Software-Modellierung und Verifikation
Informatik 2
Prof. J.-P. Katoen
RWTH Aachen

Priv.-Doz. T. Noll noll@cs.rwth-aachen.de
C. Jansen christina.jansen@cs.rwth-aachen.de

6. Exercise sheet *Semantics and Verification of Software SoSe2010*

Due to Monday, 7th June 2010, *before* the exercise course begins.

Exercise 6.1: **(4 points)**

To conclude the denotational semantics answer the following questions.

(a) What is the key difference of denotational semantics compared to operational semantics? What are its advantages or disadvantages?

(b) The denotational functional of while statements is given by $\mathfrak{C}[\![\textsf{while } b \textsf{ do } c]\!] := fix(\Phi)$. Which function is described by Φ, where does it come from and what is the meaning of $fix(\Phi)$ in this context?

(c) List the required properties needed to show that a least fixpoint always exists in our setting. Why did we define $fix(\Phi)$ to be the least fixpoint?

(d) Consider the definition of $fix(\Phi)$ from the lecture. What is the result type of $fix(\Phi)$, $\Phi(f)$, $\Phi(f)(\sigma)$ with $f : \Sigma \dashrightarrow \Sigma$?

Exercise 6.2: **(2 points)**

(a) Give an assertion $A \in Assn$ with logical variables $i, j, k \in LVar$, expressing that k is the greatest common divisor of i and j.

(b) The Smarandache-function $\mu(i)$ is defined as the smallest positive integer number satisfying $i \mid (\mu(i)!)$ (i.e. i divides $\mu(i)!$). Give an assertion $A \in Assn$ with logical variables $i, k \in LVar$, expressing that $k = \mu(i)$.

Exercise 6.3: **(3 points)**

Develop a proof rule for the statement **repeat** c **until** b.

Exercise 6.4: **(2 points)**

Let $c \in Cmd$ be given by

$$tmp := x; x := y; y := tmp;$$

Establish the validity of the partial correctness property $\{x = i \wedge y = j\}\, c\, \{x = j \wedge y = i\}$.