Parallel and distributed algorithms – Examination, Session 1 (1 hours)
February 2023

Exercise 1: Design Patterns for HPC (6 points)

In this exercise we assume the following integer vectors indexed from 0 exist:

- $A = [1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16]$
- $key = [0, 0, 0, 1, 1, 1, 2, 2, 2, 3, 3, 3, 4, 4, 4]$
- $map = [12, 4, 13, 5, 14, 6, 15, 7, 8, 0, 9, 1, 10, 2, 11, 3]$

Moreover, the used binary operator is always the integer addition, and **we consider only *inclusive*** $SCAN$. What are the results of the following parallel patterns applied to these vectors?

1. GATHER(A, map)
2. SCATTER(A, map)
3. REDUCE(A)
4. SEGMENTED-REDUCE(A, key)
5. SCAN(A)
6. SEGMENTED-SCAN(A, key)

Exercise 2: PRAM (4 points)

You have to answer as shortly as possible to the following questions.

1. Write an algorithm for PRAM CRCW machine to compute the minimum of the values of a given array?
2. Transform your algorithm for a PRAM EREW machine.