

Mathematical Description of Linear Systems with various constraints

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1 Preliminaries

1.1 Notations

- \mathbb{R} : the set of real numbers.
- $\mathbb{R}^+ = \{x \in \mathbb{R} : x \geq 0\}$: the set of nonnegative real numbers.
- \mathbb{Z} : the set of integers.
- $\mathbb{Z}^+ = \{x \in \mathbb{Z} : x \geq 0\}$: the set of nonnegative integers.
- \mathbb{R}^n : the set of the n -dimensional real vectors. For instance,

$$x = \begin{bmatrix} x_1 \\ \vdots \\ x_n \end{bmatrix} \in \mathbb{R}^n$$

which means $x_i \in \mathbb{R}$ for all $i \in \{1, 2, \dots, n\}$.

- $\mathbb{R}^{m \times n}$: the set of $m \times n$ real matrices. For instance,

$$A = [a_{ij}] = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m1} & a_{m2} & \cdots & a_{mn} \end{bmatrix}$$

which means that each element a_{ij} satisfies that $a_{ij} \in \mathbb{R}$ for all $i \in \{1, 2, \dots, m\}$ and $j \in \{1, 2, \dots, n\}$.