Software-Modellierung und Verifikation
Informatik 2
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8. Exercise sheet *Static Program Analysis 2011*

Due Mon, 27 . June 2011, *before* the exercise course begins.

Exercise 8.1: **(2 + 3 points)**

Consider the following WHILE program:

while $x > y$ **do**
$y := -x;$
$x := x * y;$

Let x and y be input variables. Determine the abstract states reachable from the initial state ...

(a) for the abstract domain $Var \to 2^{SGN}$

(b) for the abstract domain $2^{Var \to SGN}$

where $SGN = \{-, 0, +\}$.

Exercise 8.2: **(1 + 3 + 3 points)**

In Exercise 6.1 we introduced a Galois connection for n-modulo abstraction. Reconsider this Galois connection (α_n, γ_n) between $2^{\mathbb{Z}}$ and $2^{\{0,\ldots n-1\}}$ for some $n \in \mathbb{N}$:

(a) Give the extraction function β_n for the n-modulo abstraction for $n \in \mathbb{N}$.

(b) Extract the functions $+_n^\sharp$, $*_n^\sharp$, $(\mod m)_n^\sharp$ and relations $=_n^\sharp$, $>_n^\sharp$ as safe approximations of $+$, $*$, $\mod m$, $=$ and $>$.

(c) Determine the reachable abstract states from $\sigma_{[x \mapsto \{0,\ldots n-1\}]}$ for the following while program considering the n-modulo abstraction with $n = 4$:

$x := x * 3;$
while $\neg(x \mod 4 = 0)$ **do**
if $x \mod 4 = 1$ **then**
$x := x * 3;$
$x := x + 1;$

Exercise 8.3: **(2 + 1 + 1 points)**

Prove or disprove the following statements:

(a) $\alpha(\top_L) = \top_M$ for any Galois connection (α, γ) with $\alpha : L \to M$ and $\gamma : M \to L$.

(b) $\alpha(\top_L) = \top_M$ for any Galois insertion (α, γ) with $\alpha : L \to M$ and $\gamma : M \to L$.

(c) $\gamma(\bot_M) = \bot_L$ for any Galois insertion (α, γ) with $\alpha : L \to M$ and $\gamma : M \to L$.