Exercises – Algorithms for Genome Rearrangement

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http://wiki.techfak.uni-bielefeld.de/gi/Teaching/2015summer/gr

Exercise List 3 — 27.04.2015

Discussion of exercises on: 04.05.2015

Exercise 1 **(2 Points)**

Given the signed permutation (genome)

$$\pi = [0 \quad 2 \quad 1 \quad -3 \quad 4]$$

(a) Draw the breakpoint graph $BP(\pi)$ and calculate the reversal distance of π to the identity permutation.

(b) Find a sorting scenario using the overlap graph $O(\pi)$ to find safe reversals, at each step redrawing both the BP and Overlap graphs.

Exercise 2 **(2 Points)**

Given the signed permutation (genome)

$$\pi = [0 \quad -3 \quad 1 \quad 2 \quad 4 \quad 6 \quad 5 \quad 7 \quad -15 \quad -13 \quad -14 \quad -12 \quad -10 \quad -11 \quad -9 \quad 8 \quad 16]$$

(a) Draw the breakpoint graph $BP(\pi)$. You may use the software from the Wiki if you already did the Exercise 1 by hand, and you are feeling a little lazy... :-)

(b) What is the lower bound on the reversal distance of π to the identity? Is this bound tight? Why?

Exercise 3 **(3 Points)**

Consider the special case of Sorting By Reversals where only reversals of length two are allowed (swap of consecutive elements), called SB2R.

(a) Give an algorithm for SB2R of an *unsigned* permutation. Can you show if this algorithm is optimal, that is, that it sorts the permutation in the minimum possible number of swaps?

(b) The same as the previous item, but now for *signed* permutations.

Exercise 4 **(3 Points)**

In the overlap graph $O(\pi)$, applying a reversal induced by a vertex v will have two effects:

i) The subgraph induced by v and its neighbours is complemented.

ii) All neighbours of v have their orientation inverted.

Using only the fact that v is an oriented vertex (odd degree) and the item (i), prove item (ii), that is, prove that all neighbours of v have their orientation inverted.

Tip: for a neighbour u of v, check how many edges it loses and how many it gains after the reversal, and check what is the parity of the total change.