A – Prefix/suffix minima

in4026

For the list of requirements of this lab course exercise, please read the lab course manual (can be downloaded from the BlackBoard), especially Section 1.

Given an array $A = (a_1, \ldots, a_N)$ with elements drawn from a linear ordered set. The *suffix minima problem* is to determine $\min\{a_i, a_{i+1}, \ldots a_N\}$ for each i. The *prefix minima* are $\min\{a_1, a_2, \ldots a_i\}$ for each i.

Design and implement an efficient parallel program in PThreads and OpenMP that computes the prefix and suffix minima of any given array. We recommend the use of an algorithm with time complexity $\mathcal{O}(\log(N))$, however, any solution with complexity not worse than $\mathcal{O}(N)$ is acceptable if explained why it is preferred.

Test your program, among others, with the following input vector of 32 elements:

$$A = \begin{matrix} 58 & 89 & 32 & 73 & 131 & 156 & 30 & 29 \\ 141 & 37 & 133 & 151 & 88 & 53 & 122 & 126 \\ 131 & 49 & 130 & 115 & 16 & 83 & 40 & 145 \\ 10 & 112 & 20 & 147 & 14 & 104 & 111 & 92 \end{matrix}$$

The correct output should then be similar to:

i	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
prefix minima	58	58	32	32	32	32	30	29	29	29	29	29	29	29	29	29
suffix minima	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

i	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
prefix minima	29	29	29	29	16	16	16	16	10	10	10	10	10	10	10	10
suffix minima	10	10	10	10	10	10	10	10	10	14	14	14	14	92	92	92

Note that normal I/O (e.g., reading the input array from a file, displaying the solution) is not considered part of the algorithm's time complexity.