Assignment 10, Selected Topics in Combinatorial Optimization, Summer term 2014

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Exercise 10.1 (5 Points) Consider the two systems

$$\begin{pmatrix} 1 & 1 \\ 1 & 0 \\ 1 & -1 \end{pmatrix} \begin{pmatrix} x_1 \\ x_2 \end{pmatrix} \leq \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix} \text{ and } \begin{pmatrix} 1 & 1 \\ 1 & -1 \end{pmatrix} \begin{pmatrix} x_1 \\ x_2 \end{pmatrix} \leq \begin{pmatrix} 0 \\ 0 \end{pmatrix}.$$

They define the same polyhedron. Prove that exactly one of them is TDI.

Exercise 10.2 (10 Points) Let $Ax \leq b$ be TDI, $k \in \mathbb{N}$, and $\alpha > 0$ rational. Show that $\frac{1}{k}Ax \leq \alpha b$ is again TDI. Furthermore, show that $\alpha Ax \leq \alpha b$ is not necessarily TDI.

Exercise 10.3 (10 Points) Show that the incidence matrix of any odd cycle is not totally unimodular.