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Farkas lemma

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Given an $m \times n$ matrix A and an $1 \times n$ real row vector c , both with real coefficients, one and only one of the following systems has a solution:

1. $Ax \leq 0$ and $cx > 0$ for some n -column vector x ;
2. $wA = c$ and $w \geq 0$ for some m -row vector w .

Equivalently, one and only one of the following has a solution:

1. $Ax \leq 0$, $x \leq 0$ and $cx > 0$ for some n -column vector x ;
2. $wA \leq c$ and $w \geq 0$ for some m -row vector w .

Remark. Here, $Ax \geq 0$ means that every of Ax is nonnegative, and similarly with the other expressions.