

Assignment 2

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Download all python codes from

https://github.com/Kumarbegnier/IIT-HYD-INTERNSHIP/tree/main/ASSIGNMENT_2/
code

and latex-tikz codes from

[https://github.com/Kumarbegnier/IIT-HYD-INTERNSHIP/blob/main/ASSIGNMENT_2/](https://github.com/Kumarbegnier/IIT-HYD-INTERNSHIP/blob/main/ASSIGNMENT_2/latex.tex)
latex.tex

1 QUESTION NO. 2.3 - QUADRATIC FORMS

Find the locus of all the unit vectors in the xy-plane

2 SOLUTION

let, the unit vector be $\mathbf{a} = 1$, $OA = \mathbf{a}$
We know that,

$$\mathbf{a} = x\mathbf{i} + y\mathbf{j} + z\mathbf{k} \quad (2.0.1)$$

since the vector in xy plane, there is no z-coordinate. Hence,

$$\mathbf{a} = x\mathbf{i} + y\mathbf{j} \quad (2.0.2)$$

Taking a general vector

Angle AOB with x-axis in between is \mathbf{a} and \mathbf{i} is $\angle AOB$ we know that,

$$\mathbf{a} \cdot \mathbf{b} = |\mathbf{a}||\mathbf{b}| \cos AOB \quad (2.0.3)$$

$$\mathbf{a} \cdot \mathbf{b} = |\mathbf{a}||\mathbf{b}| \cos AOB \quad (2.0.4)$$

putting $a = a$, $b = i$, as we know that \mathbf{a} is unit vector

$$\mathbf{a} \cdot \mathbf{i} = \cos AOB \quad (2.0.5)$$

$$(x\mathbf{i} + y\mathbf{j} + z\mathbf{k}) \cdot \mathbf{i} = \cos AOB \quad (2.0.6)$$

$$(x\mathbf{i} + y\mathbf{j} + z\mathbf{k})(x\mathbf{i} + y\mathbf{j} + z\mathbf{k}) = \cos AOB \quad (2.0.7)$$

$$x = \cos AOB \quad (2.0.8)$$

Angle with y-axis, in between \mathbf{a} , and \mathbf{j} is $(90^\circ - \angle AOB)$
so, angle between

$$\mathbf{a} \cdot \mathbf{j} = |\mathbf{a}||\mathbf{j}|(\cos(90^\circ - \angle AOB)) \quad (2.0.9)$$

$$\mathbf{a} \cdot \mathbf{j} = (\sin AOB) \quad (2.0.10)$$

$$(x\mathbf{i} + y\mathbf{j} + z\mathbf{k}) \cdot \mathbf{j} = \cos AOB \quad (2.0.11)$$

$$(x\mathbf{i} + y\mathbf{j} + z\mathbf{k})(x\mathbf{i} + y\mathbf{j} + z\mathbf{k}) = \cos AOB \quad (2.0.12)$$

$$y = \sin AOB \quad (2.0.13)$$

Thus,

$$\mathbf{a} = x\mathbf{i} + y\mathbf{j} \quad (2.0.14)$$

$$\mathbf{a} = (\cos AOB)\mathbf{i} + (\sin AOB)\mathbf{j} \quad (2.0.15)$$

This value will be in all quadrants (0° to 360°)

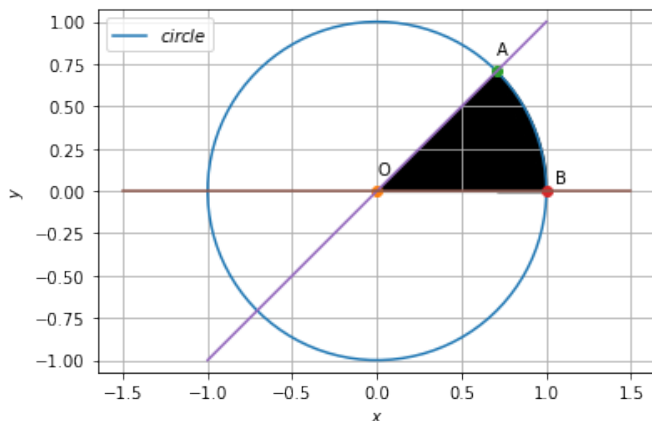


Fig. 0: unit vector