Exercises

Program Analysis (CO70020)

Sheet 2

Exercise 1 *Consider the following* **while** *program:*

$[\texttt{x := 1}]^1$;
while $[\texttt{y>0}]^2$ **do** $[\texttt{x := x-1}]^3$;
$[\texttt{x := 2}]^4$;

Perform a Live Variables Analysis for this program (state equations and construct solutions).

Exercise 2 *Construct/specify all elements of* $\mathcal{P}(\{\texttt{x}, \texttt{y}, \texttt{z}\})$*, i.e. the power set of* $\{\texttt{x}, \texttt{y}, \texttt{z}\}$*. Describe the sub-set relation on* $\mathcal{P}(\{\texttt{x}, \texttt{y}, \texttt{z}\})$*, i.e. which sub-set is a sub-set of another sub-set. What is the maximum number of sub-sets a sub-set of* $\{\texttt{x}, \texttt{y}, \texttt{z}\}$ *can be included in and/or the hight of* $\mathcal{P}(\{\texttt{x}, \texttt{y}, \texttt{z}\})$*?*

Exercise 3 *Construct/specify all elements of* $\mathcal{P}(\{\texttt{x}, \texttt{y}\} \times \{1, 2, 3\})$*, i.e. the power set of the cartesian product* $\{\texttt{x}, \texttt{y}\} \times \{1, 2, 3\}$*. Describe the sub-set relation on* $\mathcal{P}(\{\texttt{x}, \texttt{y}\} \times \{1, 2, 3\})$*. What is the maximum number of sub-sets any sub-set of* $\mathcal{P}(\{\texttt{x}, \texttt{y}\} \times \{1, 2, 3\})$ *can be included in?*

Exercise 4 *Consider the following* **While** *program*

while (x>0) **do** y:=y-1

Describe the possible RD *solutions at every program point. What is the size of this "property space" and how many possible solution are there for the* RD *analysis?*

Exercise 5 *Consider the set of all sets of the form:*

$$\{*\}, \{*, \{*\}\}, \ldots, \{*, \{*, \{*, \ldots\}\}\}, \ldots$$

i.e. $S_1 = \{*\}$ *and* $S_n = \{*\} \cup \{S_{n-1}\}$ *where* $*$ *is some element/object. Describe the element relation on this set of sets. What is the maximum number of sets any set of can be included in (be element of)?*

Exercise 6 *Consider the power set* $\mathcal{P}(X)$ *of* $X = \{a, b, c, d\}$*.*

1. *Draw the Hasse diagram.*
2. *Give a monotone map from* $(\mathcal{P}(X), \subseteq)$ *into* $(\mathbb{Z}, \leq)$*.*
3. *Give a monotone map from* $(\mathbb{Z}, \leq)$ *into* $(\mathcal{P}(X), \subseteq)$*.*