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Discrete Mathematics for Bioinformatics (P1)

WS 2009/10

Exercises 3

1. **(Critical Mixed Cycles)**

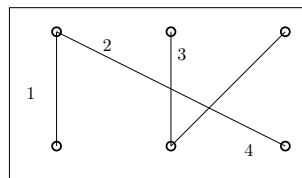
Prove the following lemma (see lecture script):

A subset $T \subseteq E$ is a trace, if and only if $G' = (V, T, H)$ does not contain a critical mixed cycle.

2. **(Maximum gapped trace problem)**

Read the definition of the gapped alignment graph (pdf on course page) and extend the ILP for the MWT to solve the maximum gapped trace problem.

3. **(PORTA – Polyhedron Representation Transformation Algorithm)**



Let $x_i = 1$, iff the i -th edge is part of the alignment. Evidently a *trace* cannot contain all edges at once since some of them are contradicting.

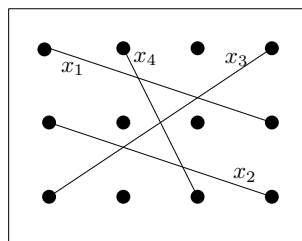
Build ‘manually’ a system of inequalities that permits all legal combinations of edges but prohibits impossible combinations.

The program *traf* of the porta PORTA package computes all facet defining inequalities given a list of all legal combinations of alignment edges.

Generate all legal combinations and apply *traf*.

How does your system of inequalities differ from the system computed by PORTA?

4. (PORTA – Polyhedron Representation Transformation Algorithm)



Given the following ILP:

$$\begin{array}{ll}
 \max & x_1 + x_2 + x_3 + x_4 \\
 \text{w.r.t.} & \\
 & x_1 + x_2 + x_3 \leq 2 \\
 & x_1 + x_2 + x_4 \leq 2 \\
 & x_3 + x_4 \leq 1
 \end{array}$$

$$x_1, x_2, x_3, x_4 \text{ integral}$$

- (a) Solve the LP relaxation with a solver (e.g lp-solve or soplex).
- (b) Generate all feasible integral points using program *vint* (PORTA package).
- (c) Transform the point representation into the halfspace representation using program *traf* (PORTA package).
- (d) Solve the resulting linear program again with your lp solver.