Principles of Programming Languages - Homework 5

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1 Problem 1

(a)

(i)
$$\cfrac{\cfrac{\cfrac{}{\{x\to3,y\to-2\}\vdash3\Downarrow3}EvalVal \quad \cfrac{x\in dom(\{x\to3,y\to-2\})}{\{x\to3,y\to-2\}\vdash x\Downarrow3}EvalVar}{\{x\to3,y\to-2\}\vdash x*3\Downarrow9}EvalTimes \quad \cfrac{}{(\{x\to3,y\to-2\})\vdash2\Downarrow2}EvalVal}{\{x\to3,y\to-2\}\vdash3*x+2\Downarrow11}EvalPlus$$

(ii)
$$\cfrac{\cfrac{\cfrac{\cfrac{}{\{x\to3,y\to-2\}\vdash2\Downarrow2}EvalVal \quad \cfrac{y\in dom(\{x\to3,y\to-2\})}{\{x\to3,y\to-2\}\vdash y\Downarrow-2}EvalVar}{\{x\to3,y\to-2\}\vdash2+y\Downarrow0}EvalPlus}{\{x\to3,y\to-2\}\vdash constb=0\Downarrow0}EvalConstDecl \quad false=toBool(0) \quad \cfrac{y\in dom(\{x\to3,y\to-2\})}{\{x\to3,y\to-2\}\vdash y\Downarrow-2}EvalVar}{\{x\to3,y\to-2\}\vdash b?x:y\Downarrow-2}EvalIfThen$$

(b)

(i)
$$\cfrac{\cfrac{toBool(1)=true}{\{\varnothing\}\vdash1\&\&5\to5}DoAndTrue \quad v=toNum(3)+toNum(5)}{\{\varnothing\}\vdash3+(1\&\&5)\to v}DoPlus$$

$3 + \underline{(1 \ \&\& \ 5)} \xrightarrow{a} 3 + \underline{(1 \ \&\& \ 5)} \xrightarrow{b} \underline{3 + 5} \xrightarrow{c} 8$

a: SearchConstDecl2, DoAndTrue

b: SearchConstDecl3, DoPlus

c: DoConstDecl

(ii)
$$\cfrac{\cfrac{\cfrac{v_0=toNum(2)+toNum(1)}{\{\varnothing\}\vdash2+1\to3}DoPlus}{\{v_0=3\}\vdash const\ x=3}DoConstDecl \quad \cfrac{v_1=toNum(x)*toNum(0)}{\{v_0=3,x=3\}\vdash x*0\to0}DoTimes \quad \cfrac{toBool(v_1)=false}{\{v_0=3,x=3,v_1=0\}\vdash?x:x+x\to x+x}DoIfElse \quad v_2=toNum(3)+toNum(3)}{\{v_0=3,x=3,v_1=0\}\vdash x+x\to v_2}DoPlu$$

const x = $\underline{2 + 1}$; x * 0 ? x : x + x $\xrightarrow{a}$ const x = 3; $\underline{x}$ * 0 ? x : x + x $\xrightarrow{c}$ const x = 3; $\underline{0}$? x : x + x $\xrightarrow{d}$ const x = 3; $\underline{x + x}$ $\xrightarrow{e}$ 6

a: SearchConstDecl1, DoPlus
b: SearchConstDecl2, DoVar
c: SearchIf
d: SearchConstDecl3, DoPlus
e: DoConstDecl

(c)

(d)

(e)

2 Problem 2

(a)

$$e_1 = (3 * y) + 4$$

(b)

$$e_1 = (x * y) + 4$$

(c)

$$e_2 = const\ y = y;\ 3 + y$$

(d)

$$e_2 = const\ y = 2;\ x + y$$

(e)

$$e_3 = const\ x = (function(y)(x(y)));\ x(y(2))$$

(f)

$$e_3 = const\ x = (function(y)((y(x))(y)));\ x(y)$$