1 Exercise 2.22

(a) Transfer function for \([x := x.sel]^l\)

This statement can be translated into a sequence of statements: \([t := x.sel]^l_1; [x := t]^l_2; [x := nil]^l_3\). Therefore, the transfer function \(f_{l}^{SA}\) can be obtained as \(f_{l}^{SA} = f_{l_1}^{SA} \circ f_{l_2}^{SA} \circ f_{l_3}^{SA}\). The three transfer functions for \(l_1\), \(l_2\), and \(l_3\) are covered in the section 2.6 of the text book.

(b) Transfer function for \([x.sel := x]^l\)

This statement can be translated into a sequence of statements: \([t := x]^l_1; [x.sel := t]^l_2; [t := nil]^l_3\). Therefore, the transfer function \(f_{l}^{SA}\) can be obtained as \(f_{l}^{SA} = f_{l_1}^{SA} \circ f_{l_2}^{SA} \circ f_{l_3}^{SA}\). The three transfer functions for \(l_1\), \(l_2\), and \(l_3\) are covered in the section 2.6 of the text book.

(c) Transfer function for \([x.sel := x.sel']\) This statement can be translated into a sequence of statements: \([t := x.sel]^l_1; [x : sel := t]^l_2; [t := nil]^l_3\). Therefore, the transfer function \(f_{l}^{SA}\) can be obtained as \(f_{l}^{SA} = f_{l_1}^{SA} \circ f_{l_2}^{SA} \circ f_{l_3}^{SA}\). The three transfer functions for \(l_1\), \(l_2\), and \(l_3\) are covered in the section 2.6 of the text book.

(d) Transfer function for \([malloc(x.sel)]^l\) This statement can be translated into a sequence of statements: \([malloc]^l_1; [x.sel := t]^l_2; [t := nil]^l_3\). Therefore, the transfer function \(f_{l}^{SA}\) can be obtained as \(f_{l}^{SA} = f_{l_1}^{SA} \circ f_{l_2}^{SA} \circ f_{l_3}^{SA}\). The three transfer functions for \(l_1\), \(l_2\), and \(l_3\) are covered in the section 2.6 of the text book.

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\(\text{Shape}_1(1) = f_1^{SA}(\text{Shape}_0(1)) = f_1^{SA}(t)\)

\(\text{Shape}_2(2) = f_2^{SA}(\text{Shape}_0(2)) = f_2^{SA}(\text{Shape}_1(1))\)

\(\text{Shape}_3(3) = f_3^{SA}(\text{Shape}_0(3)) = f_3^{SA}(\text{Shape}_2(2))\)

\(\text{Shape}_4(4) = f_4^{SA}(\text{Shape}_0(4)) = f_4^{SA}(\text{Shape}_3(3))\)

Note that there will be multiple multiple shape graphs in \(\phi^{SA}((S, H, is))\), as each of assignment 2, assignment 3, assignment 4 may cause the summary node \(n_{\phi}\) to be “split” into different shapes.