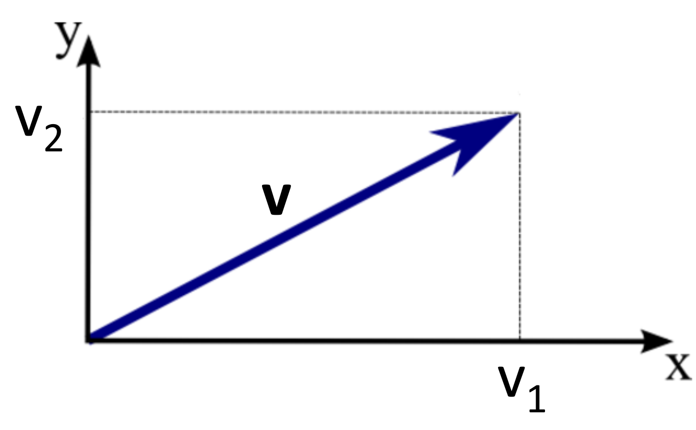
Vector

(You already learned in high school)

Vectors

$$\mathbf{v} = \begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}$$

- A vector **v** is a set of numbers
- ***Components***: the entries of a vector.
  - The i-th component of vector **v** refers to v_i
  - $v_1=1$, $v_2=2$, $v_3=3$
- If a vector only has less than four components, you can visualize it.

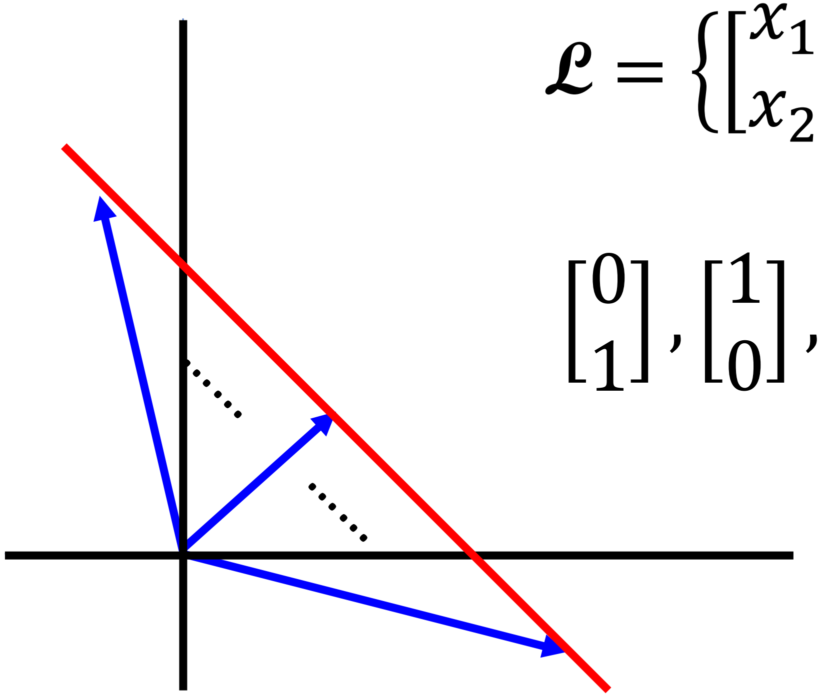


Vector Set

$$\left\{\begin{bmatrix}1\\2\\3\end{bmatrix},\begin{bmatrix}4\\5\\6\end{bmatrix},\begin{bmatrix}6\\8\\9\end{bmatrix},\begin{bmatrix}9\\0\\2\end{bmatrix}\right\}$$

A vector set with 4 elements

- A vector set can contain infinite elements

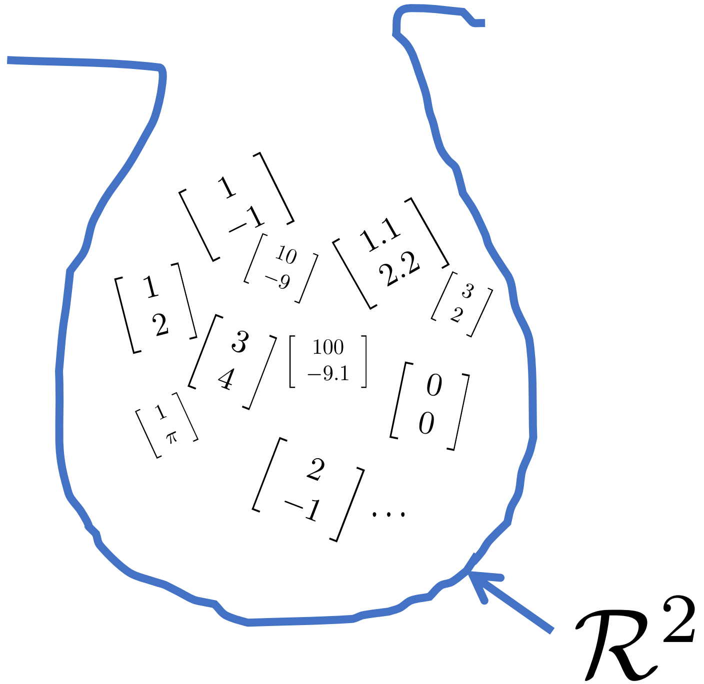


$$\mathcal{L}=\left\{\begin{bmatrix}x_1\\x_2\end{bmatrix}: x_1+x_2=1\right\}$$

$$\begin{bmatrix}0\\1\end{bmatrix},\begin{bmatrix}1\\0\end{bmatrix},\begin{bmatrix}0.3\\0.7\end{bmatrix},\begin{bmatrix}0.7\\0.3\end{bmatrix}\cdots\cdots$$

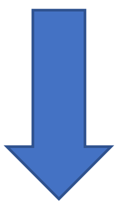
Vector Set

- $\mathcal{R}^n$:We denote the set of all **vectors** with *n* entries by $\mathcal{R}^n$

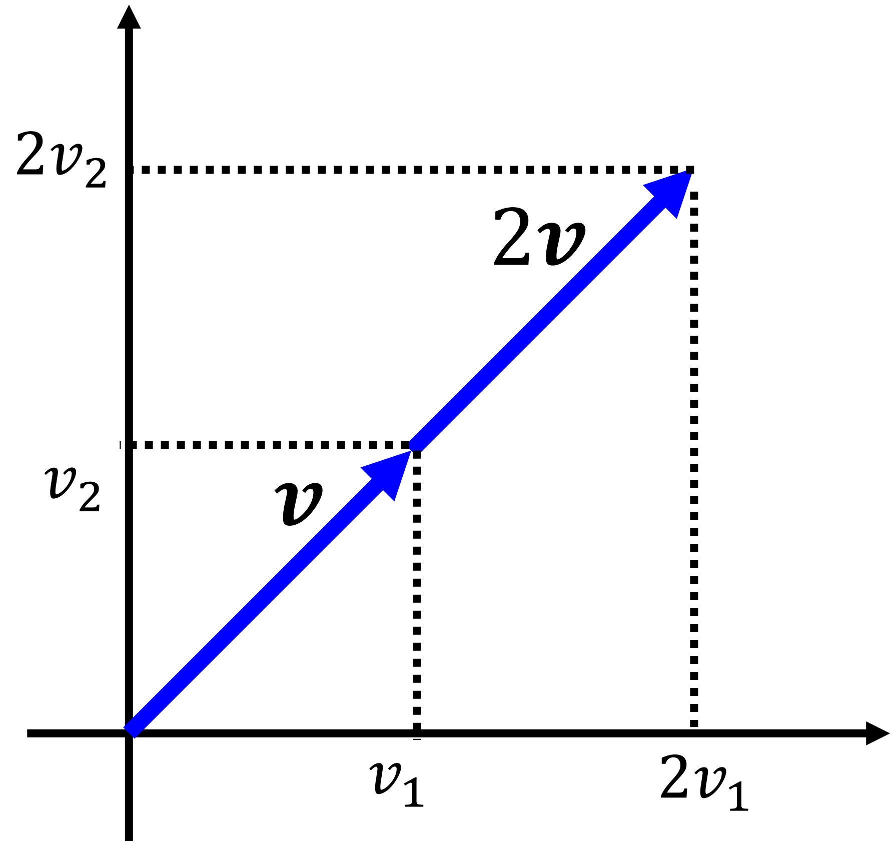


Scalar Multiplication

$$\boldsymbol{v} = \begin{bmatrix} v_1 \\ v_2 \end{bmatrix}$$

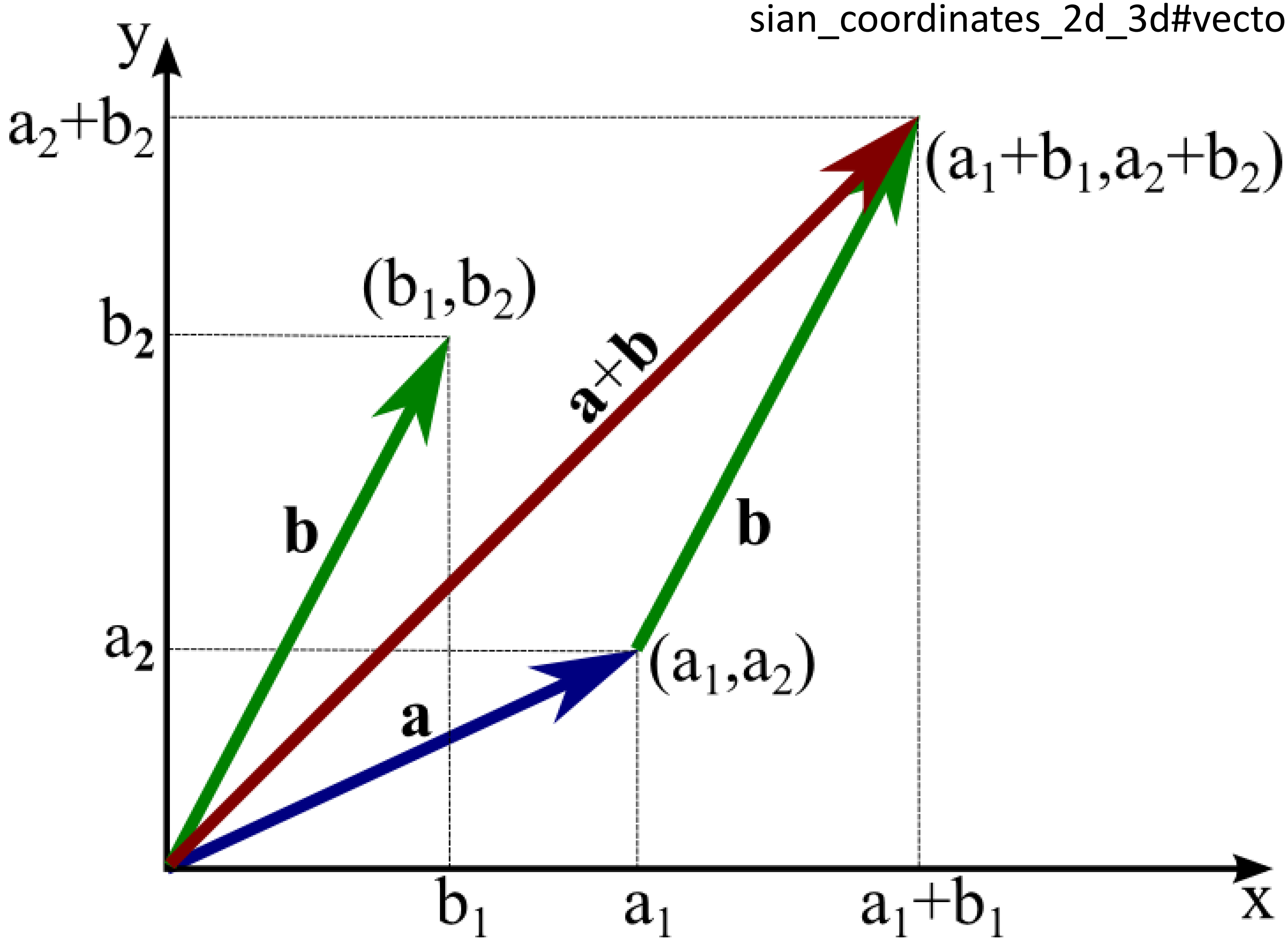


$c\boldsymbol{v}$



Vector Addition

http://mathinsight.org/vectors_cartesian_coordinates_2d_3d#vector3D



Properties of Vector

The objects have the following 8 properties are "vectors".

For any vectors **u**, **v** and **w** in $\mathscr{R}^n$, and any scalars a and b

- **u** + **v** = **v** + **u**
- (**u** + **v**) + **w** = **u** + (**v** + **w**)
- There is an element $\mathbf{0}$ in $\mathscr{R}^n$ such that $\mathbf{0}$ + **u** = **u**
- There is an element **u'** in $\mathscr{R}^n$ such that **u'** + **u** = $\mathbf{0}$

  u' = - **u**
- 1**u** = **u**
- (ab)**u** = a(b**u**)
- a(**u**+**v**) = a**u** + a**v**
- (a+b)**u** = a**u** + b**u**

$$\mathbf{0} = \begin{bmatrix} 0 \\ \vdots \\ 0 \end{bmatrix}$$ zero vector