Exercises

Program Analysis (CO70020)

Sheet 4

Exercise 1 *Consider the following* Fun *expression*

$$\begin{array}{ll}\texttt{(let} & f_1 \texttt{ = (fn } x_1 \texttt{ => } x_1\texttt{)} \\ \texttt{in} & \texttt{(let } f_2 \texttt{ = (fn } x_2 \texttt{ => } x_2\texttt{)} \\ & \quad \texttt{in ((}f_1\ f_2\texttt{) (fn } y \texttt{ => } y\texttt{))))}\end{array}$$

1. *Label this* Fun *expression.*
2. *Write down the constraints that are generated for the Control Flow Analysis of this function.*
3. *Give a walkthrough of the algorithm to develop a solution to the constraints.*

Exercise 2 *Consider the (labelled)* Fun *expression e:*

$$\begin{array}{lll}\texttt{(let} & f \texttt{ = (fn } x \texttt{ =>} & \texttt{(if } (x^1 > 0^2)^3 \texttt{ then (fn } y \texttt{ => } y^4)^5 \\ & & \texttt{else (fn } z \texttt{ => } 25^6)^7)^8)^9 \\ \texttt{in} & ((f^{10}3^{11})^{12}0^{13})^{14})^{15} & \end{array}$$

Write down the constraints that get generated by the combined Control and Data Flow. Solve them to show that the identity is the only closure that is produced at label 12.

Exercise 3 *We consider the language (i.e. the pure λ calculus):*

$$L ::= x \mid \lambda x.L \mid L_1 L_2$$

where $\lambda x.L$ represents a function with a single bound variable x and $L_1 L_2$ denotes application of L_1 to L_2. You are asked to develop a 0-CFA for this language by the following steps:

- *Write down a suitably labelled version of the syntax and define the components needed (e.g. cache) for your 0-CFA specification.*
- *Write down the specification of the 0-CFA.*