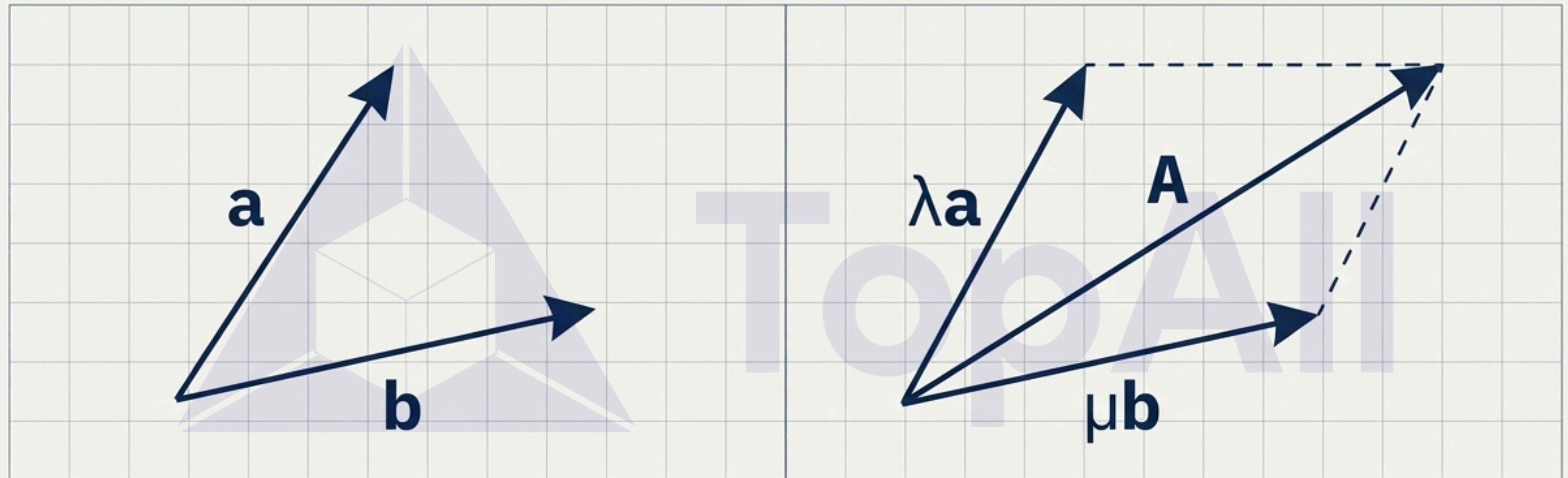


Motion in a Plane · Concept 4

Resolution of Vectors

Deconstructing vectors into planar and spatial components.

A vector **A** can be resolved into two component vectors along any two non-zero, non-collinear vectors.

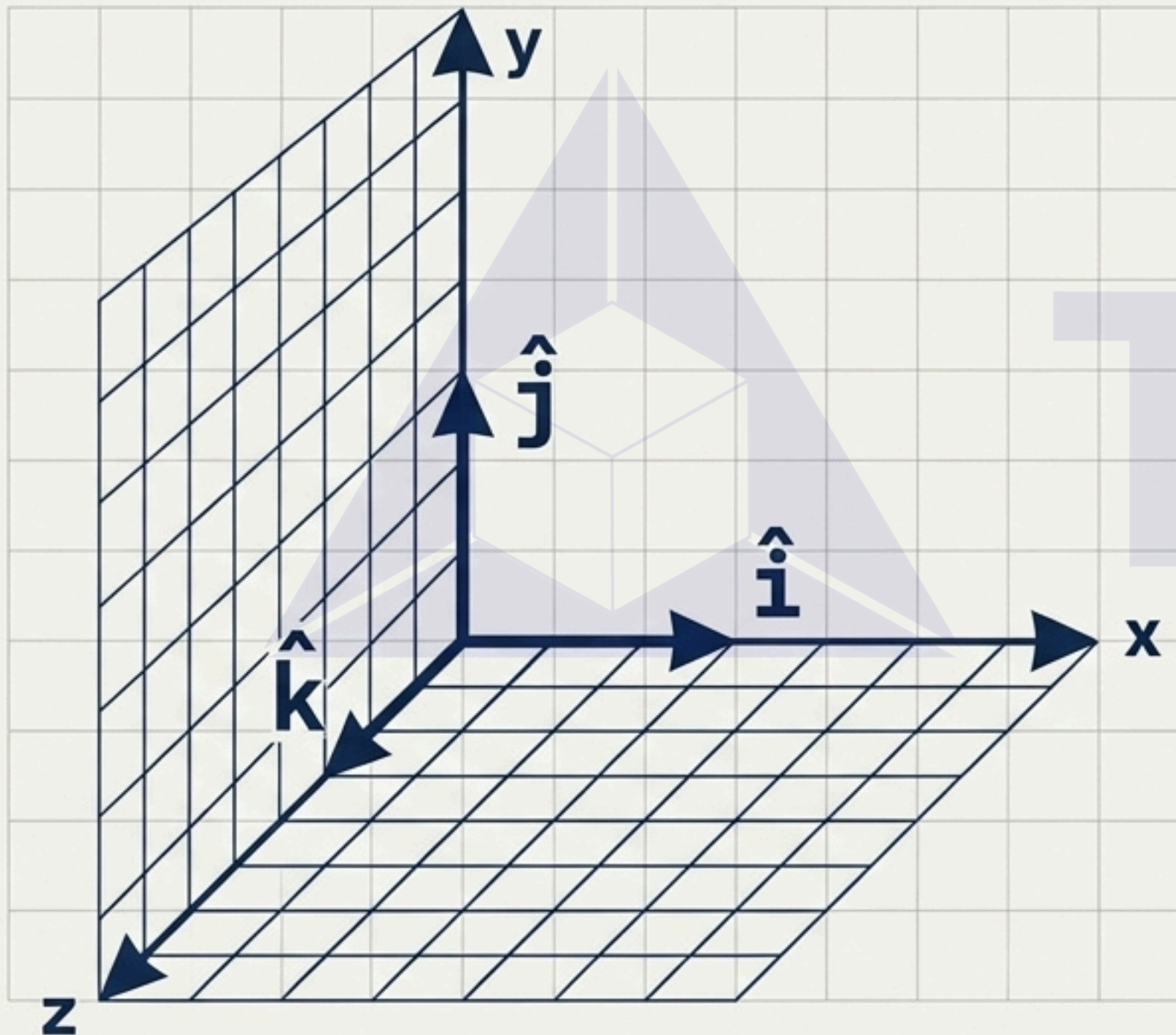


$$\mathbf{A} = \lambda \mathbf{a} + \mu \mathbf{b}$$



Where λ and μ are real numbers representing scaling factors.

Axis Legend and by definition card



Standardizing the grid:
We use unit vectors to specify direction in a rectangular coordinate system.

A unit vector has a magnitude of exactly 1, carries no dimensions, and defines direction only.

$$|\hat{\mathbf{i}}| = |\hat{\mathbf{j}}| = |\hat{\mathbf{k}}| = 1$$

General form:

$$\mathbf{A} = |\mathbf{A}| \hat{\mathbf{n}}$$

(where $\hat{\mathbf{n}}$ is a unit vector along $\mathbf{A}$)



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$$E=mc^2$$



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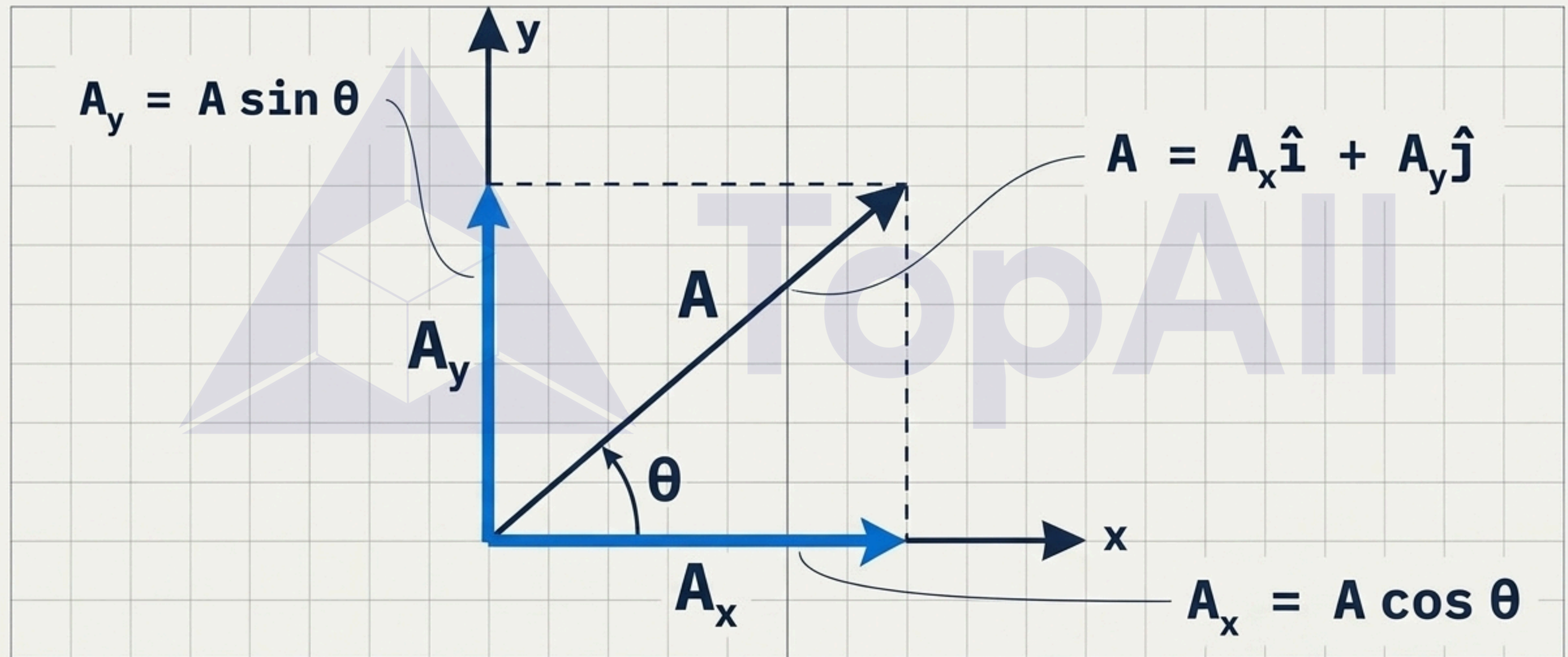
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Resolving a vector means finding its shadows along the perpendicular axes using basic trigonometry.



Reconstructing the Vector

If the scalar components are known, the original vector's magnitude and angle can be determined using the Pythagorean theorem and trigonometry.



Magnitude

$$A = \sqrt{(A_x^2 + A_y^2)}$$

Direction

$$\tan \theta = A_y / A_x$$



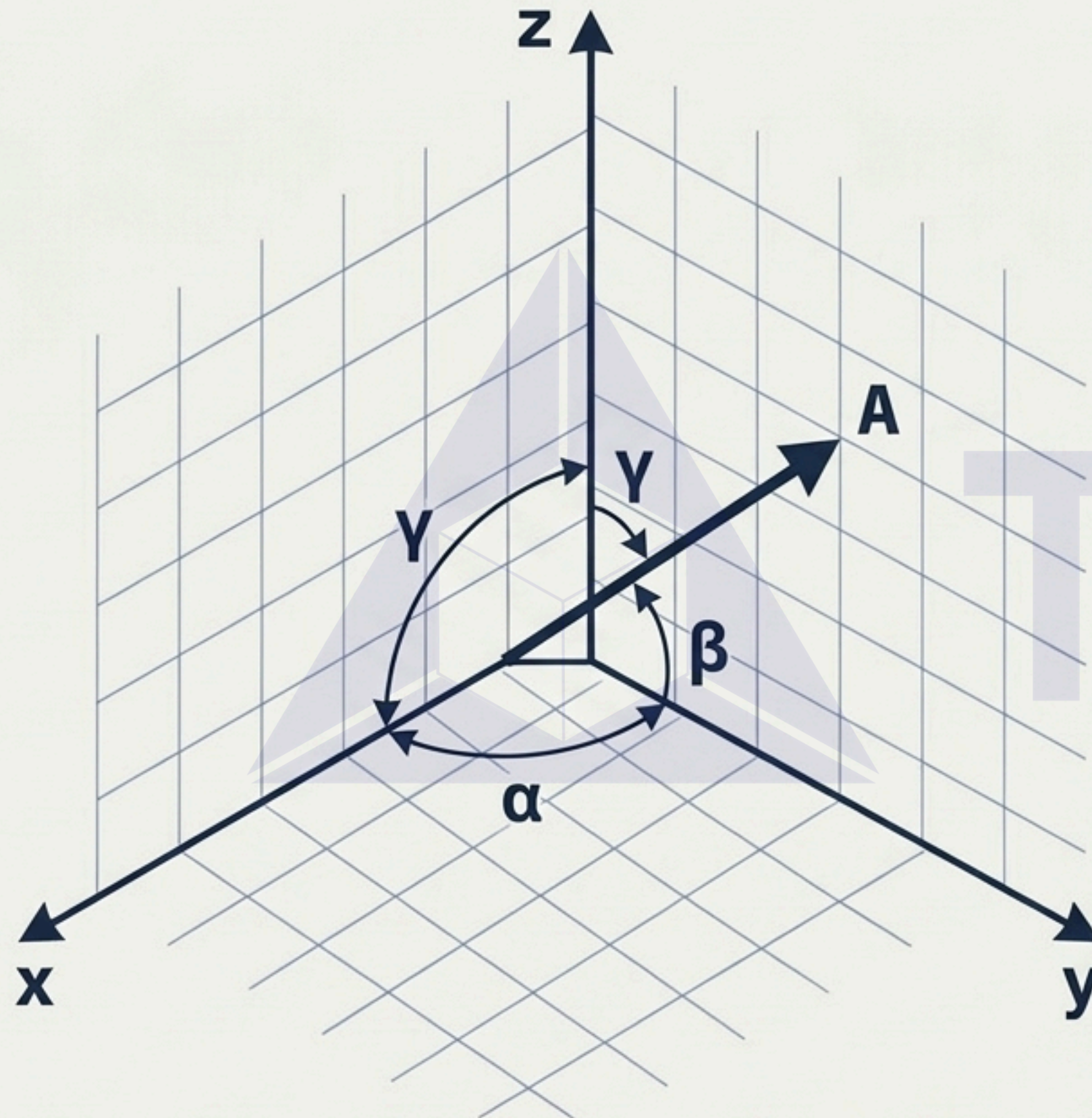
TRAP: Confusing components
with component vectors.



A_x is itself NOT
a vector.

$$A_x \hat{i}$$

Only $A_x \hat{i}$ (with the
unit vector attached)
is a vector.



Extending to 3D Space.

The angles α , β , and γ are angles in space between pairs of lines, not coplanar angles. The position vector $\mathbf{r}$ specifies a point in this 3D grid.

Components:

$$A_x = A \cos \alpha \mid A_y = A \cos \beta \mid A_z = A \cos \gamma$$

Vector:

$$\mathbf{A} = A_x \hat{\mathbf{i}} + A_y \hat{\mathbf{j}} + A_z \hat{\mathbf{k}}$$

Magnitude:

$$A = \sqrt{A_x^2 + A_y^2 + A_z^2}$$

Position Vector:

$$\mathbf{r} = x \hat{\mathbf{i}} + y \hat{\mathbf{j}} + z \hat{\mathbf{k}}$$

Key Takeaways: Resolution of Vectors



Any planar vector can be resolved along perpendicular axes using trigonometric projections.

$$A_x = A \cos \theta, A_y = A \sin \theta$$



Components are plain numbers (scalars). Only component VECTORS carry the unit vector.

$$\mathbf{A} = A_x \hat{i} + A_y \hat{j} (+ A_z \hat{k})$$



Vector magnitude is always reconstructed using the Pythagorean sum of its orthogonal scalar components.

$$A = \sqrt{A_x^2 + A_y^2}$$



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