

# Homework 9 (15 points + 5 extra)

## Linear programming

1. Consider the following linear problem:

$$\begin{array}{ll}\text{Maximize} & 2x + 2y + z \\ \text{subject to} & \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} \leq \begin{bmatrix} 5 \\ 4 \\ 4 \end{bmatrix} \\ & x \geq 0, y \geq 0, z \geq 0.\end{array}$$

- 1.1 (5 points) The constraints define a 3D polytope. What shape is it? What is the number of its vertices, edges and facets?
  - 1.2 (5 points) Solve the problem.

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## Linear programming

### 2. An intersection of a 2D plane

$$ax + by + cz = d$$

and a unit cube

$$\left\{ \{x, y, z\} \in \mathbb{R}^3 \mid 0 \leq x, y, z \leq 1 \right\}$$

is a (sometimes degenerate) 2D polytope.

- 2.1 (5 points) What types of polytopes can be obtained this way (triangle? square? ...?) For each polytope type state the equation of the corresponding plane.
- 2.2 (5 points extra) What types of polytopes can be obtained by intersecting a 2D plane with a four dimensional cube?

E-mail the answers to [ljank@ippt.pan.pl](mailto:ljank@ippt.pan.pl).