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Discrete Mathematics for Bioinformatics (P1)

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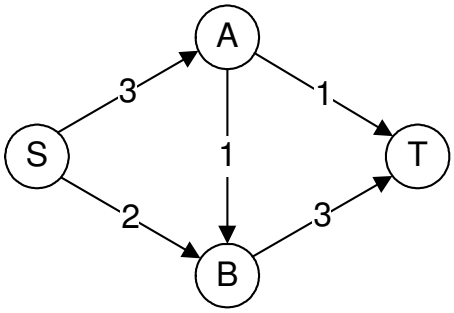
Exercises 8

1. **Porta** Install the PORTA package and read the manpages (http://www2.iwr.uni-heidelberg.de/groups/comopt/software/PORTA).

2. **Network Flows and Duality**

   Consider the network shown in the figure below, and the corresponding max-flow problem:



   (a) Model the problem as linear program (see script).

   (b) Write down the dual problem (D) of the LP above. Give interpretations for the variables in the dual problem.

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

   Given the following ILP:

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

$$x_1, x_2, x_3, x_4 \quad \textit{integral}$$

   (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.

4. **Branch and Bound**

$$
\begin{array}{lrcrcrcrcl}
\max & 8x_1 & + & 11x_2 & + & 6x_3 & + & 4x_4 & & \\
\text{w.r.t.} & & & & & & & & & \\
 & 5x_1 & + & 7x_2 & + & 4x_3 & + & 3x_4 & \leq & 14 \\
x_1, x_2, x_3, x_4 \in \{0, 1\} & & & & & & & & &
\end{array}
$$

(a) Solve the LP relaxation with a solver (e.g lp-solve or soplex).

(b) Apply branch and bound to find the optimal solution to the ILP.