University of Helsinki
Department of Computer Science

Intensive Course on Genome Rearrangements, Winter 2018

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Exercises

Exercise 01, 08.01.2018

1. Given permutation $\pi = (\ 2\ 1\ 3\ 5\ 4\ )$,
   (a) calculate the reversal distance $srd(\pi)$
   (b) find a sorting scenario, i.e. a sequence of reversals $\rho_1, \cdots, \rho_d$ such that $\pi \circ \rho_1 \circ \cdots \circ \rho_d = \mathbf{id}$ and $srd(\pi) = d$.
2. Develop a linear time algorithm to count the number of cycles in a graph whose vertices have all degree 2.
3. Is the problem of computing the reversal distance for unsigned permutations simpler than that for signed permutations? Study the breakpoint graph for unsigned permutations to derive your arguments.

   The breakpoint graph $BG(\pi)$ for an unsigned permutation π is constructed analog to that of a signed permutation, except that each element of π is not represented by two vertices, but one:

   Definition *The* breakpoint graph *of an unsigned permutation π with n elements is the graph $BG(\pi) = (V, E)$ whose vertex set is $V = \{0, \ldots, n+1\}$ and whose edge set E is the union of two hamiltonian paths $R = \{\{\pi_i, \pi_{i+1}\} \mid 0 \leq i < n\}$ (reality edges) and $D = \{\{i, i+1\} \mid 0 \leq i \leq n\}$ (desire edges) that both cover all vertices of V.*
4. The distance $rd2(\pi)$ is a variant of the unsigned reversal distance where only reversals of length two are allowed. Give an algorithm for its computation. Then, extend your results to the signed case, by developing an algorithm that computes distance $srd2(\sigma)$ for a signed permutation σ, restricting reversals to be of length *at most* 2.

Discussion of solutions in tutorial on 09.01.2018 10:15-11:45 AM