

Straight Lines Assignment

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Abstract—This document contains the solution to Question 1 of Exercise 1 in Chapter 10 of the class 11 NCERT textbook.

- 1) Draw a quadrilateral in the Cartesian plane, whose vertices are

$$\mathbf{A} = \begin{pmatrix} -4 \\ 5 \end{pmatrix} \quad \mathbf{B} = \begin{pmatrix} 0 \\ 7 \end{pmatrix} \quad (1)$$

$$\mathbf{C} = \begin{pmatrix} 5 \\ -5 \end{pmatrix} \quad \mathbf{D} = \begin{pmatrix} -4 \\ -2 \end{pmatrix} \quad (2)$$

Also, find its area.

Solution: The points are plotted in Fig. 1. The plot is generated using the Python code codes/quad.py.

The area vector (denoted by \mathbf{R}_X for region X) of the quadrilateral is perpendicular to the plane of the quadrilateral and its orientation is assumed to be in the positive z -direction here.

$$\mathbf{R}_{ABCD} = \mathbf{R}_{ABC} + \mathbf{R}_{ACD} \quad (3)$$

$$= \frac{1}{2} ((\mathbf{B} - \mathbf{A}) \times (\mathbf{C} - \mathbf{A}) + (\mathbf{C} - \mathbf{A}) \times (\mathbf{D} - \mathbf{A})) \quad (4)$$

$$= \frac{1}{2} ((\mathbf{C} - \mathbf{A}) \times (\mathbf{D} - \mathbf{A} + \mathbf{A} - \mathbf{B})) \quad (5)$$

$$= \frac{1}{2} ((\mathbf{C} - \mathbf{A}) \times (\mathbf{D} - \mathbf{B})) \quad (6)$$

$$(7)$$

Thus the area of quadrilateral ABCD is

$$\text{ar}(ABCD) = \|\mathbf{R}_{ABCD}\| \quad (8)$$

$$= \frac{1}{2} \|(\mathbf{C} - \mathbf{A}) \times (\mathbf{D} - \mathbf{B})\| \quad (9)$$

$$= \frac{1}{2} \begin{vmatrix} 9 & -4 \\ -10 & -9 \end{vmatrix} \quad (10)$$

$$= 60.5 \text{ sq. units.} \quad (11)$$

This is verified in the Python code codes/area.py.

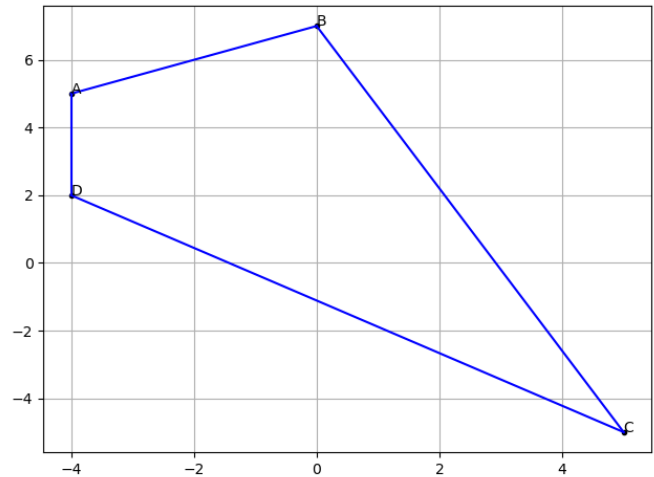


Fig. 1: Plot of quadrilateral ABCD