Software-Modellierung und Verifikation
Informatik 2
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8. Exercise sheet *Semantics and Verification of Software SoSe2010*

Due to Monday, 21st June 2010, *before* the exercise course begins.

Exercise 8.1: **(2 points)**

Using the Hoare rules for total correctness, show that the program fragment from below terminates for inputs $n \geq 0$ and $a \geq 0$.

```
$k := n; s := 1;$
while $k > 0$ do
    $s := a \cdot s;$
    $k := k - 1;$
end while
```

Exercise 8.2: **(1+3+2 points)**

Consider the partial correctness property of a code fragment containing nested while loops:

```
$\{x = i \geq 0\}$
$m := 0; n := 0; s := 0;$
while $x > 0$ do {outer loop invariant: $C$}
    $x := x - 1; n := m + 2; m := m + 1;$
    while $m > 0$ do {inner loop invariant: $D$}
        $m := m - 1; s := s + 1;$
    end while;
    $m := n;$
end while;
$\{s = i^2\}$
```

(a) Provide loop invariants C and D, which can be used to prove the validity of the given partial correctness property.

(b) Prove the validity of the given partial correctness property using the Hoare proof system from the lecture.

(c) Show by means of the Hoare rules for total correctness that the given code fragment terminates.

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

Consider a language containing the following features:

- non-recursive procedure declarations without parameters
- procedure calls as commands
- blocks with a command section only (i.e. no local variables)

(a) Extend the syntax of our WHILE-programs from the lecture in order to handle the constructs given above.

(b) Lift the definition of axiomatic semantics for partial correctness properties to meet the extended WHILE-language.