}{\vdash (\text{Fun } x : (\text{Int} \rightarrow \text{Int}) \rightarrow x \text{ False}) : \text{Bool}}$$

no matching types, not possible to type check

d.

$$\frac{\frac{x:\text{int } x:\text{Bool} \vdash x:\text{bool} \quad x:\text{int } x:\text{Bool} \vdash 1:\text{Int}}{x:\text{int } x:\text{Bool} \vdash \cancel{x} + 1} \quad x:\text{Int} \vdash \text{Fun } x:\text{Bool} \rightarrow x+1}{\vdash (\text{Fun } x:\text{Int} \rightarrow \text{Fun } x:\text{Bool} \rightarrow x+1)}$$

unable to add bool
and int, thus
impossible to type check