

**Exercises for
“Advances in Theoretical Computer Science”
Exercise sheet 4**

Exercise 4.1:

Let P be the following LOOP-program.

```
loop  $x_1$  do
   $x_3 := x_3 + 1$ 
end;
// (1)
loop  $x_3$  do
   $x_2 := x_2 + x_3$ 
end;
//(2)
 $x_3 := 0$ 
```

- (1) Fill in the following table with the values of the registers x_1, x_2, x_3 at points (1) and (2) in the program: (i) for input 3; (ii) for input 5.

Input 3	x_1	x_2	x_3
(1)			
(2)			

Input 5	x_1	x_2	x_3
(1)			
(2)			

- (2) Which is the output of P for input 3? Which is the output of P for input 5?
(3) Which function $f : \mathbb{N} \rightarrow \mathbb{N}$ is computed by P ?

Exercise 4.2:

Write a LOOP-program that computes the function

$$\text{fac} : \mathbb{N} \rightarrow \mathbb{N}$$

defined, for every $n \in \mathbb{N}$, by $\text{fac}(n) := n!$.

Remark: You are allowed to use all instructions introduced in the lecture.

Exercise 4.3:

Write a WHILE-program that computes the function

$$\text{fib} : \mathbb{N} \rightarrow \mathbb{N}$$

defined, for every $n \in \mathbb{N}$, by $\text{fib}(n) := \begin{cases} 1 & \text{if } n = 0 \\ 1 & \text{if } n = 1 \\ \text{fib}(n-1) + \text{fib}(n-2) & \text{otherwise.} \end{cases}$

Remark: *You are allowed to use all instructions introduced in the lecture.*

Exercise 4.4:

Write a WHILE-program or a LOOP-program that computes the function

$\text{prime} : \mathbb{N} \rightarrow \mathbb{N}$

defined, for every $n \in \mathbb{N}$, by $\text{prime}(n) := \begin{cases} 1 & \text{if } n \text{ is prime} \\ 0 & \text{otherwise.} \end{cases}$

Remark: *You are allowed to use all instructions introduced in the lecture.*

The submission of the solutions is not compulsory. If you want to submit your solutions, please do so until Tuesday, 19.11.2013, 10:00 s.t.. Joint solutions prepared by up to three persons are allowed. Please do not forget to write your name on your solution.

Submission possibilities:

- By e-mail to mbender@uni-koblenz.de with the keyword "Homework ACTCS" in the subject.
- Put it in the box in front of Room B 222.