Assignment 1

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Download all python codes from

https://github.com/grajanarsavva/Matrix−theory/codes

and latex-tikz codes from

https://github.com/grajanarsavva/Matrix−theory

1 Question No. 2.9

Draw a $\triangle ABC$ in which $\angle C = 90°, \angle B = 30° \angle A = 60° and$a+b+c=11

2 Explanation

Given,

$$\angle C = 90°, \angle B = 30° \angle A = 60° and \text{a+b+c=11} \tag{2.0.1}$$

By using Sin Rule:

$$\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c} \tag{2.0.2}$$
$$\implies b \sin C = c \sin B \tag{2.0.3}$$
$$b \sin 90 = c sin 30 \tag{2.0.4}$$
$$\implies c = 2b \tag{2.0.5}$$

$$a \sin B = b \sin A \tag{2.0.6}$$
$$a \sin 30 = b \sin 60 \tag{2.0.7}$$
$$\implies a = \sqrt{3} b \tag{2.0.8}$$

Then, AX=B
which can be expressed as the matrix equation

$$\begin{pmatrix} 0 & -2 & 1 \\ 1 & -\sqrt{3} & 0 \\ 1 & 1 & 1 \end{pmatrix} \begin{pmatrix} a \\ b \\ c \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \\ 11 \end{pmatrix} \tag{2.0.9}$$

By solving (2.0.9) , we get values :

$$\implies a = 4.02627944; \tag{2.0.10}$$
$$\implies b = 2.32457352; \tag{2.0.11}$$
$$\implies c = 4.64914704 \tag{2.0.12}$$

The Vertices of $\triangle ABC$ are

$$\mathbf{A} = \begin{pmatrix} 0 \\ c \end{pmatrix} = \begin{pmatrix} 0 \\ 4.64 \end{pmatrix} \tag{2.0.13}$$
$$\mathbf{B} = \begin{pmatrix} 0 \\ 0 \end{pmatrix} \tag{2.0.14}$$
$$\mathbf{C} = \begin{pmatrix} a \\ 0 \end{pmatrix} = \begin{pmatrix} 4.02 \\ 0 \end{pmatrix} \tag{2.0.15}$$
$$\mathbf{D} = \begin{pmatrix} p \\ 0 \end{pmatrix} = \begin{pmatrix} 4.02 \\ 0 \end{pmatrix} \tag{2.0.16}$$

Now,

$$AB = \|\mathbf{A} - \mathbf{B}\|^2 = \|\mathbf{A}\|^2 = c^2 = 21.61 \tag{2.0.17}$$
$$BC = \|\mathbf{C} - \mathbf{B}\|^2 = \|\mathbf{C}\|^2 = a^2 = 16.21 \tag{2.0.18}$$
$$AC = \|\mathbf{A} - \mathbf{C}\|^2 = b^2 = 5.4 \tag{2.0.19}$$

from AC

$$b^2 = \|\mathbf{A} - \mathbf{C}\|^2 = (\mathbf{A} - \mathbf{C})^T (\mathbf{A} - \mathbf{C}) \tag{2.0.20}$$
$$= \mathbf{A}^T \mathbf{A} + \mathbf{C}^T \mathbf{C} - \mathbf{A}^T \mathbf{C} - \mathbf{C}^T \mathbf{A} \tag{2.0.21}$$
$$= \|\mathbf{A}\|^2 + \|\mathbf{C}\|^2 - 2\mathbf{A}^T \mathbf{C} \tag{2.0.22}$$
$$= a^2 + b^2 - 2ap \tag{2.0.23}$$

yielding

$$p = \left(\frac{a^2 + c^2 - b^2}{2a} \right) = 4.026; \tag{2.0.24}$$
$$\|\mathbf{A}\|^2 = c^2 = p^2 + q^2 \tag{2.0.25}$$
$$\implies q = \pm \sqrt{c^2 - p^2} = \pm 2.324 \tag{2.0.26}$$

Plot the $\triangle ABC$ is as follows:

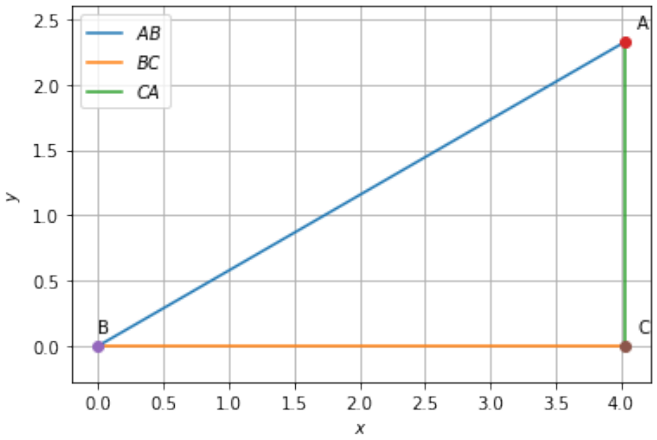

Fig. 2.1: $\triangle ABC$