

Exercises for  
Advances in Theoretical Computer Science  
Exercise Sheet 4

Due at 13.11.12, 09:00 s.t.

**Exercise 4.1**

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 4.2**

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 4.3**

Let  $\text{prime} : \mathbb{N} \rightarrow \mathbb{N}$  be a total function that is defined as follows:

$$\text{prime}(n) := \begin{cases} 1 & \text{if } n \text{ is prime} \\ 0 & \text{otherwise.} \end{cases}$$

Write a WHILE-program or a LOOP-program that computes  $\text{prime}(n)$ .

**Remark:** *You are allowed to use all operations that were introduced in the lecture.*

## Exercise 4.4

In the last part of the lecture from 8.11.2012, it was stated that the LOOP-program “loop  $x_i$  do P end” can be simulated by a WHILE program.

Prove, with the help of this result (by induction on the structure of LOOP programs) that all LOOP-programs can be simulated by WHILE-programs.

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The submission of the solutions is not compulsory. If you want to submit your solutions, please do so until 13.11.12, 09:00 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](mailto:mbender@uni-koblenz.de) with the keyword “Homework ACTCS” in the subject.
- Put it in the box in front of Room B 222.