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

Due Mon, 16. May 2011, *before* the exercise course begins.

Exercise 3.1: **(4 points)**

Answer the following questions about dataflow analysis.

(a) Which dataflow analyses do you know and how do they differ from each other?

(b) Give the intuition behind the isolated entry/exit property!

(c) For which purpose do we need fixpoint iteration in context of dataflow analysis? Why is fixpoint iteration a suitable method? Why is it safe to use?

(d) What is the MOP-solution and how can it be related to fixpoint iteration?

Exercise 3.2: **(4 points)**

Consider the following program:

$x := 0;$
$y := 100;$
while $x >= 0$ **do**
  $x := x + 1;$
  $y := x + y;$

Perfom an interval analysis of the given program and show its non-termination by means of a fixpoint iteration without widening.

Exercise 3.3: **(2+2 points)**

For the WHILE-language as presented in the lecture the effects of a division by zero are not clear. Assume that every value is a valid result in such a case.

(a) Formalize the val_δ function for interval division.

(b) Show that the transfer functions of the interval analysis (including division) are monotone.

Exercise 3.4: **(3 points)**

Show that the following mapping ∇ is indeed a widening operator for the interval analysis.

$$\begin{aligned}
\emptyset \nabla I &:= I \nabla \emptyset := I \\
[x_1, x_2] \nabla [y_1, y_2] &:= [z_1, z_2] \quad \text{where} \\
z_1 &:= \begin{cases} x_1 & \text{if } x_1 \leq y_1 \\ -\infty & \text{otherwise} \end{cases} \\
z_2 &:= \begin{cases} x_2 & \text{if } y_2 \leq x_2 \\ +\infty & \text{otherwise} \end{cases}
\end{aligned}$$