Lab1 – Exercises

EXERCISE 1.

The United States of Algorithmica (for short: USA) comprise 2^n states, but the exact value of n is unknown. The flag of USA is blue; it has $n+1$ rows, each (except the first one) with 2^{n-1} red stars and 2^{n-1} white stars.

The first row contains just a sequence of 2^n red stars. The second row starts with 2^{n-1} red stars followed by 2^{n-1} white stars. The third row starts with a sequence of 2^{n-2} red stars followed by 2^{n-2} white stars, again 2^{n-2} red stars, and finally 2^{n-2} white stars. This continues in the same way, so the last row contains an alternating sequence of red and white stars starting with a red one.

Once there was a big argument between the states how to program the flag, which led (temporarily) to a separation of the country into the Iterative States of Algorithmica (for short: ISA) and the Recursive States of Algorithmica (for short: RSA).

  (i) Implement in C++ a sequential algorithm used in ISA that takes n as input and produces the flag of USA.

  (ii) Implement in C++ a recursive algorithm used in RSA that takes n as input and produces the flag of USA.

EXERCISE 2. Define three different functions `fib1`, `fib2` and `fib3` that return for an input $n \in \mathbb{N}$ the n'th Fibonacci number:

  (i) Implement `fib1` in C++ by an iterative algorithm.
  (ii) Implement `fib2` in C++ by a recursive algorithm.
  (iii) Implement `fib3` in C++ by an algorithm that exploits multiplication.

The solutions are provided in the folders `C++ Fibonacci1`, `C++ Fibonacci2` and `C++ Fibonacci3`.