Exercises – Algorithms for Genome Rearrangement

Exercise List 7 — 18.05.2015

Discussion of exercises on: 25.05.2015

Exercise 1   **(5 Points)**

Given the following genomes:

$$A = \{1_t, 1_h 6_h, 6_t 2_h, 2_t 5_t, 5_h 4_h, 4_t, 3_h, 3_t 7_t, 7_h, 9_h 8_t, 8_h 9_t, 12_t 10_h, 10_t 11_t, 11_h 12_h\}$$

$$B = \{3_h 1_t, 1_h 2_t, 2_h 3_t, 4_t, 4_h 5_t, 5_h 6_t, 6_h 7_t, 7_h 8_t, 8_h 9_t, 9_h, 12_h 10_t, 10_h 11_t, 11_h 12_t\}$$

(a) Draw the chromosomes of A and B.

(b) Draw the adjacency graph of A and B.

(c) Compute the DCJ distance between A and B.

(d) Find 3 different DCJ operations applied in A that decrease its distance to B, and redraw the adjacency graph for each operation.

(e) What is type of the operations that you applied in (c)? (Reversal, translocation, fission...)

Exercise 2   **(2 Points)**

Given a genome A with l_1 linear chromosomes, and B with l_2 linear chromosomes, how many paths does the adjacency graph $AG(A, B)$ have?

Exercise 3   **(5 Points)**

A genome can be seen as a *matching* on the set of all $2n$ extremities, where adjacencies correspond to two matched extremities, and telomeres are extremities that are not matched to any other. For instance, the genome
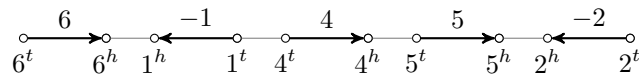
has the matching

which is basically the graph representation considering only the grey edges.

Let's count the total number of possible genomes with n genes, which is the same as counting matchings on $2n$ extremities.

(a) What is the total number of different *circular* genomes with n genes? *Tip: a circular genome does not have telomeres, only adjacencies, therefore it is the same as counting all perfect matchings, that is, matchings where all vertices are matched.*

(b) Try to find a recursive equation for the total number of genomes with n genes. *Tip: consider a matching of size n and fix a certain vertex v. In a matching, there are two options for this vertex: connect him with any other of the $n - 1$ vertices, or do not connect v. Each option can be expressed recursively, and the sum of the two gives the full recursion.*