Principles of Programming Languages - Homework 5

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1 Problem 1

(a)

(i) $$\dfrac{\dfrac{}{\{x\to 3,y\to -2\}\vdash 3\Downarrow 3}\,EvalVal \quad \dfrac{x\in dom(\{x\to 3,y\to -2\})}{\{x\to 3,y\to -2\}\vdash x\Downarrow 3}\,EvalVar}{\{x\to 3,y\to -2\}\vdash x*3\Downarrow 9}\,EvalTimes \quad \dfrac{}{(\{x\to 3,y\to -2\})\vdash 2\Downarrow 2}\,EvalVal}{\{x\to 3,y\to -2\}\vdash 3*x+2\Downarrow 11}\,EvalPlus$$

(ii) $$\dfrac{\dfrac{\dfrac{\{x\to 3,y\to -2\}\vdash 2\Downarrow 2}{\{x\to 3,y\to -2\}\vdash 2+y\Downarrow 0}\,EvalVal \quad \dfrac{y\in dom(\{x\to 3,y\to -2\})}{\{x\to 3,y\to -2\}\vdash y\Downarrow -2}\,EvalVar}{\{x\to 3,y\to -2\}\vdash const b=0\Downarrow 0}\,EvalPlus \quad EvalConstDecl\ false=toBool(0) \quad \dfrac{y\in dom(\{x\to 3,y\to -2\})}{\{x\to 3,y\to -2\}\vdash y\Downarrow -2}\,EvalVar}{\{x\to 3,y\to -2\}\vdash b?x:y\Downarrow -2}\,EvalIfThen$$

(b)

(i) $$\dfrac{\dfrac{}{\{\varnothing\}\vdash 1\&\&5\to 5}\,toBool(1)=true}{\{\varnothing\}\vdash 3+(1\&\&5)\to v}\,DoAndTrue\ \ v=toNum(3)+toNum(5)\,DoPlus$$

$\underline{3}$ + (1 && 5)

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

(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)

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