Assignment 1

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Download all python codes from

```
https://github.com/Y.Nagarani/Matrix−Theory/tree/
main/Assignment1/Codes
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and latex-tikz codes from

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https://github.com/Y.Nagarani/Matrix−Theory/tree/
main/Assignment1
```

1 Question No. 2.1

Construct $\triangle ABC$ of sides $a = 4$, $b = 5$ and c=6

2 Explanation

Let us assume that:

$$\mathbf{A} = \begin{pmatrix} p \\ q \end{pmatrix}, \mathbf{B} = \begin{pmatrix} 0 \\ 0 \end{pmatrix}, \mathbf{C} = \begin{pmatrix} a \\ 0 \end{pmatrix}, \mathbf{D} = \begin{pmatrix} p \\ 0 \end{pmatrix} \tag{2.0.1}$$

Then

$$AB = \|\mathbf{A} - \mathbf{B}\|^2 = \|\mathbf{A}\|^2 = c^2 \quad \because \mathbf{B} = \mathbf{0} \tag{2.0.2}$$

$$BC = \|\mathbf{C} - \mathbf{B}\|^2 = \|\mathbf{C}\|^2 = a^2 \tag{2.0.3}$$

$$AC = \|\mathbf{A} - \mathbf{C}\|^2 = b^2 \tag{2.0.4}$$

From (2.0.4),

$$b^2 = \|\mathbf{A} - \mathbf{C}\|^2 = \|\mathbf{A} - \mathbf{C}\|^T \|\mathbf{A} - \mathbf{C}\| \tag{2.0.5}$$

$$= \mathbf{A}^T\mathbf{A} + \mathbf{C}^T\mathbf{C} - \mathbf{A}^T\mathbf{C} - \mathbf{C}^T\mathbf{A} \tag{2.0.6}$$

$$= \|\mathbf{A}\|^2 + \|\mathbf{C}\|^2 - 2\mathbf{A}^T\mathbf{C} \quad \left(\because \mathbf{A}^T\mathbf{C} = \mathbf{C}^T\mathbf{A}\right) \tag{2.0.7}$$

The vertex $\mathbf{A}$ can be expressed in *polar coordinate form* as

$$\mathbf{A} = c\begin{pmatrix} \cos B \\ \sin B \end{pmatrix} \tag{2.0.8}$$

From $\triangle ABC$,we use the law of cosines:

$$b^2 = a^2 + c^2 - 2ac\cos B \tag{2.0.9}$$

$$\cos B = \frac{a^2 + c^2 - b^2}{2ac} \tag{2.0.10}$$

$$\cos B = \frac{27}{48} \tag{2.0.11}$$

$$\cos B = 0.5625 \tag{2.0.12}$$

$$\tag{2.0.13}$$

we know that

$$sinB = \sqrt{1 - cos^2B} \tag{2.0.14}$$

$$sinB = 0.8267972 \tag{2.0.15}$$

So,the vertices of $\triangle ABC$ in fig.

$$\mathbf{A} = \begin{pmatrix} 3.375 \\ 4.960 \end{pmatrix}, \mathbf{B} = \begin{pmatrix} 0 \\ 0 \end{pmatrix}, \mathbf{C} = \begin{pmatrix} 4 \\ 0 \end{pmatrix} \tag{2.0.16}$$

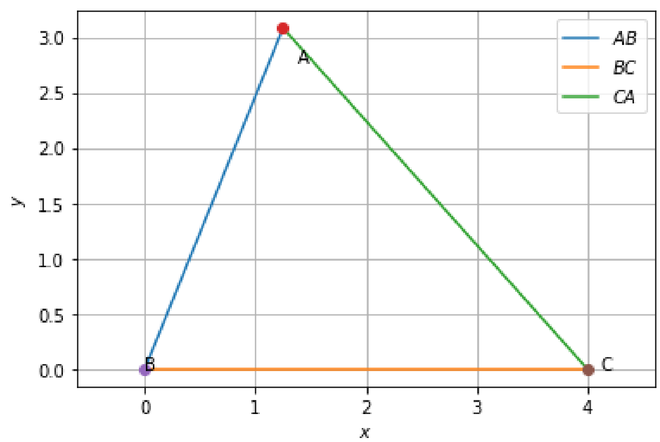

Fig. 0: $\triangle ABC$