ASSIGNMENT 3

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Download all python codes from

https://github.com/Dishank422/EE3900/blob/main/assignment3/codes

and latex-tikz codes from

https://github.com/Dishank422/EE3900/blob/main/assignment3/Assignment3.tex

1 Vectors 2.13

Construct a quadrilateral ABCD such that BC = 4.5, AC = 5.5, CD = 5, BD = 7 and AD = 5.5.

2 Solution

Using AC = 5.5,

$$\text{Let } \mathbf{A} = \begin{pmatrix} 0 \\ 0 \end{pmatrix}, \ \mathbf{C} = \begin{pmatrix} 5.5 \\ 0 \end{pmatrix} \tag{2.0.1}$$

$$\mathbf{B} = \begin{pmatrix} x \\ y \end{pmatrix}, \ \mathbf{D} = \begin{pmatrix} h \\ k \end{pmatrix} \tag{2.0.2}$$

We know

$$\|\mathbf{D} - \mathbf{A}\| = 5.5 \tag{2.0.3}$$

$$\|\mathbf{D} - \mathbf{C}\| = 5 \tag{2.0.4}$$

$$\|\mathbf{B} - \mathbf{C}\| = 4.5 \tag{2.0.5}$$

$$\|\mathbf{B} - \mathbf{D}\| = 7 \tag{2.0.6}$$

$$h = \frac{AC^2 + AD^2 - CD^2}{2AC} \tag{2.0.7}$$

$$= \frac{5.5^2 + 5.5^2 - 5^2}{2 \times 5.5} \tag{2.0.8}$$

$$= 3.23 \tag{2.0.9}$$

$$k = \sqrt{(AD^2 - h^2)} \tag{2.0.10}$$

$$= \sqrt{(5.5^2 - h^2)} \tag{2.0.11}$$

$$= 4.45 \tag{2.0.12}$$

$$\implies \mathbf{D} = \begin{pmatrix} 3.23 \\ 4.45 \end{pmatrix} \tag{2.0.13}$$

Note: Above computations can be found in codes/finding_D.py.

From 2.0.5 and 2.0.6,

$$(x - 5.5)^2 + (y - 0)^2 = 4.5^2 \tag{2.0.14}$$

$$(x - 3.23)^2 + (y - 4.45)^2 = 7^2 \tag{2.0.15}$$

$$\implies x^2 - 11x + 30.25 + y^2 = 20.25 \tag{2.0.16}$$

$$\implies x^2 - 6.46x + 10.43 + y^2 - 8.9y + 19.8 = 49 \tag{2.0.17}$$

$$\implies 4.34x - 8.9y = 28.77 \tag{2.0.18}$$

$$\implies y = 0.49x - 3.23 \tag{2.0.19}$$

$$\implies x^2 - 11x + 30.25 + (0.49x - 3.23)^2 = 20.25 \tag{2.0.20}$$

$$\implies 1.24x^2 - 14.17x + 0.43 = 0 \tag{2.0.21}$$

$$\implies x = 0.03, 11.4 \tag{2.0.22}$$

$$\implies y = -3.22, 2.37 \tag{2.0.23}$$

Note: The values of x are found using codes/quadratic_solve.py. Since $\mathbf{A}$, $\mathbf{B}$, $\mathbf{C}$ and $\mathbf{D}$ are in that order,

$$\mathbf{B} = \begin{pmatrix} 0.03 \\ -3.22 \end{pmatrix} \tag{2.0.24}$$

Using the co-ordinates of the vertices as found, the following quadrilateral is plotted.