Prof. P. Thiemann, M. Geffken Summer Term 2014

Static Program Analysis

http://proglang.informatik.uni-freiburg.de/teaching/programanalysis/2014ss/

Exercise Sheet 8

10.07.2014

Exercise 1 (Monotone Frameworks)
Read up Sec. 2.3 in the Nielson&Nielson book and familiarise yourself with the *Monotone Frameworks*.

1. Show that Constant Propagation (as defined in Sec. 2.3.3 of Nielson&Nielson and on the slides) is a Monotone Framework.
2. A *Bit Vector Framework* is a special instance of a Monotone Framework where
   - $L = (\mathcal{P}(D), \sqsubseteq)$ for some finite set D and where $\sqsubseteq$ is either $\subseteq$ or $\supseteq$, and
   - $\mathcal{F} = \{f : \mathcal{P}(D) \to \mathcal{P}(D) \mid \exists Y_f^1, Y_f^2 \subseteq D : \forall Y \subseteq D : f(Y) = (Y \cap Y_f^1) \cup Y_f^2\}$

   a) Show that the Reaching Definitions Analysis is a Bit Vector Framework.

   b) Show that all Bit Vector Frameworks are indeed Distributive Frameworks.

Exercise 2 (Relations)
Consider a context free grammar with start symbol N and productions $N ::= \mathit{Zero} \mid \mathit{Succ}(N)$. It can be rephrased as an inductive definition:

$$\mathit{Zero} \in N \qquad \frac{n \in N}{\mathit{Succ}(n) \in N}$$

1. What set N is defined if you interpret the rules inductively? What does a coinductive interpretation yield?
2. Let us now define a relation $\leq$ on N in the following way:

$$\mathit{Zero} \leq n \quad \forall n \in S \qquad \frac{n \leq m}{\mathit{Succ}(n) \leq \mathit{Succ}(m)}$$

   Let $R = \{(x, y) | x, y \in N : x \leq y\} \subseteq N \times N$.
   - Define the generating function $S : \mathcal{P}(N \times N) \to \mathcal{P}(N \times N)$ for this relation. Check that S is a monotone function.
   - Can you find a pair (x, y) such that $(x, y) \in \mathit{gfp}(S)$, but$(x, y) \notin \mathit{lfp}(S)$?
   - Prove that $\mathit{gfp}(S)$ is transitive and reflexive.

Submission In PDF format via email to `geffken AT informatik.uni-freiburg.de`. Please name your single file with the scheme: `ex08-name.pdf`.

- Deadline: **17.07.2014, 12:00**
- Late submissions will not be marked.
- Do not forget to write your name on the exercise sheet.