Assignment 4: 2.9.6

EE25BTECH11055 - Subhodeep Chakraborty

Question:
$|\mathbf{a}| = 8, |\mathbf{b}| = 3,$ and $\mathbf{a} \cdot \mathbf{b} = 12\sqrt{3}$, then the value $|\mathbf{a} \times \mathbf{b}|$ is
Solution:
Given:

$$\|\mathbf{a}\| = 8 \tag{1}$$
$$\|\mathbf{b}\| = 3 \tag{2}$$
$$\mathbf{a}^\top \mathbf{b} = 12\sqrt{3} \tag{3}$$

We know:

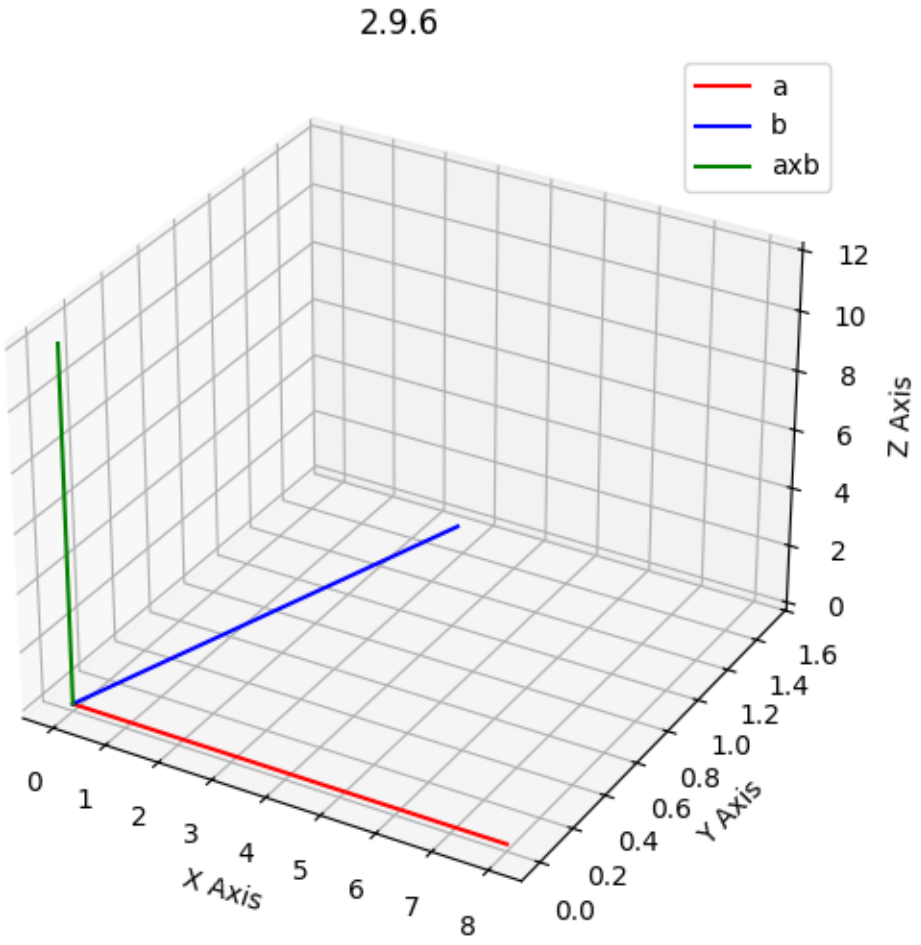
$$\|\mathbf{a} \times \mathbf{b}\| = \|\mathbf{a}\| \|\mathbf{b}\| \sin\theta \tag{4}$$
$$\cos\theta = \frac{\mathbf{a}^\top \mathbf{b}}{\|\mathbf{a}\| \|\mathbf{b}\|} \tag{5}$$

Thus

$$\left(\mathbf{a}^\top \mathbf{b}\right)^2 + \left(\|\mathbf{a} \times \mathbf{b}\|\right)^2 = \|\mathbf{a}\|^2 \|\mathbf{b}\|^2 \tag{6}$$

Substituting values

$$\|\mathbf{a} \times \mathbf{b}\| = \sqrt{64 \times 9 - 144 \times 3} \tag{7}$$
$$\|\mathbf{a} \times \mathbf{b}\| = 12 \tag{8}$$


2.9.6
a
b
axb
X Axis
Y Axis
Z Axis
0
1
2
3
4
5
6
7
8
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
0
2
4
6
8
10
12