

Exercises – Algorithms for Genome Rearrangement

Universität Bielefeld, SS 2014, Dr. Pedro Feijao

<http://wiki.techfak.uni-bielefeld.de/gi/Teaching/2014summer/gr>

Exercise List 9 — 23.06.2014

Hand in exercises by: 30.06.2014

Exercise 1

(6 Points)

Given genomes $\pi = (1\ 3\ 5\ 4\ 2)$ and $\sigma = (1\ 2\ 3\ 4\ 5)$:

- Find the Fusion, Fission, Transposition distance between π and σ .
- Find an optimal rearrangement scenario transforming π into σ , with at least one transposition.

Exercise 2

(6 Points)

Signed genomes can be modeled in the algebraic theory by using 2 cycles for each chromosome, corresponding to a direct strand and the reverse complementary strand. For instance, $(1\ 2\ 3)(-3\ -2\ -1)$ represents a circular chromosome with genes 1, 2 and 3. Consider a genome

$$\pi = (1\ 2\ 3\ 4)(-4\ -3\ -2\ -1)(5\ 6\ 7)(-7\ -6\ -5)$$

that is, with two circular chromosomes.

A Double-Cut-and-Join operation can be modeled as a permutation $\rho = (a\ b)(\pi\Gamma(a)\ \pi\Gamma(b))$, where

$$\Gamma = (1\ -1)(2\ -2) \cdots (n\ -n)$$

For instance, choosing $a = 2$ and $b = 5$, we have that $\pi\Gamma(2) = \pi(-2) = -1$ and $\pi\Gamma(5) = \pi(-5) = -7$, so $\rho = (2\ 5)(-1\ -7)$ is a DCJ operation. The type of the operation depends on which a and b are chosen. For the different a and b possibilities below, find the permutation $\rho = (a\ b)(\pi\Gamma(a)\ \pi\Gamma(b))$ and apply in π (finding the product $\rho\pi$). What is the type of each operation? (reversal, fusion, etc.)

- Choose a and b in the same cycle.
- Choose a and b in the chromosome, but in different strands.
- Choose a and b in different chromosomes (any strand is ok).

Exercise 3

(2 Points)

Find the result of the product $\pi\Gamma$ from the last exercise.