Assignment 1 - (2 points)

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

a) 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.)

b) 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:

\[
\begin{align*}
n &= 5 \\
\text{Sequence } s &= 0 \ 5 \ 0 \ 2 \ 2 \\
\text{Without duplicates: } &\ 0 \ 5 \ 2 \\
\end{align*}
\]

\[
\begin{align*}
n &= 7 \\
\text{Sequence } s &= 5 \ 10 \ 0 \ 0 \ 1 \ 0 \ 0 \\
\text{Without duplicates: } &\ 5 \ 10 \ 0 \ 1 \\
\end{align*}
\]

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 \( \{2, \ldots, n - 1\} \). How many 7-composite numbers are there for \( n = 1,000,000 \)?

Challenge - (8 points)

Exercise 75 from the lecture notes.