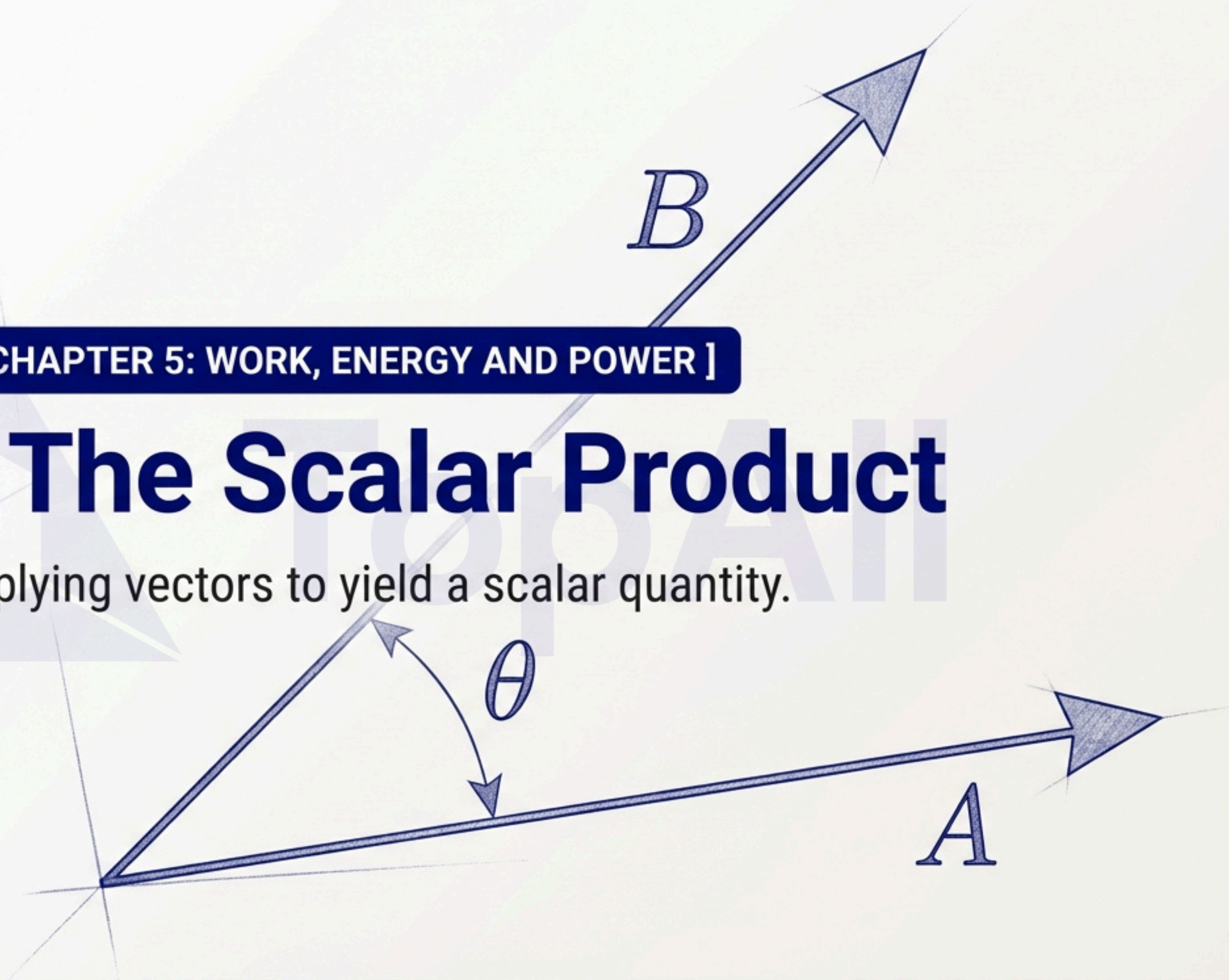


[CHAPTER 5: WORK, ENERGY AND POWER]

5.1.1 The Scalar Product

Multiplying vectors to yield a scalar quantity.



Multiplying Vectors

Scalar Product (Dot Product)

Yields a SCALAR

- Calculates quantities with magnitude but no direction (e.g., $\text{Work} = \text{Force} \times \text{Displacement}$).

Vector Product (Cross Product)

Yields a VECTOR

- Calculates quantities with magnitude and direction (Covered in Chapter 6).

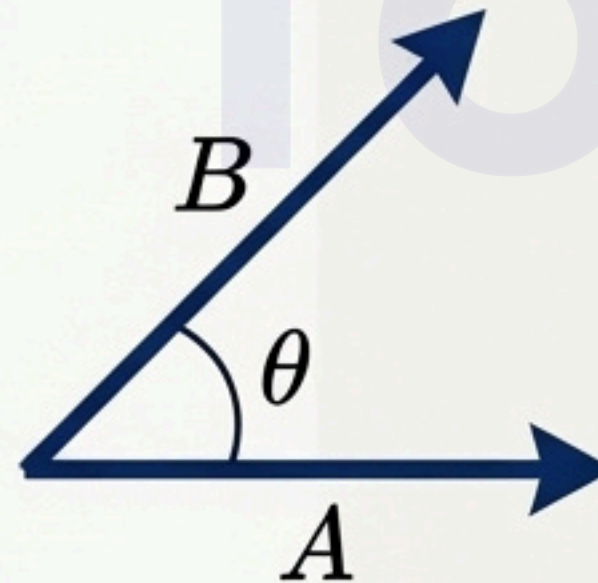
[ALGEBRAIC DEFINITION]

$$A \cdot B = AB \cos \theta$$

The Dot Product

Magnitudes of the vectors
(always positive scalars)

Directional alignment factor
(θ is the angle between vectors)



RESULT IS ALWAYS A SCALAR (No Direction)



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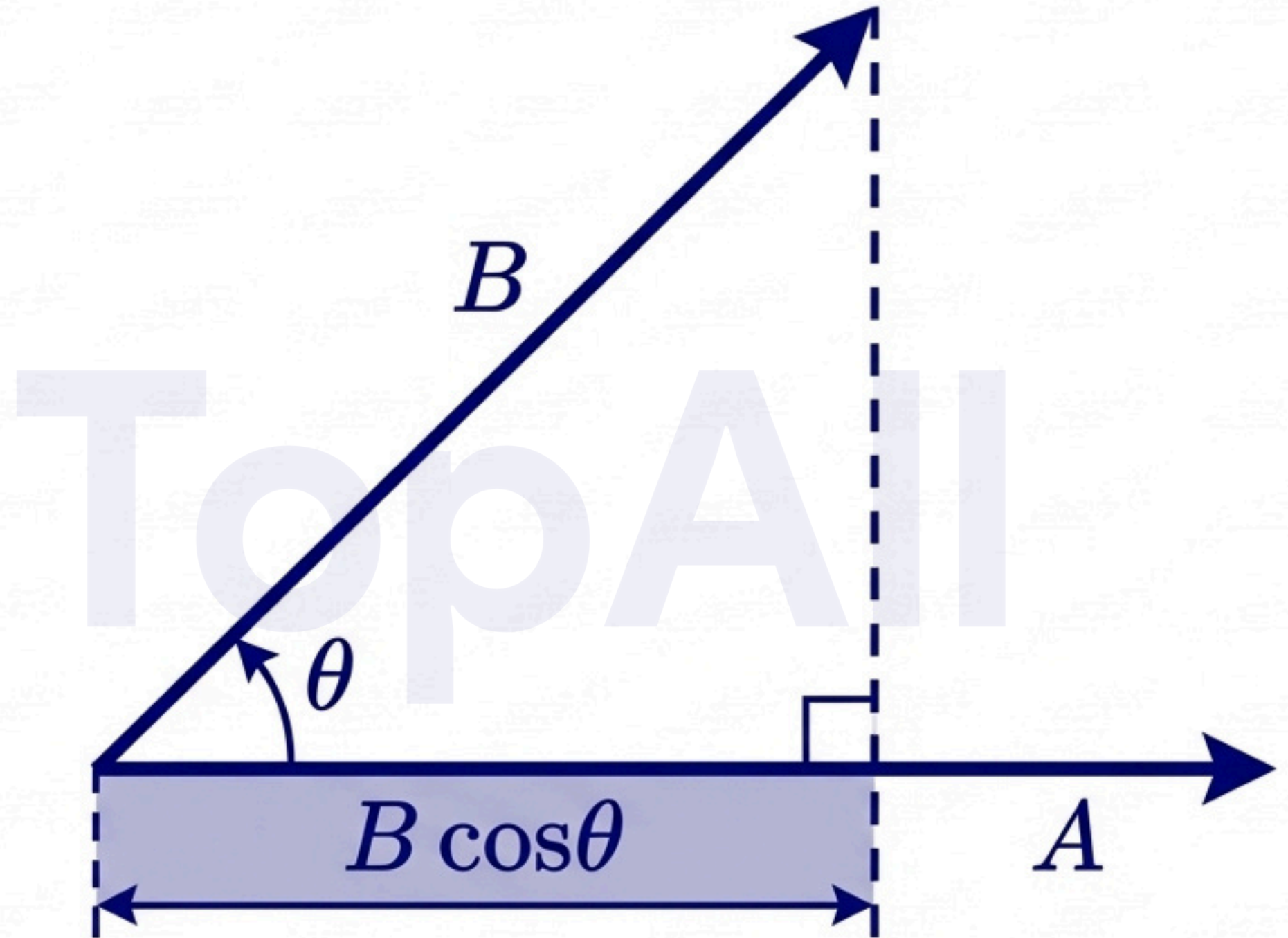


[GEOMETRIC INTUITION]

Projection of B on A

$B \cos\theta$ is the “shadow” or projection of B along the direction of A. The scalar product is the magnitude of A multiplied by the component of B that aligns with A.

$$A \cdot B = A (B \cos\theta)$$



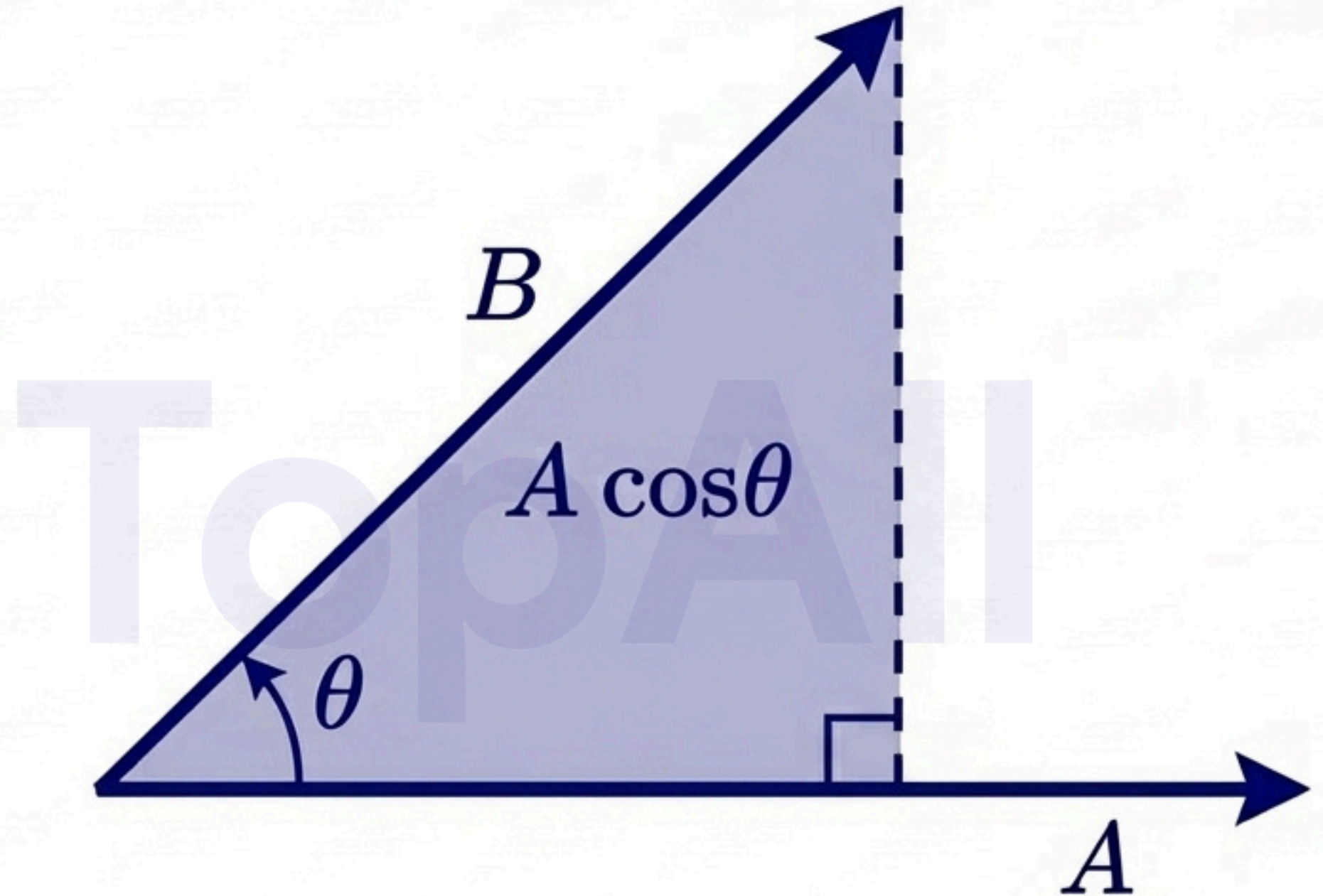
[SYMMETRY]

Projection of A on B

Alternatively, the product is the magnitude of B multiplied by the component of A along B. The resulting area/value is identical.

$$A \cdot B = B (A \cos \theta)$$

[COMMUTATIVE
PROPERTY PROVEN]



Key Takeaways: The Scalar Product

✓ Core Formula

$$A \cdot B = AB \cos \theta$$

✓ Commutative Law

$$A \cdot B = B \cdot A \text{ (Order does not matter).}$$

✓ Distributive Law

$$A \cdot (B + C) = A \cdot B + A \cdot C \text{ (Expands like standard algebra).}$$

✓ Orthogonal Condition

$$\text{If } A \perp B \text{ } (\theta = 90^\circ), \text{ then } A \cdot B = 0. \\ \text{(Crucial for finding perpendicular vectors).}$$



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