Algorithms in Comparative Genomics

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`https://gi.cebitec.uni-bielefeld.de/teaching/2023summer/cg`

Exercise sheet 12, 30.6.2023

Exercise 1 (Common intervals from generators) (5 pts)

Consider permutation $(4\,3\,2\,1\,5\,6\,7)$ from Exercise 2 from the previous exercise sheet. We determined the generator (Sup, Inf), where:

$$Sup = [7, 4, 4, 4, 7, 7, 7]$$
$$Inf = [1, 1, 1, 1, 1, 1, 1].$$

1. Determine *Support* for *Sup*.

2. Compute the common intervals using *Sup* following Algorithm 4 in: Bergeron et al. "Computing common intervals of K permutations with applications to modular decomposition of graphs", SIAM J. Descrete Math., 2008.
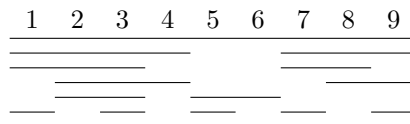
Exercise 2 (Common intervals and PQ-trees) (5 pts)

Consider the set $\{Id_9, P_1, P_2, P_3\}$ of permutations on 1 through 9, where

$$Id_9 = (1, 2, 3, 4, 5, 6, 7, 8, 9),$$
$$P_1 = (9, 8, 7, 5, 6, 4, 3, 2, 1),$$
$$P_2 = (6, 5, 7, 8, 9, 1, 2, 3, 4),$$
$$P_3 = (1, 3, 2, 4, 5, 6, 9, 8, 7).$$

The following graphical representation shows all their common intervals.

1. Identify all strong common intervals.

2. Construct the corresponding PQ-tree.

Exercise 3 (Range Minimum Queries) (5 pts)

Have a look at the following paper to answer the questions below:

Bender, M. A., and Farach-Colton, M. *The LCA problem revisited.* Proceedings of CPM, 1776 (Chapter 9), 88–94, 2000.

1. What is the LCA problem?

2. What is the RMQ problem?

3. What is the $\pm$1RMQ problem?

4. Which problem is reduced to which, and what are the known or induced time complexities for preprocessing and query each?