$$+ \qquad \times$$

$$- \qquad \div$$

VECTOR → mathematical object that encodes a length and direction

Vector in R^n

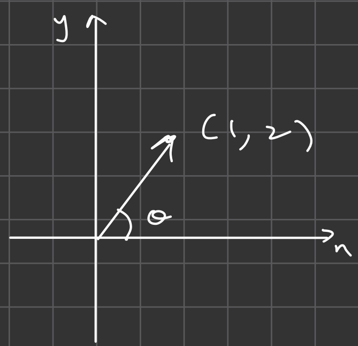
$v = [v_1, v_2 \ldots\ldots v_n] \in R^n$

if $v \in R$ (real vector of dimention n)

$$v = \begin{bmatrix} v_1 \\ v_2 \\ \vdots \\ v_n \end{bmatrix} \in R^n$$

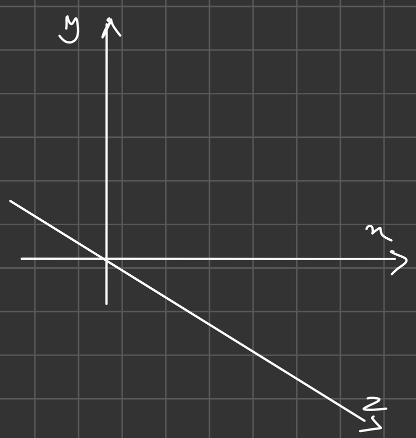
Take $n = 2$: R^2 $(R \times R)$

$v = (1, 2)$

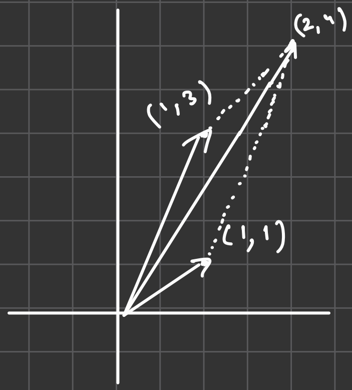


when $n = 3$ (3-D)

$v = (1, 2, 3)$



VECTOR ALGERA



Addition | Substraction

$v_1 = (1, 3)$ and $v_2 = (1, 1)$

$v_1 + v_2 = (2, 4)$ — x component of v_1 + x component of v_2; y component of v_1 + y component of v_2

Similarly

$v_1 - v_2 \; (0, 2)$

$R^n \Rightarrow \quad v_1 = (x_1, x_2 \ldots\ldots x_n)$
$\qquad\quad v_2 = (y_1, y_2 \ldots\ldots y_n)$

$v_1 \pm v_2 = (x_1 \pm y_1, x_2 \pm y_2 \ldots\ldots x_n \pm y_n)$

Dot Product

$v_1 = (x_1, x_2, \ldots\ldots x_n) \in R^n$

$v_2 = (y_1, y_2, \ldots\ldots y_n) \in R^n$

$v_1 \cdot v_2 = x_1 y_1 + x_2 y_2 + \ldots\ldots x_n y_n$

$= \sum_{i=1}^{n} x_i y_i$

Ex: In R^3, $v_1 = (1, 1, -1)$
$v_2 = (2, 3, 1)$

$v_1 \cdot v_2 = (2 + 3 - 1) = 4$

Length / Magnitude

$\vec{v} = (x_1, x_2, \ldots\ldots x_n)$

$|\vec{v}| = v = \sqrt{\vec{v} \cdot \vec{v}} = \sqrt{x_1^2 + x_2^2 \ldots + x_n^2}$

Ex → $\vec{J} = (1, -1, 2)$

$|\vec{v}| = \sqrt{1^2 + (-1)^2 + (2)^2}$

$= \sqrt{1 + 1 + 4} = \sqrt{6}$

Angle between two vectors

Angle : $v_1, v_2 \in R^n$

$\theta = \cos^{-1}\left(\frac{v_1 \cdot v_2}{|v_1||v_2|}\right)$

Linear Combination of vectors

Consider a set $S = \{$