

# Assignment 5

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- 1) Find the perpendicular distance from the origin to the line  $x-y = 4$  and angle between perpendicular and the positive x-axis.

**Solution:** The given problem can be expressed as

$$\min_{\mathbf{x}} g(\mathbf{x}) = \|\mathbf{x} - \mathbf{P}\|^2 \quad (0.0.1)$$

$$\text{s.t. } \mathbf{n}^T \mathbf{x} = c \quad (0.0.2)$$

where

$$\mathbf{P} = \begin{pmatrix} 0 \\ 0 \end{pmatrix} \quad (0.0.3)$$

$$\mathbf{n} = \begin{pmatrix} 1 \\ -1 \end{pmatrix} \quad (0.0.4)$$

$$c = 4 \quad (0.0.5)$$

Solving the equation (0.0.1) using cvxpy we get the solution as,

$$\mathbf{x} = \begin{pmatrix} 2 \\ -2 \end{pmatrix} \quad (0.0.6)$$

The direction vector of the perpendicular is given by,

$$\mathbf{m} = \begin{pmatrix} 1 \\ -1 \end{pmatrix} \quad (0.0.7)$$

The angle between the perpendicular and the positive x-axis is given by,

$$\mathbf{e}_1 = \begin{pmatrix} 1 \\ 0 \end{pmatrix} \quad (0.0.8)$$

$$\cos \theta = \frac{\mathbf{m}^T \mathbf{e}_1}{\|\mathbf{m}\| \|\mathbf{e}_1\|} \quad (0.0.9)$$

$$= \frac{1}{\sqrt{2}} \quad (0.0.10)$$

$$\implies \theta = 45 \quad (0.0.11)$$