

# Optimization Assignment - 1

Mohamed Hamdan

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**Problem Statement** - The longest side of a triangle is 3 times the shortest side and the third side is 2 cm shorter than the longest side. If the perimeter of the triangle is at least 61 cm, find the minimum length of the shortest side.

## Solution

Let  $x$  be the largest side,  $z$  the shortest side and  $y$  be other side of the triangle. The problem can be formulated as

$$P = \min_{x,y,z} z \quad (1)$$

$$x - 3z = 0 \quad (2)$$

$$x - y = 2 \quad (3)$$

$$x + y + z \geq 61 \quad (4)$$

which can be expressed in vector form as

$$P = \min_{\mathbf{x}} (0 \quad 0 \quad 1) \mathbf{x} \quad (5)$$

$$\begin{pmatrix} 1 & 0 & -3 \\ 1 & -1 & 0 \end{pmatrix} \mathbf{x} = \begin{pmatrix} 0 \\ 2 \end{pmatrix} \quad (6)$$

$$(1 \quad 1 \quad 1) \mathbf{x} \geq (61) \quad (7)$$

$$\mathbf{x} \geq \mathbf{0} \quad (8)$$

Solving using cvxpy, we get

$$P_{min} = 9 \quad (9)$$

$$\mathbf{x} = \begin{pmatrix} 27 \\ 25 \\ 9 \end{pmatrix} \quad (10)$$