

# VECTORS

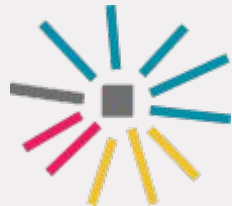
PALIMPSEST

# VECTORS

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- Definition
- Vector Addition
- Dot Product
- Distance Formula
- EXERCISE
- Matrices

# VECTORS



# What are they?

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Not this guy.





Hi, Vector.

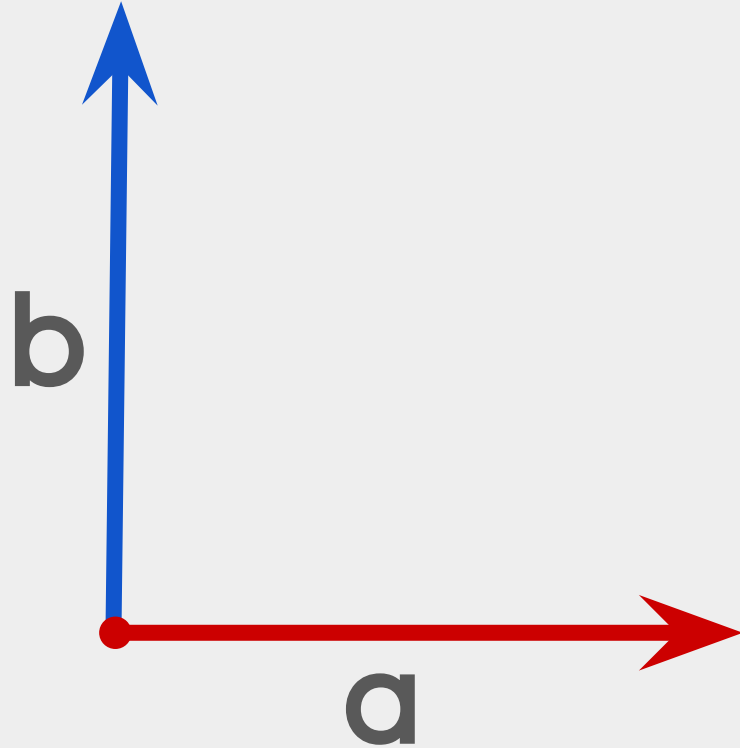
**Vectors have:**

**Magnitude**

**Direction**

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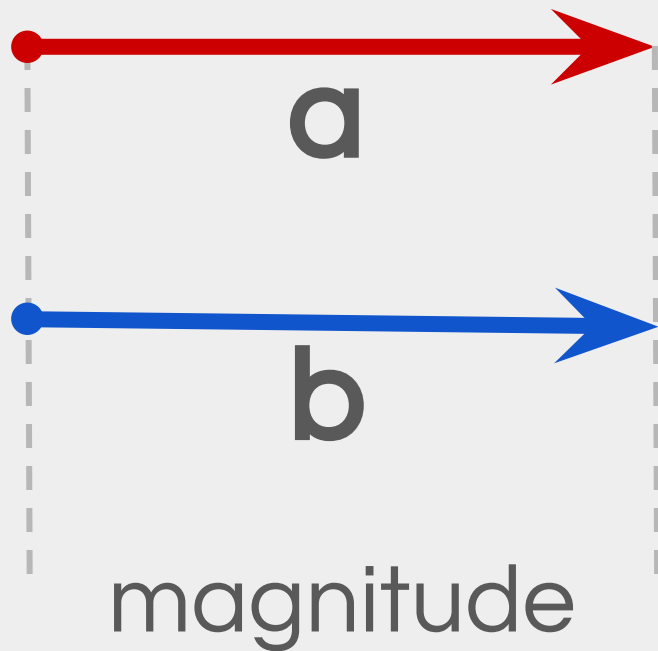
# VECTOR DIRECTION



Vector **a** Right

Vector **b** Up

# VECTOR MAGNITUDE



Vector

**a**

Vector

**b**

# ADDING VECTORS

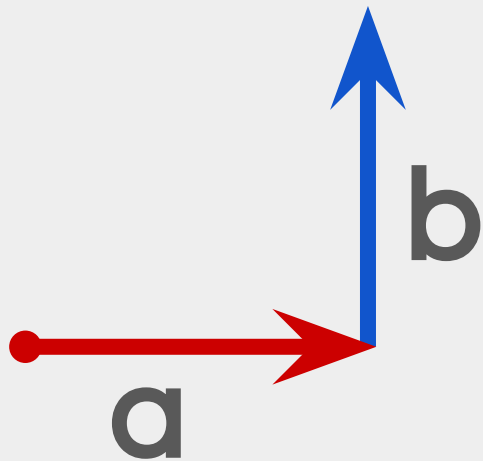


The diagram illustrates the addition of two variables. It consists of four colored boxes arranged horizontally: a red box containing the variable 'a', a light gray box containing a yellow plus sign '+', a blue box containing the variable 'b', and a light gray box containing a yellow equals sign '='. This visualizes the expression  $a + b$ .

The diagram illustrates the addition of two vectors. On the left, a red vector labeled 'a' points horizontally to the right. To its right is a plus sign '+'. Next is a blue vector labeled 'b' pointing vertically upwards. To the right of vector 'b' is an equals sign '='.

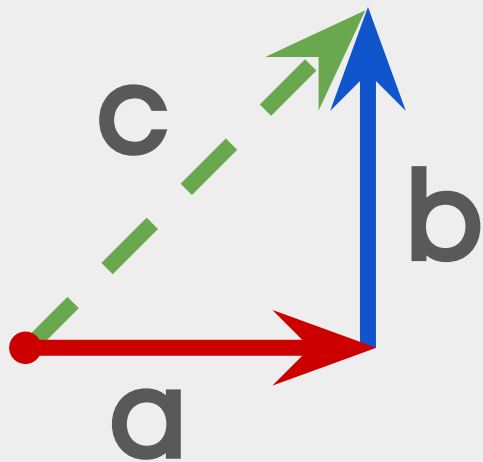
# ADDING VECTORS

$$\boxed{a} + \boxed{b} =$$



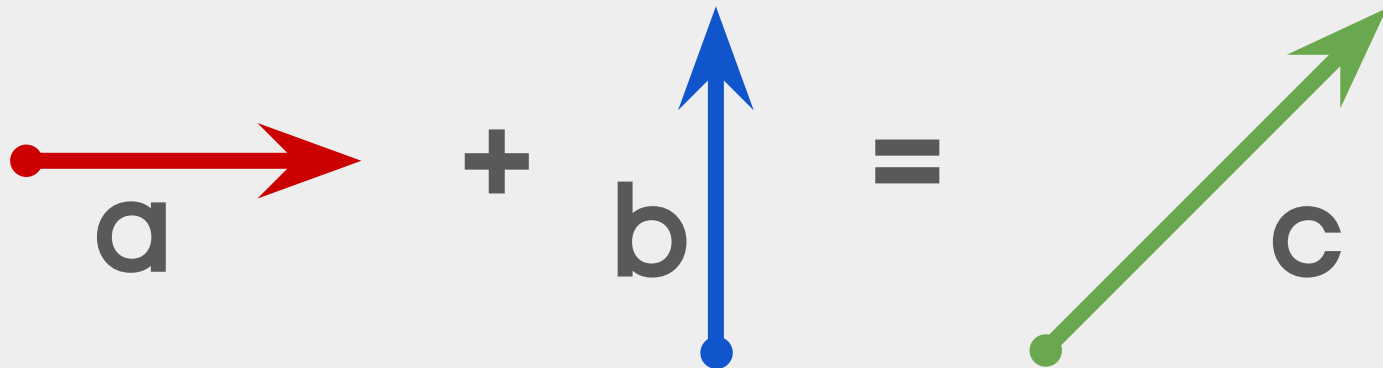
# ADDING VECTORS

$$\boxed{a} + \boxed{b} = \boxed{c}$$



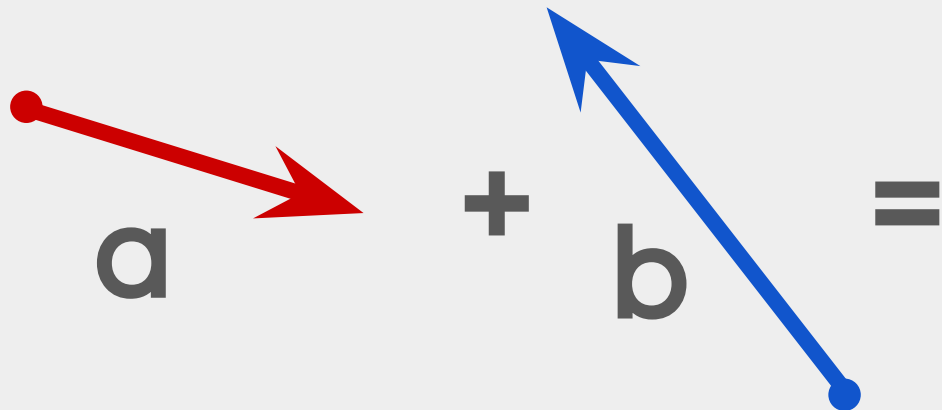
# ADDING VECTORS

$$\boxed{a} + \boxed{b} = \boxed{c}$$



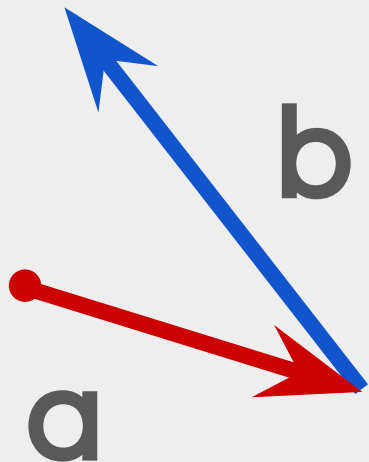
# ADDING VECTORS

$$\boxed{a} + \boxed{b} =$$



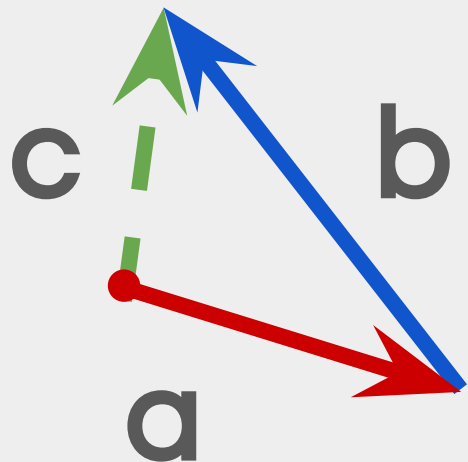
# ADDING VECTORS

$$\boxed{a} + \boxed{b} =$$



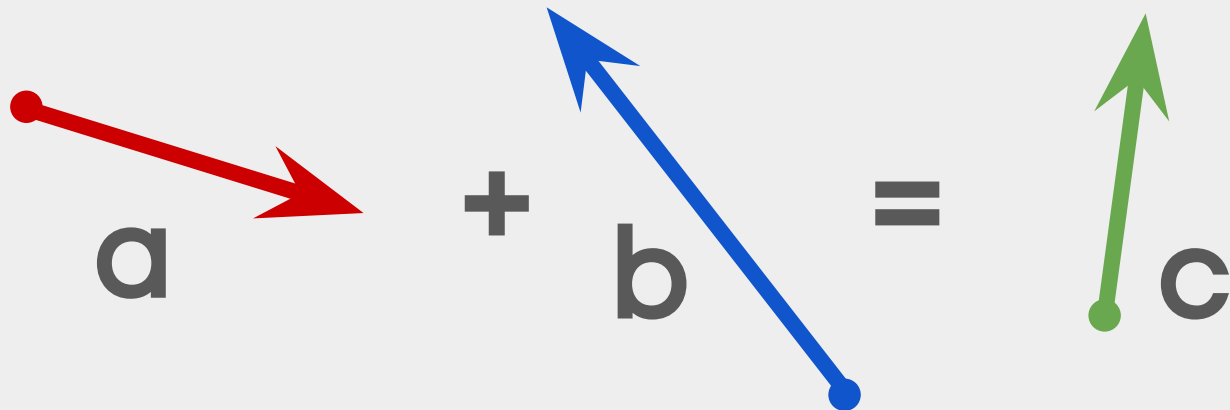
# ADDING VECTORS

$$\boxed{a} + \boxed{b} = \boxed{c}$$



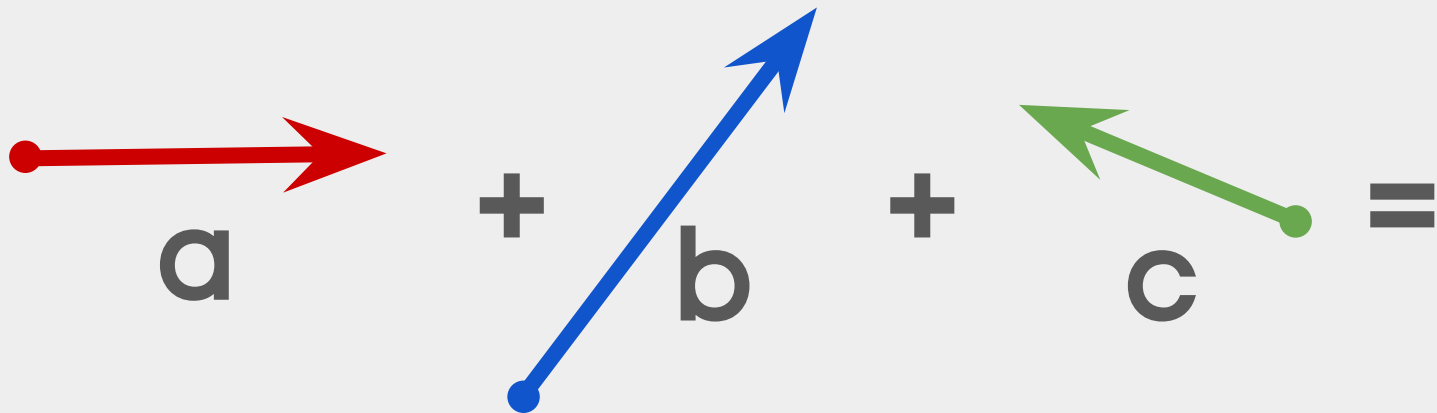
# ADDING VECTORS

$$\boxed{a} + \boxed{b} = \boxed{c}$$



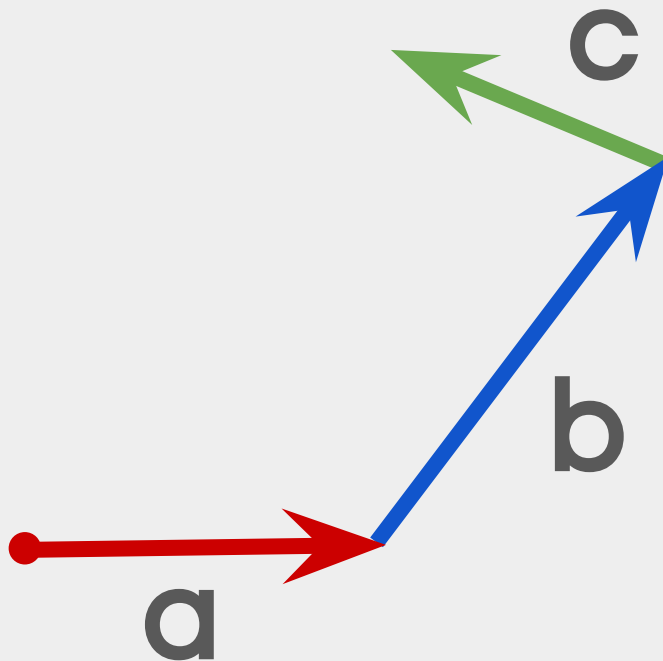
# ADDING VECTORS

$$\boxed{a} + \boxed{b} + \boxed{c} =$$

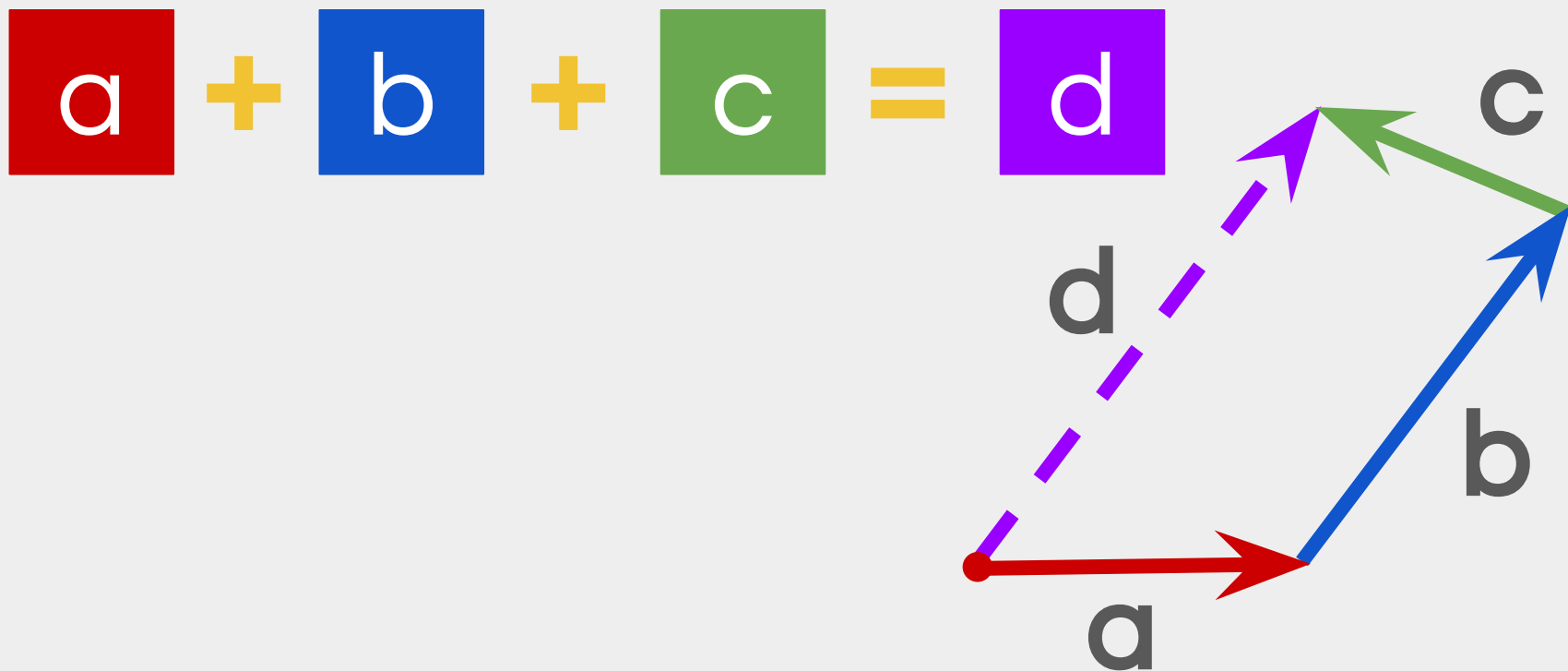


# ADDING VECTORS

$$\boxed{a} + \boxed{b} + \boxed{c} =$$

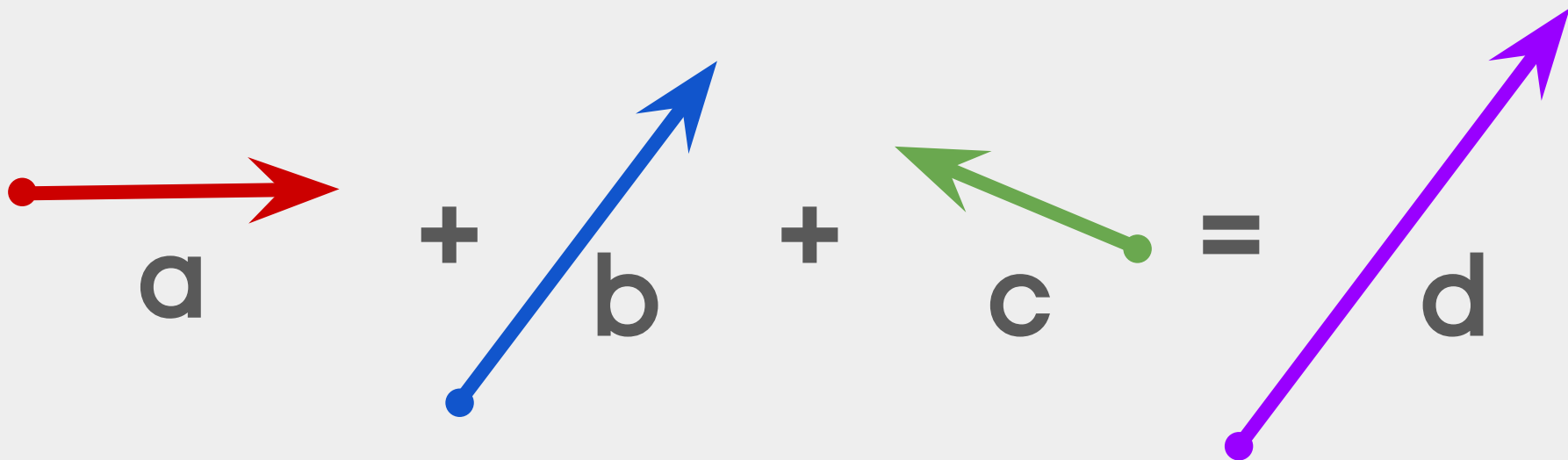


# ADDING VECTORS



# ADDING VECTORS

$$\boxed{a} + \boxed{b} + \boxed{c} = \boxed{d}$$

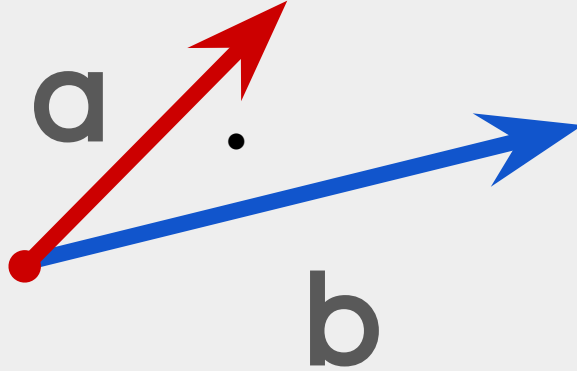


A vector can be anywhere

# DOT PRODUCT

Dot Product shows how vectors overlap.

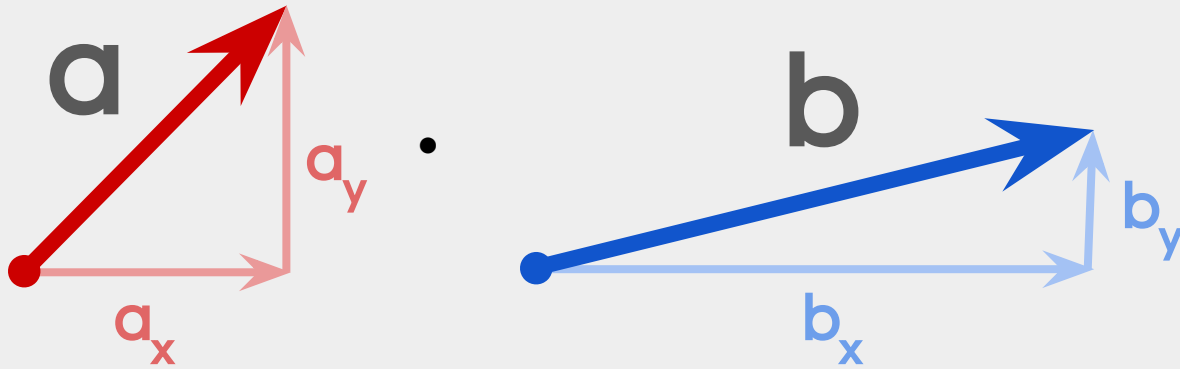
Break each vector into its X and Y components.

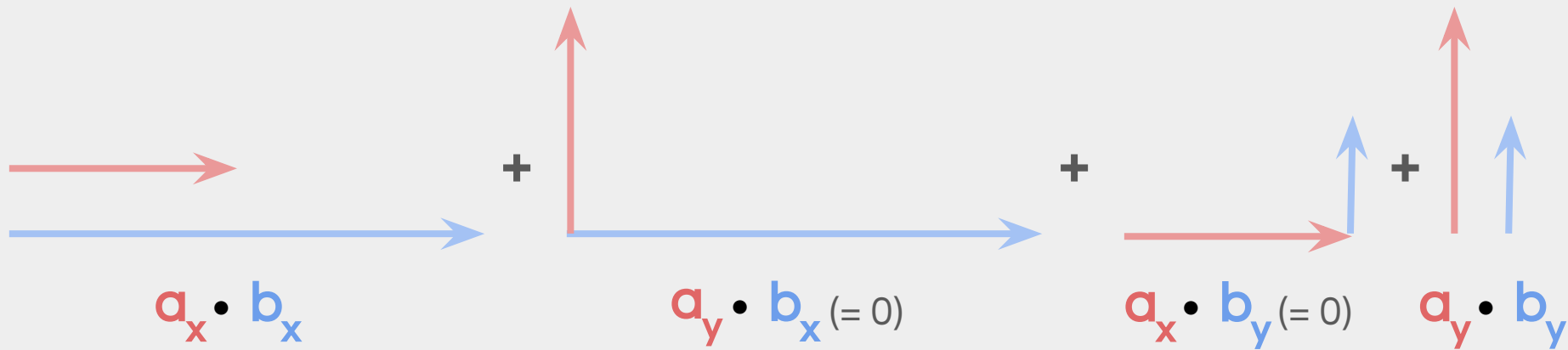
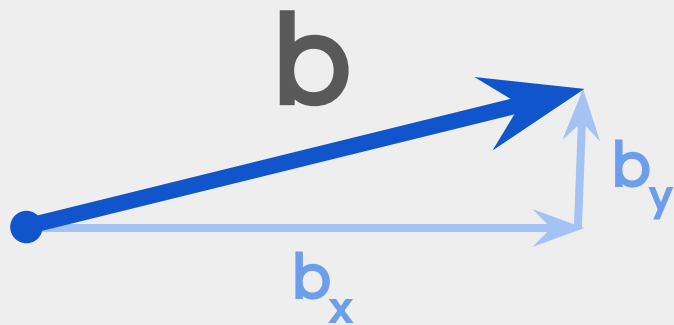
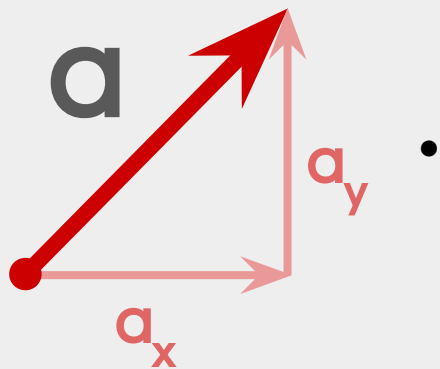


# DOT PRODUCT

Dot Product shows how vectors overlap.

Break each vector into its X and Y components.





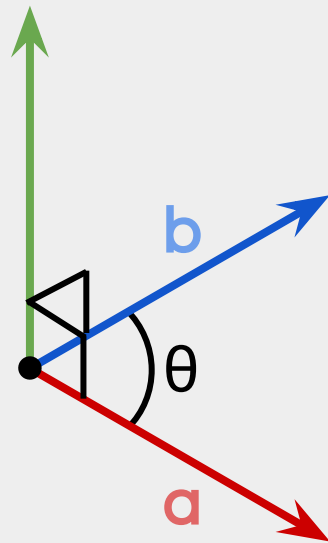
$$a_x \cdot b_x + a_y \cdot b_y$$

# CROSS PRODUCT

The vectors **a** and **b**  
together define a plane.

To find a vector parallel to both **a** and **b**...

(otherwise known as ... ?)

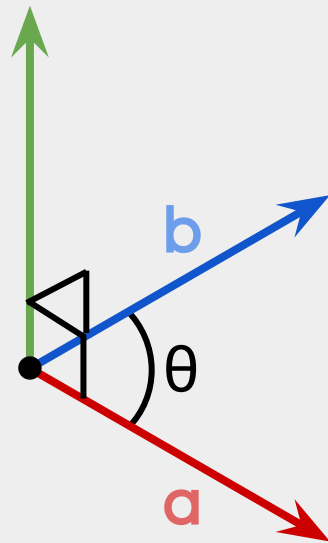


# CROSS PRODUCT

The vectors **a** and **b**  
together define a plane.

To find a vector parallel to both **a** and **b**...

(otherwise known as the 3rd Dimension)

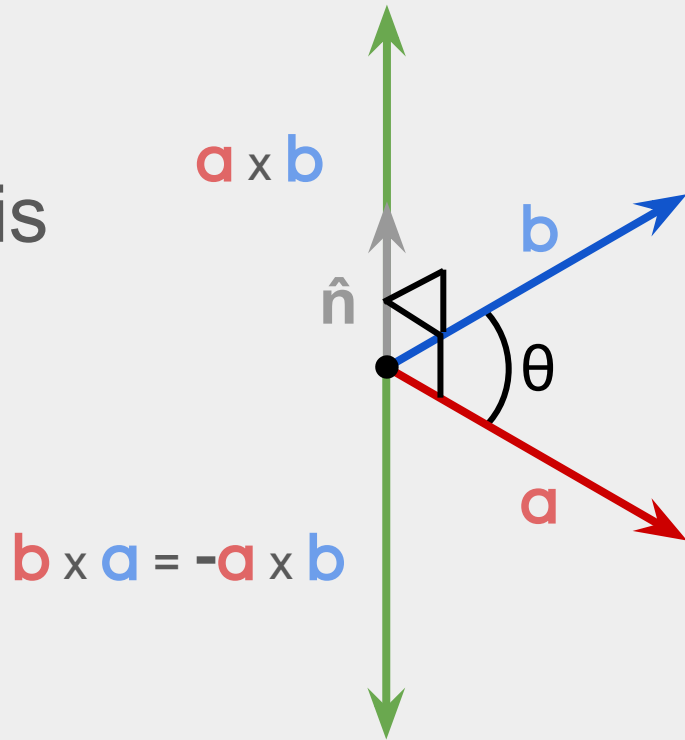


# CROSS PRODUCT

Use the cross product.

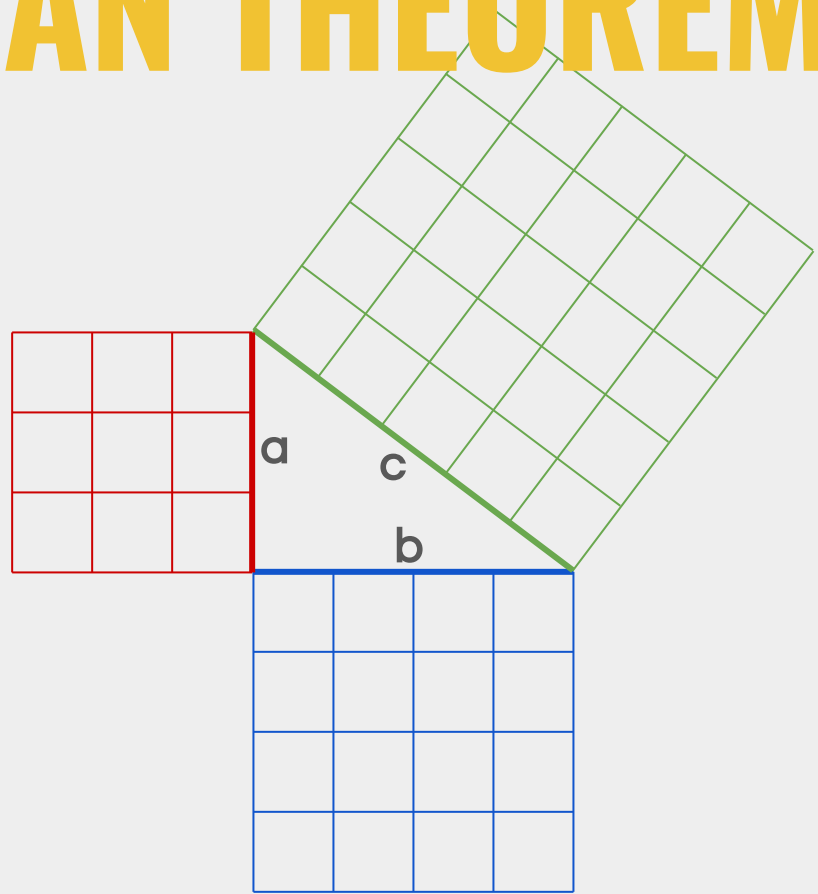
This gets the vector that is perpendicular to both vectors.

The  $\hat{n}$  vector is called the normal.



# PYTHAGOREAN THEOREM

$$a^2 + b^2 = c^2$$



An abstract background composed of numerous overlapping triangles in various shades of orange, yellow, red, purple, and teal, creating a mosaic-like effect.

# Pythagorean Physical Proof

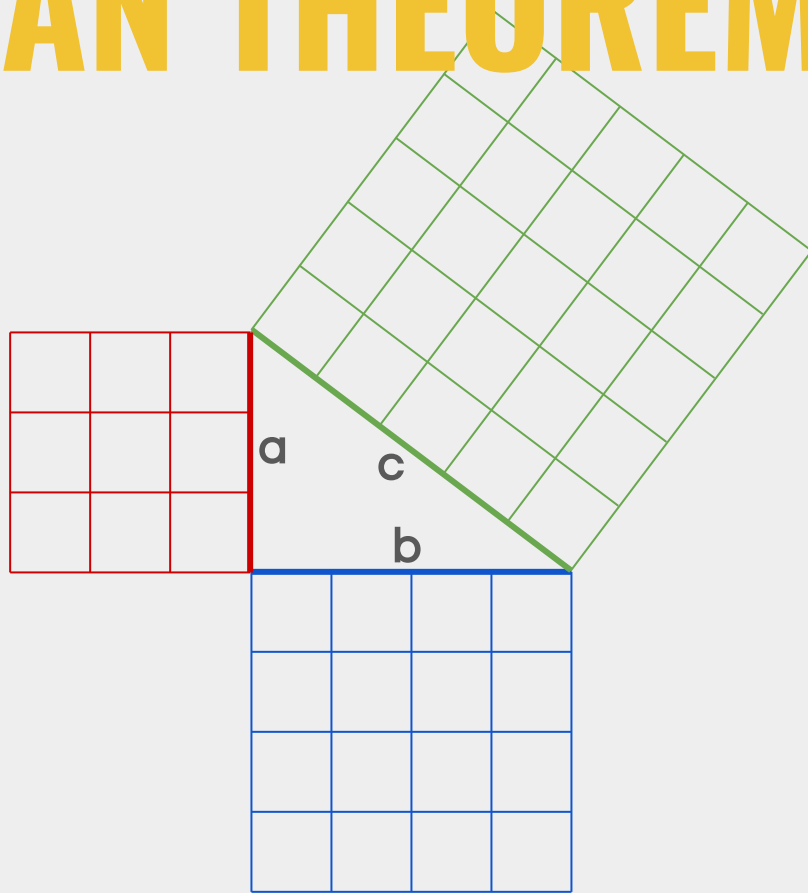
**EXERCISE**

# PYTHAGOREAN THEOREM

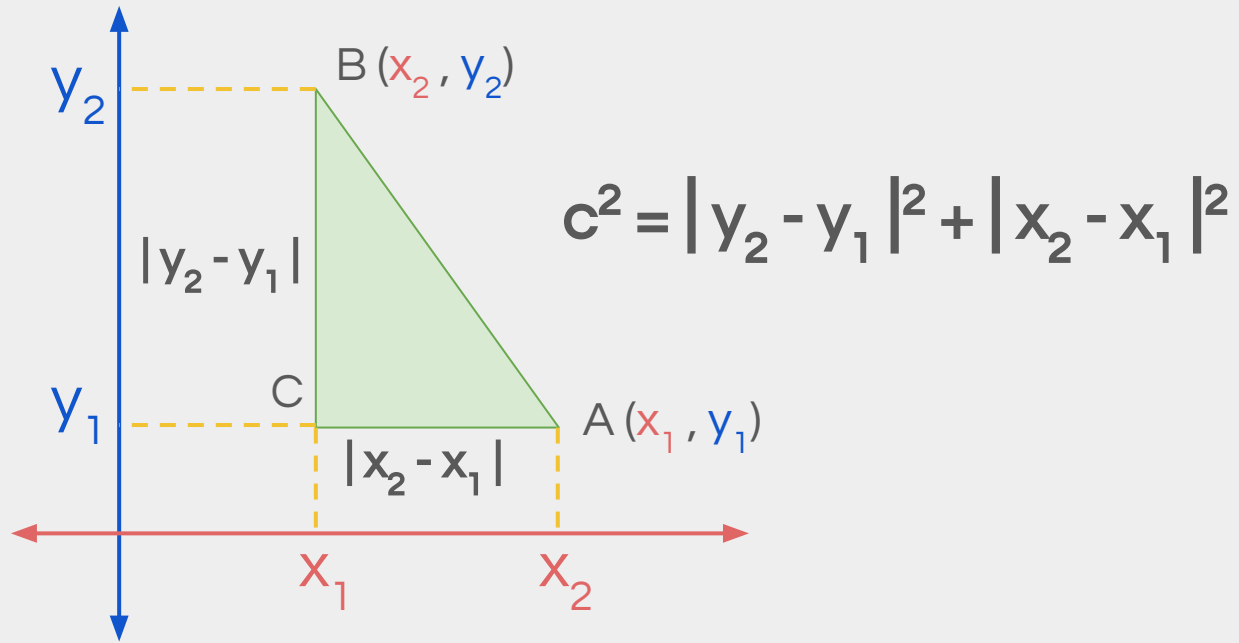
$$a^2 + b^2 = c^2$$

We can use this to  
get the distance  
between two points.

How?

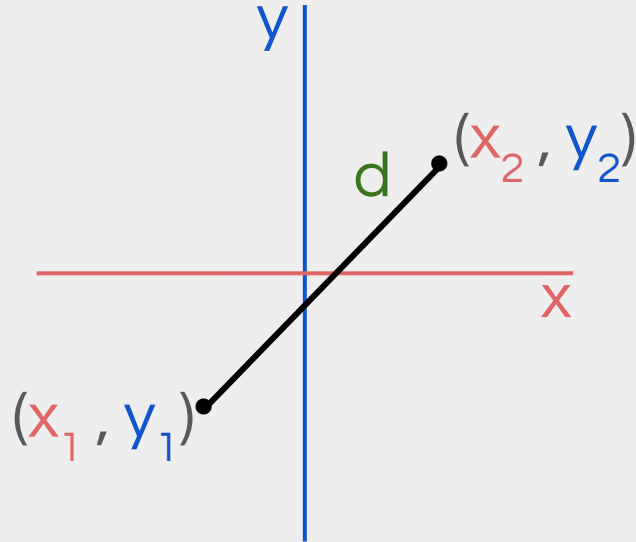


# DISTANCE FORMULA



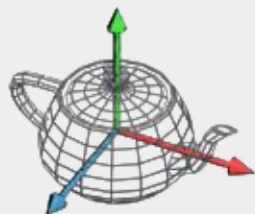
# DISTANCE FORMULA

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

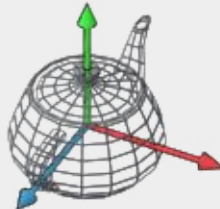


# SCALE/ROTATION/TRANSLATION

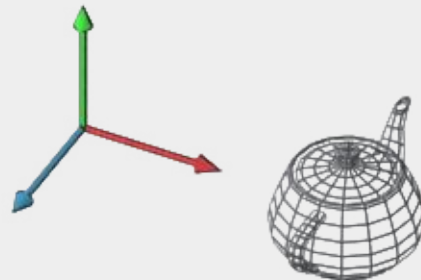
Order matters!



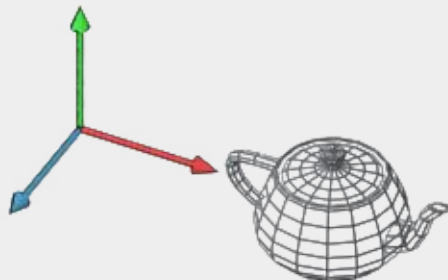
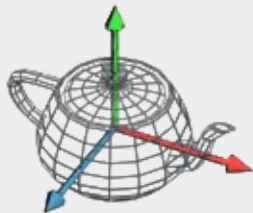
Rotation 90° around Y



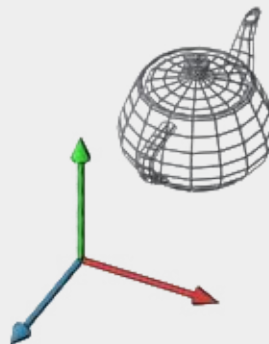
Translate along X



Translate along X



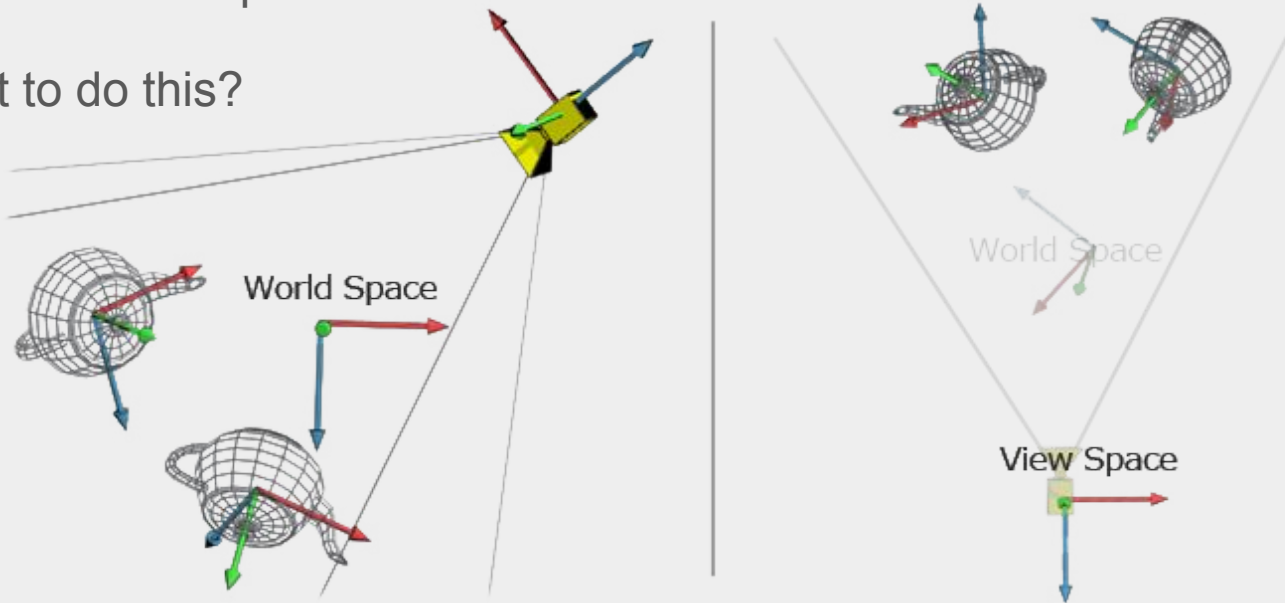
Rotation 90° around Y



# MATRICES

Matrices are a fancy way to hold multiple vectors together. If you want to take the scale, rotation, and translation (position) of an object and *transform* it from one space to another, you'd use a special *transformation matrix*.

Why might you want to do this?



The background of the slide is an abstract geometric pattern composed of numerous triangles of various sizes. The colors transition from warm tones (yellow, orange, red) on the left to cooler tones (purple, blue, green) on the right. The triangles are arranged in a way that creates a sense of depth and movement.

# Matrix Transformation

**EXERCISE**

NEXT UP

Hardware

