

# Informatik für Mathematiker und Physiker HS12

## Exercise Sheet 5

Submission deadline: 3.15pm - Tuesday 23rd October, 2012

Course URL: [http://www.ti.inf.ethz.ch/ew/Lehre/Info1\\_12/](http://www.ti.inf.ethz.ch/ew/Lehre/Info1_12/)

**Note:** You are not allowed to use any algorithmic libraries. Only libraries that you are allowed to use throughout this exercise sheet are `<iostream>` and `<IFM/Integer>`.

### Assignment 1 - (2 points)

Assume that in some program, `a` is an array of underlying type `int` and length `n`.

- Given a variable `i` of type `int` with value  $0 \leq i \leq n$ , how can you obtain a pointer `p` to the element of index `i` in `a`?  
(Note: if  $i = n$ , this is asking for a past-the-end pointer.)
- Given a pointer `p` to some element in `a`, how can you obtain the index `i` of this element?  
(Note: if `p` is a past-the-end pointer, the index is defined as `n`.)

Write code fragments that compute `p` from `i` in a) and `i` from `p` in b).

### Assignment 2 - (4 points)

Write a program `kSmallestIntegers.cpp` that reads from the standard input integers `n` and `k`, such that  $n, k \in \mathbb{N}$  and  $k \leq n$ . After that, it reads `n` integers from the standard input (let's call these a sequence `s`), and outputs the `k` smallest integers from `s`.

Here is an example input with corresponding output:

```
n =? 10
k =? 4
Sequence s =? 3 1 0 0 3 9 1 3 10 -1
The k smallest integers are: -1 0 0 1
```

### Assignment 3 - (5 points)

Write a program `removeDuplicates.cpp` that reads a positive integer  $n$  from the standard input and after that  $n$  integers between 0 and 1000 (let's call these a sequence  $s$ ). The program should output a sequence  $s'$  that is composed from  $s$  in such a way that only the first (left-most) occurrence of an element  $e$  is kept and all the other occurrences of  $e$  (i.e. duplicates) are removed.

Here are some example inputs and corresponding outputs:

`n =? 5`

`Sequence s: 0 5 0 2 2`

`Without duplicates: 0 5 2`

`n =? 7`

`Sequence s: 5 10 0 0 1 0 0`

`Without dfuplicates: 5 10 0 1`

### Assignment 4 - (5 points)

Let us call a natural number  $k$ -*composite* if and only if it is divisible by exactly  $k$  different prime numbers. For example, prime powers are 1-composite, and  $6 = 2 \cdot 3$  as well as  $20 = 2 \cdot 2 \cdot 5$  are 2-composite. Write a program `k_composite.cpp` that reads numbers  $n \geq 0$  and  $k \geq 0$  from the input and then outputs all  $k$ -composite numbers in  $\{2, \dots, n - 1\}$ . How many 7-composite numbers are there for  $n = 1,000,000$ ?

### Challenge - (8 points)

**Exercise 75** from the lecture notes.