

1-1.11-3

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Question: If a line makes 60° and 45° angles with the positive directions of the X-axis and Z-axis respectively, then find the angle that it makes with the positive direction of the Y-axis. Hence, write the direction cosines of the line.

Solution: Let α , β and γ be the angles made by the line with the X, Y and Z axes respectively. Now the unit direction vector \mathbf{x} can be expressed as

$$\mathbf{x} = \begin{pmatrix} \cos \alpha \\ \cos \beta \\ \cos \gamma \end{pmatrix}$$

$$\|\mathbf{x}\| = 1$$

$$\sqrt{\mathbf{x}\mathbf{x}^T} = 1$$

$$\cos^2 \alpha + \cos^2 \beta + \cos^2 \gamma = 1$$

$$\cos^2 60^\circ + \cos^2 \beta + \cos^2 45^\circ = 1$$

$$\frac{1}{4} + \cos^2 \beta + \frac{1}{2} = 1$$

$$\cos^2 \beta = \frac{1}{4}$$

$$\cos \beta = \pm \frac{1}{2}$$

$$\beta = 60^\circ$$

Hence the direction cosines are

$$\mathbf{x} = \begin{pmatrix} \cos \alpha \\ \cos \beta \\ \cos \gamma \end{pmatrix} = \begin{pmatrix} \cos 60^\circ \\ \cos 60^\circ \\ \cos 45^\circ \end{pmatrix} = \begin{pmatrix} \frac{1}{2} \\ \frac{1}{2} \\ \frac{1}{\sqrt{2}} \end{pmatrix}$$

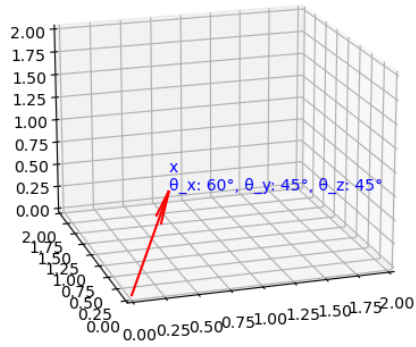


Fig. 0: Plot of the described vector

Code for this plot can be found at:

```
Codes/main.py  
Codes/main.c
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