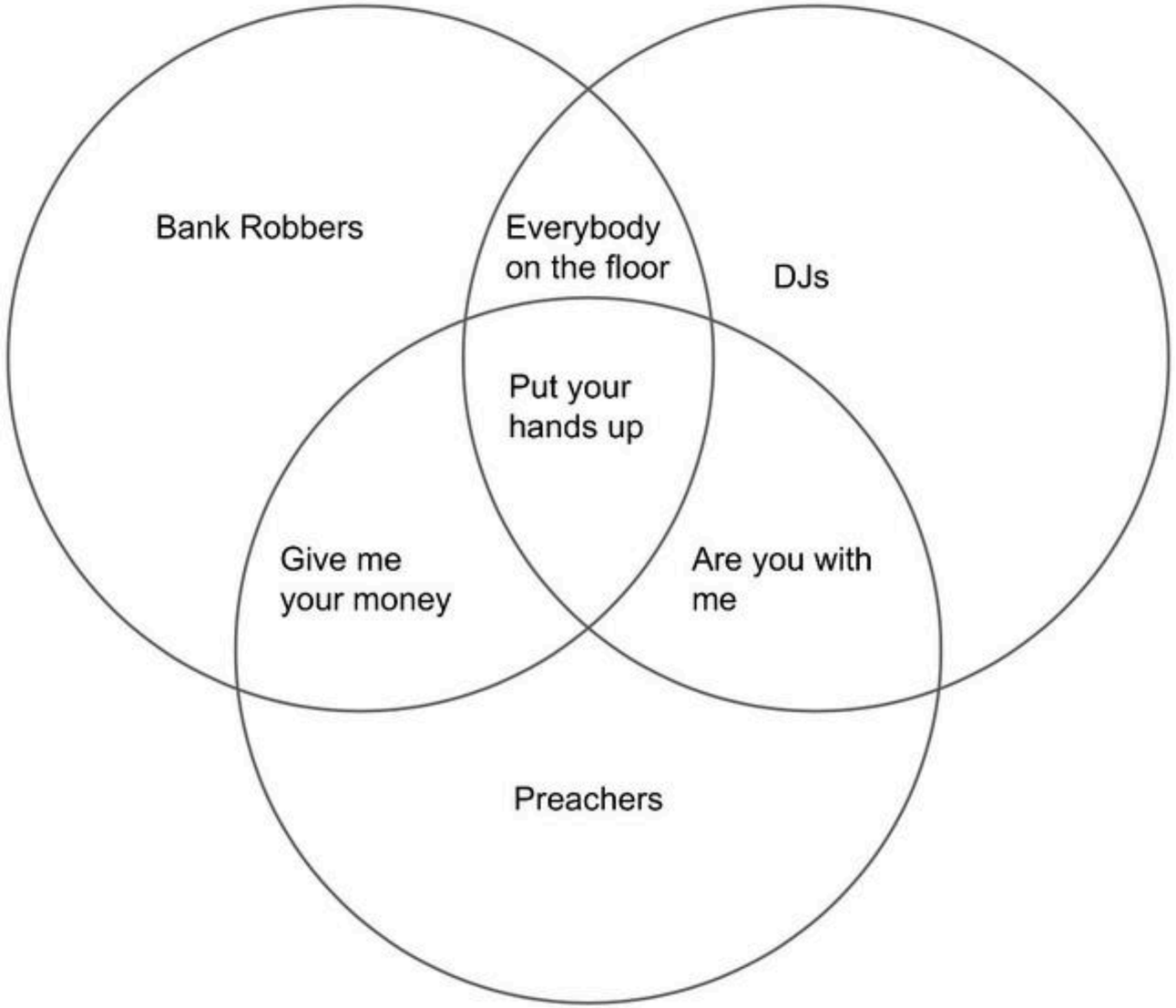
Natural Language Processing

CS 174 Section B TTh 1100-1230
CTC214

Linear Algebra Basics

CS 174 Section B TTh 1100-1230
CTC214

Sets


Bank Robbers
Everybody on the floor
DJs
Put your hands up
Give me your money
Are you with me
Preachers

Symbol	Name	Example	Explanation
$\{\}$	Set	$A = \{1,3\}$ $B = \{2,3,9\}$ $C = \{3,9\}$	Collection of objects
$\cap$	Intersect	$A \cap B = \{3\}$	Belong to both set A and set B
$\cup$	Union	$A \cup B = \{1,2,3,9\}$	Belong to set A or set B
$\subset$	Proper Subset	$\{1\} \subset A$ $C \subset B$	A set that is contained in another set
$\subseteq$	Subset	$\{1\} \subseteq A$ $\{1,3\} \subseteq A$	A set that is contained in or equal to another set
$\not\subset$	Not a Proper Subset	$\{1.3\} \not\subset A$	A set that is not contained in another set
$\supset$	Superset	$B \supset C$	Set B includes set C
$\in$	Is a member	$3 \in A$	3 is an element in set A
$\notin$	Is not a member	$4 \notin A$	4 is not an element in set A

Algebra

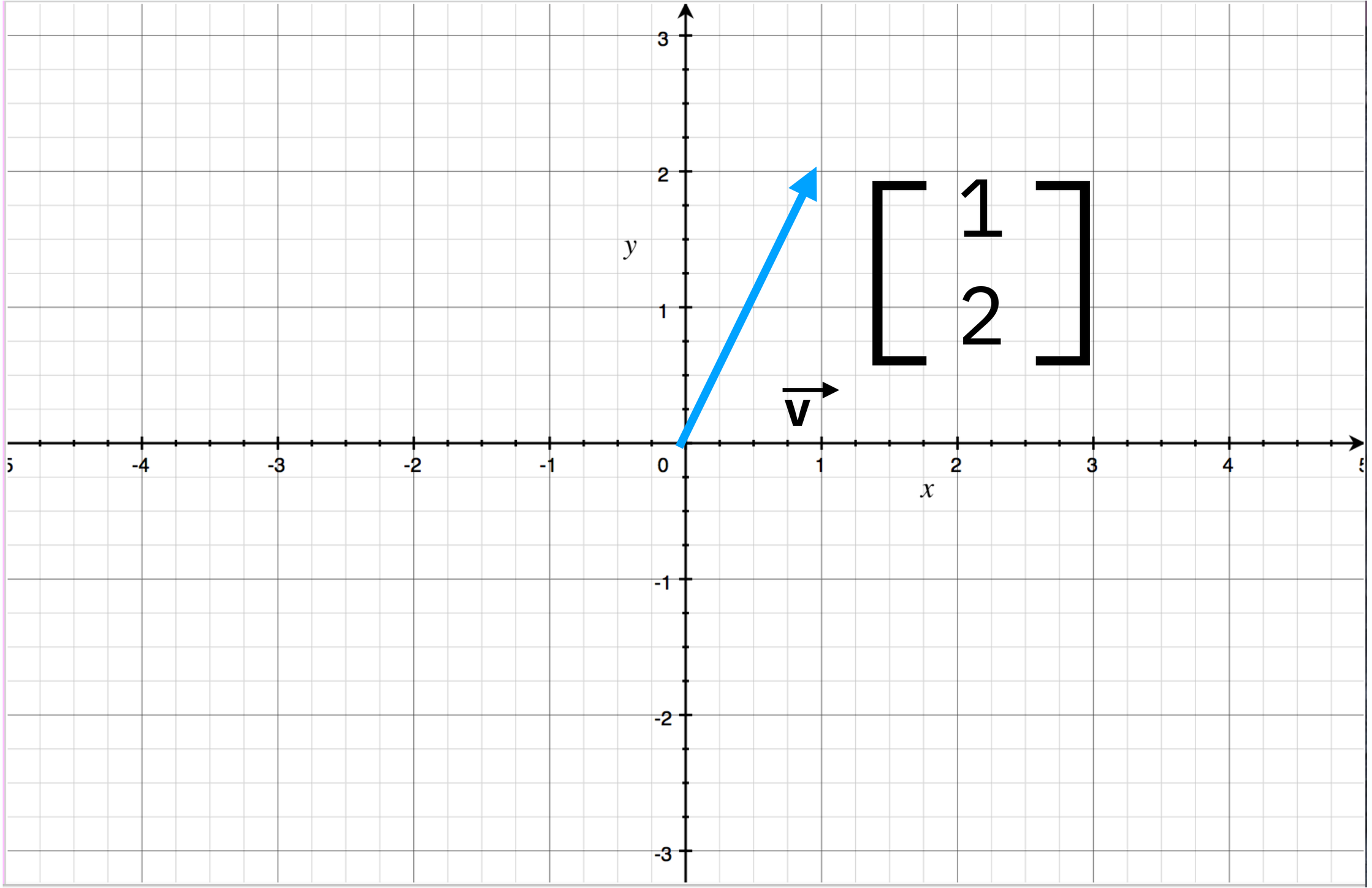
A **set** closed with operations of **multiplication, addition, and scalar multiplication** by elements of the **same set**.

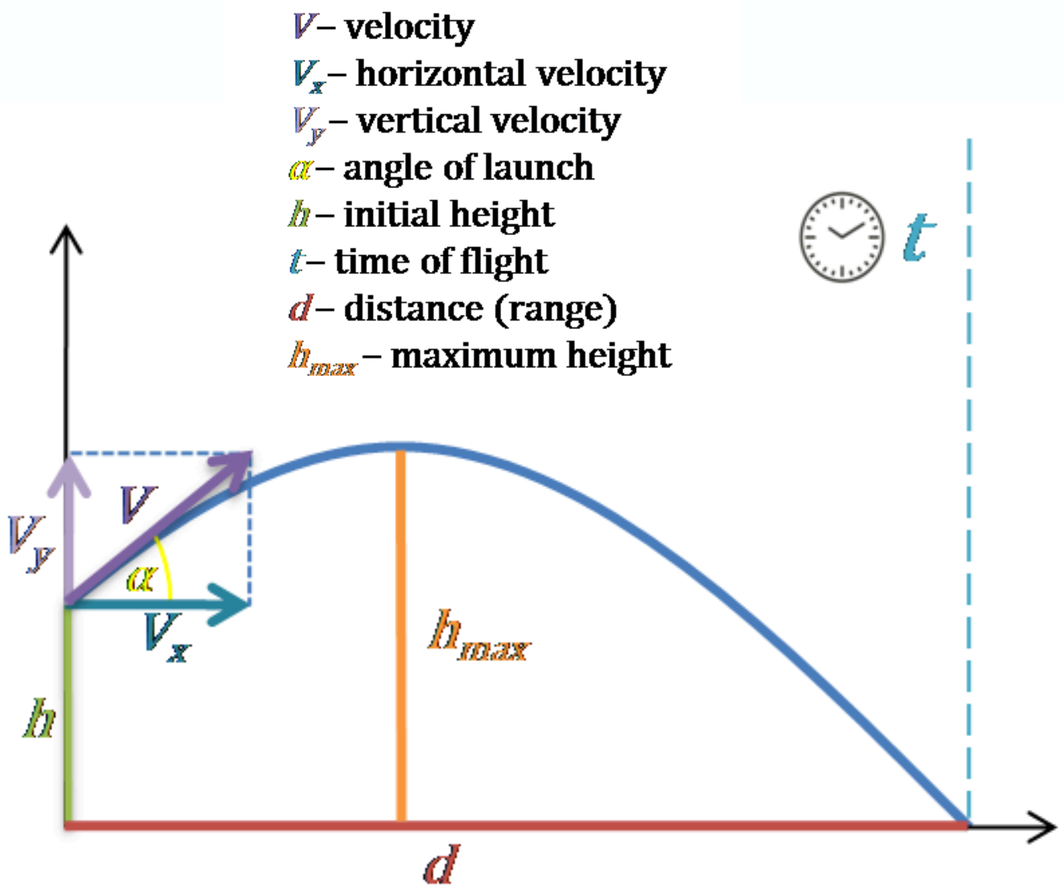
Closure

A set is **closed under an operation** if the operation on members of the set produces a **member** of the same set.

The **set of positive integers** are **closed under addition** but **not subtraction**.

Linear Algebra


3
2
1
y
-1
-2
-3
-4
-3
-2
-1
0
1
2
3
4
x
v
[1]
[2]

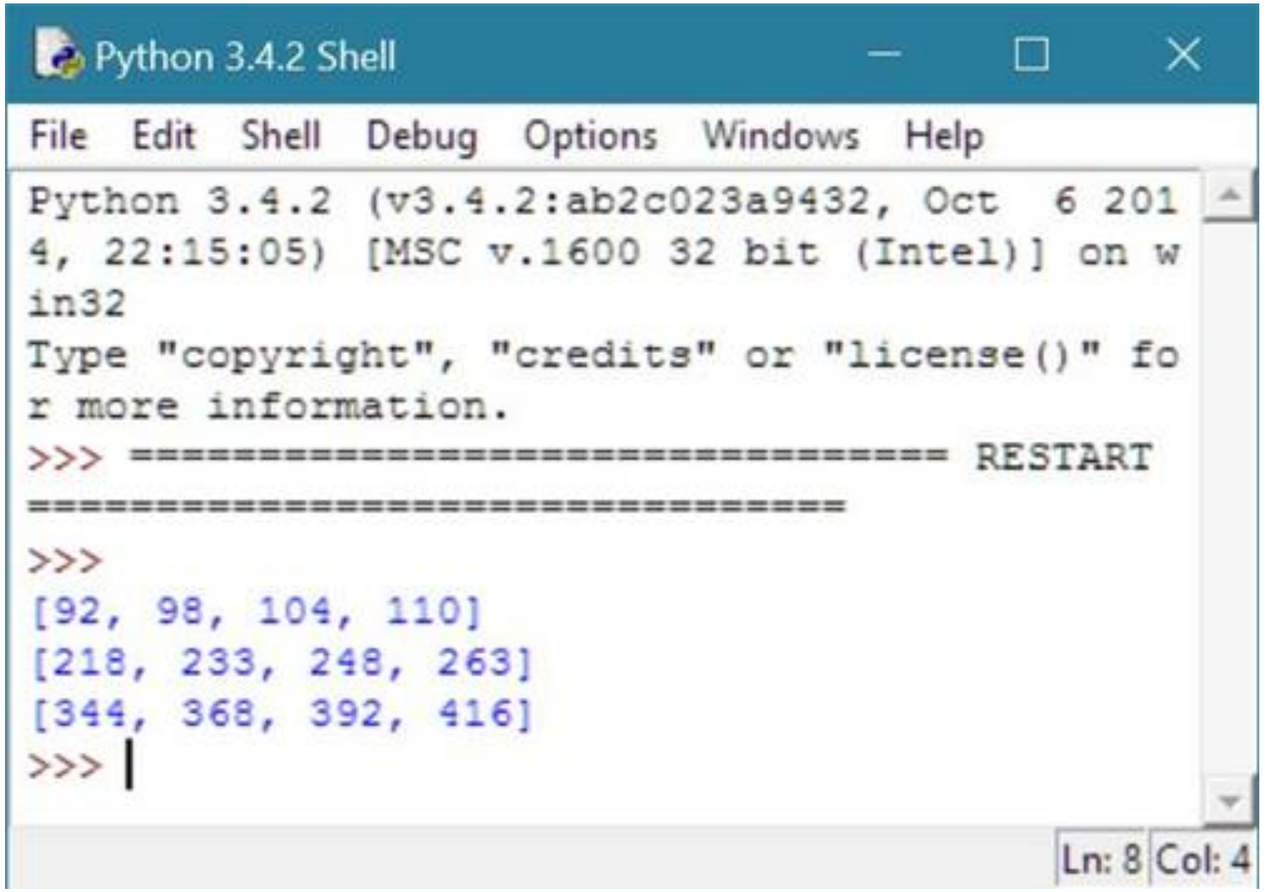


Classical Mechanics

Physics

Mathematician

Computer Science

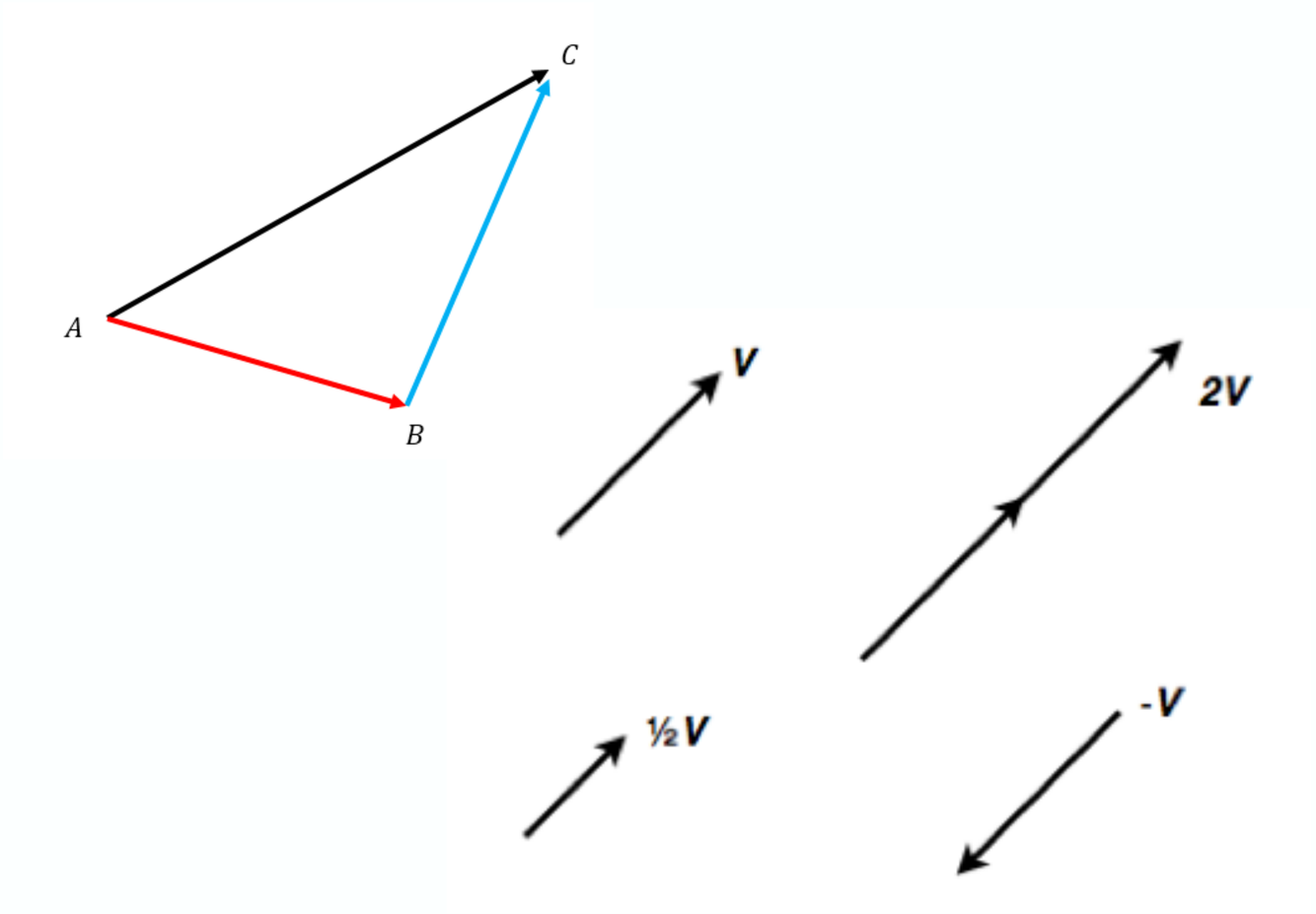


2D Arrays or Lists

Physics

Mathematician

Computer Science

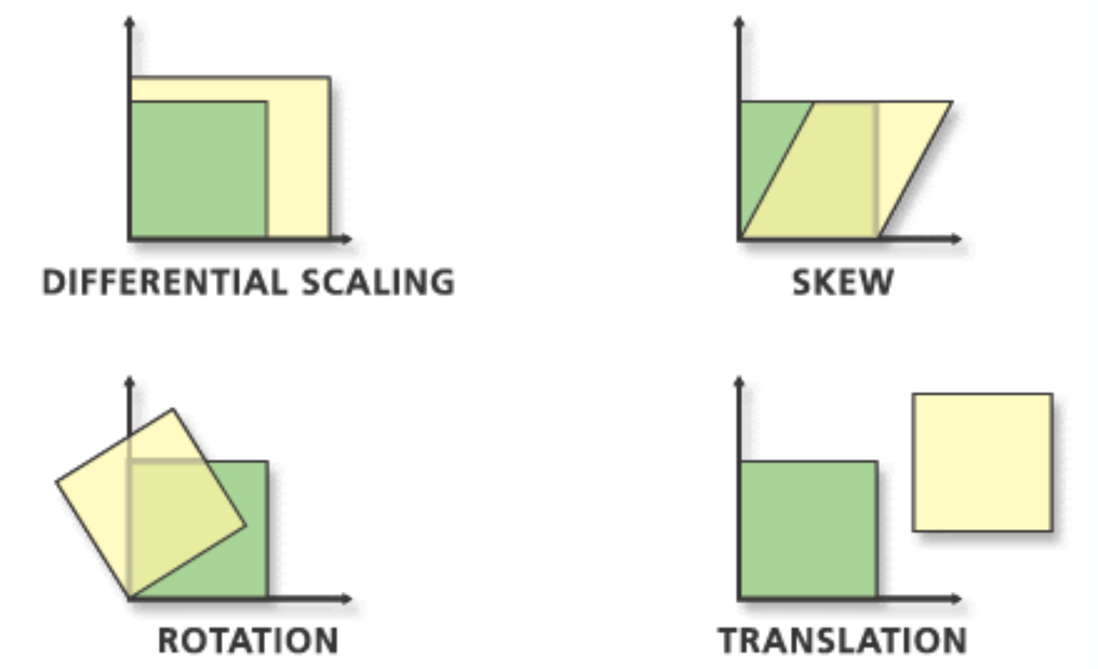


Most things that can be represented and transformed spatially

Physics

Mathematician

Computer Science



Physics

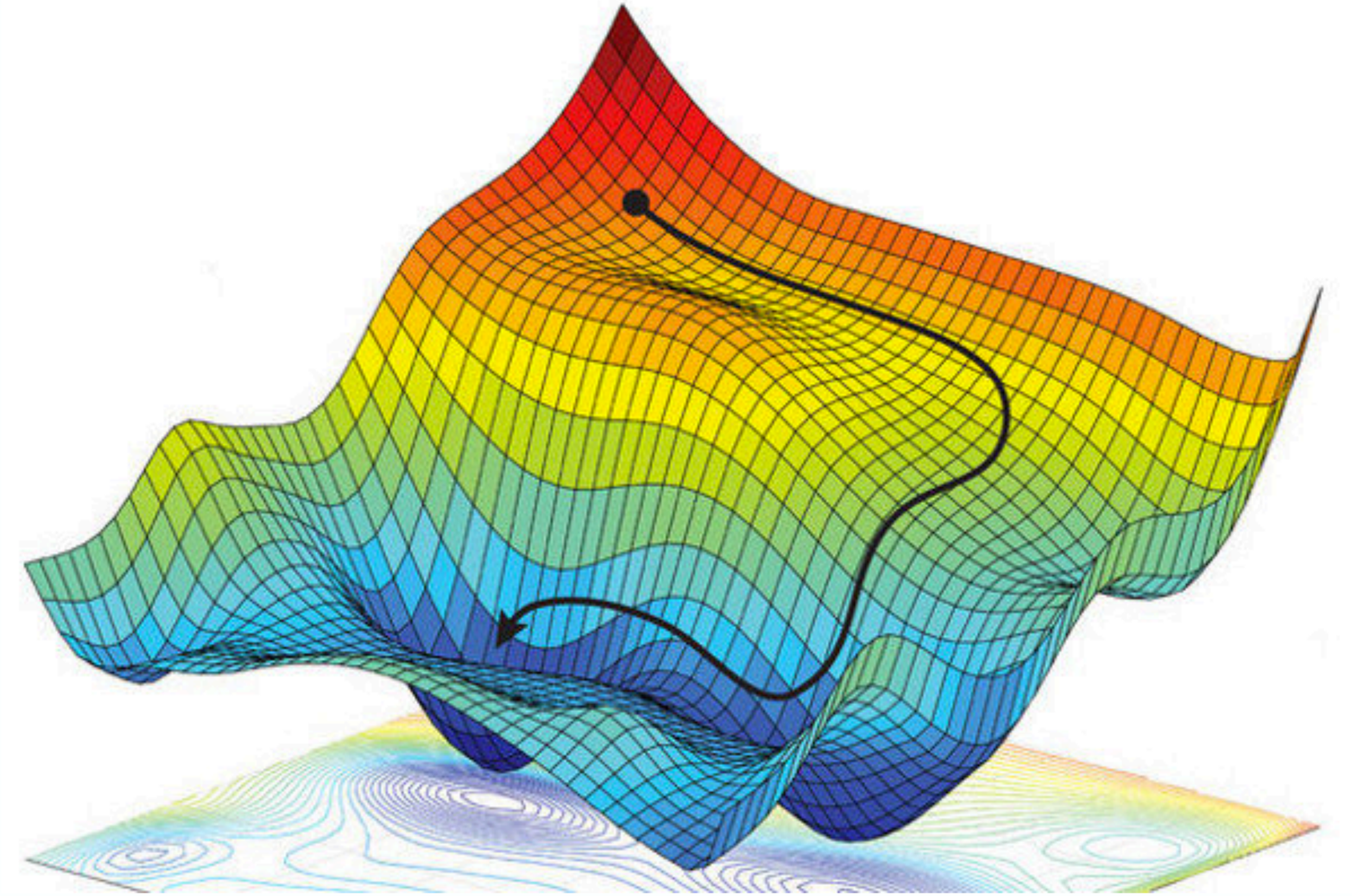
Mathematician

Computer Science

Most things that can be represented and transformed spatially

Physics **Mathematician** **Computer Science**

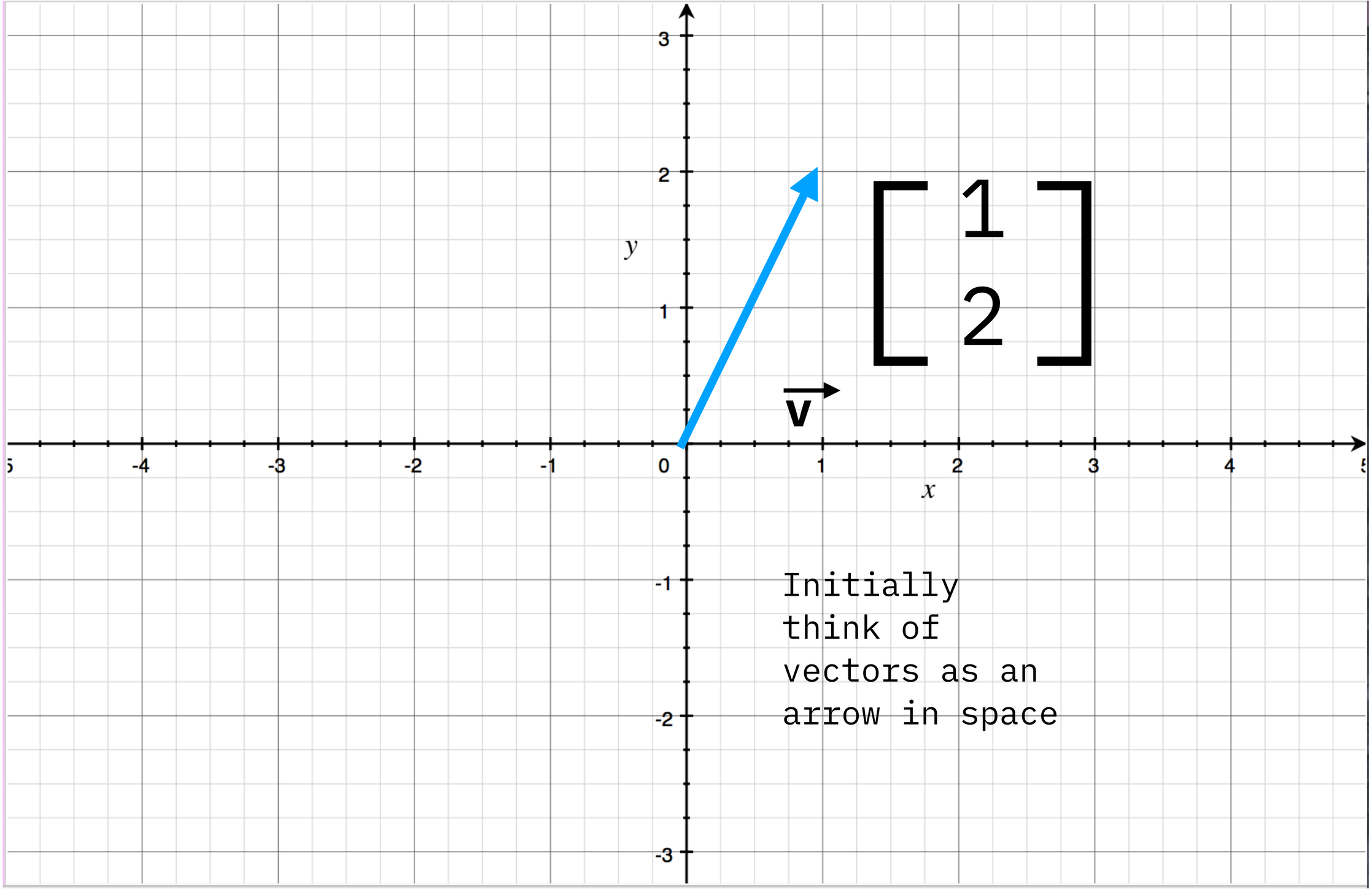
Physics **Mathematician** **Computer Science**



Physics Mathematician Computer Science

Linear Algebra as a **framework** for **representing the problem**

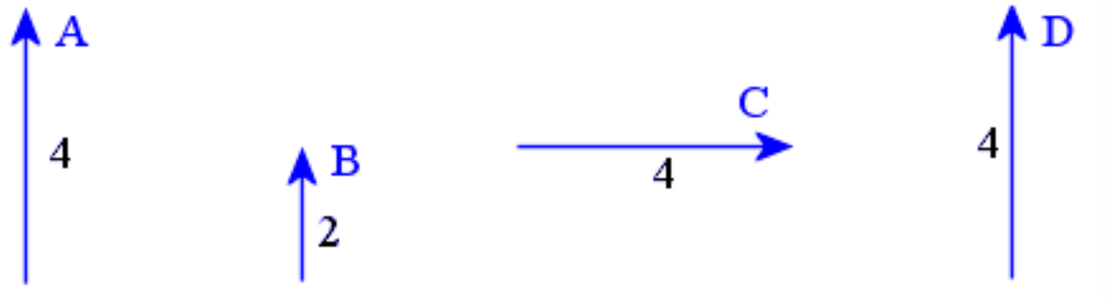
Vectors


3
2
1
y
-1
-2
-3
-4
-3
-2
-1
0
1
2
3
4
x
v
[1]
[2]
Initially
think of
vectors as an
arrow in space

coordinate

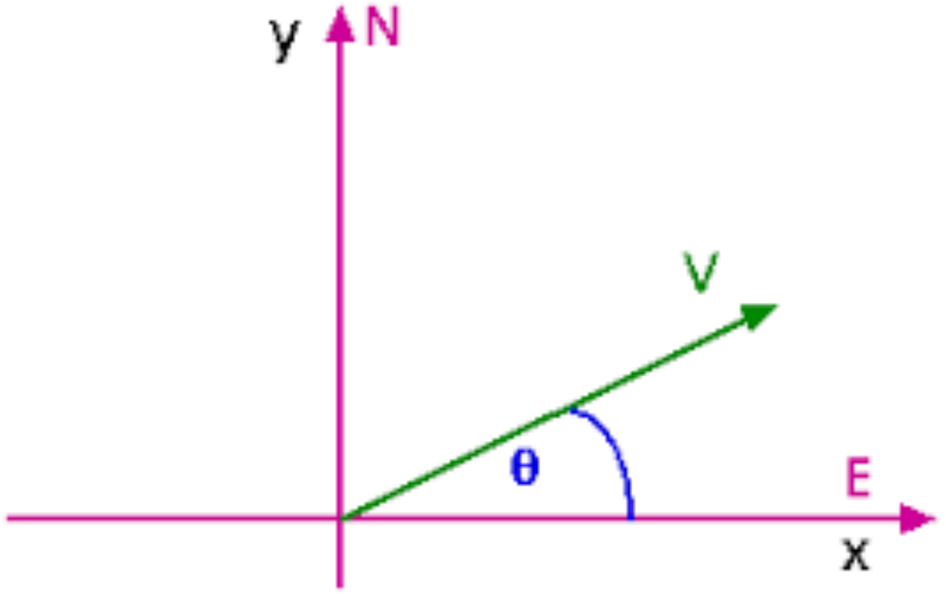
Initially think of vectors as an **arrow** in **space**

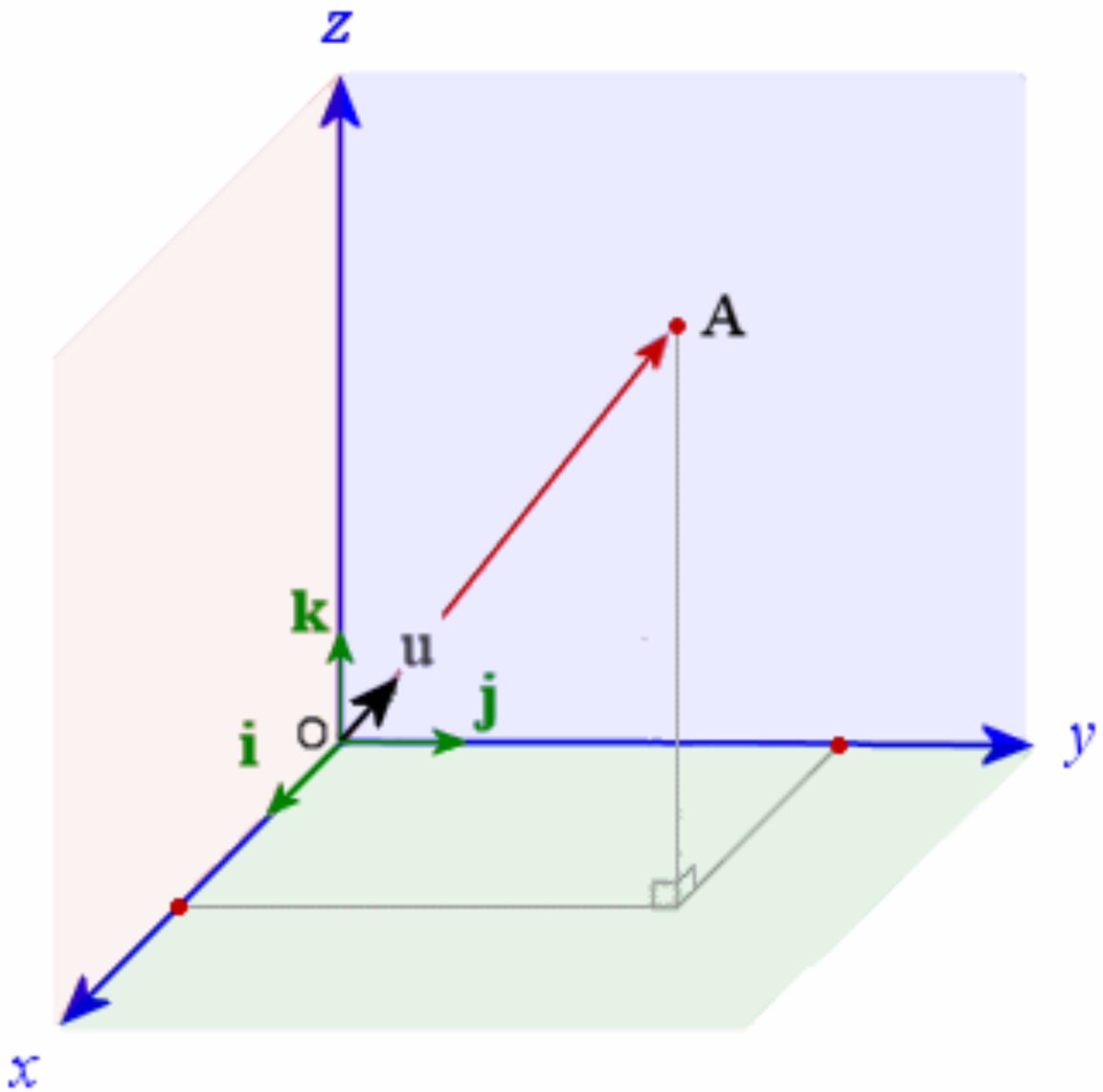
$\mathbb{R}^n$



1 Dimensional Vectors

2D Vector





3D Vector

a = [1,2,3,4,5,6,7,8,9,10]

b = [2,4,6,8]

v = [0,0,0,0,0]

N-Dimensional Row Vectors

Beyond 3D?

Column Vector

Row(s) x Column(s)

34

$$\begin{bmatrix} 1 \\ 2 \end{bmatrix}$$

$$\begin{bmatrix} 1, 0 \\ 3, 5 \end{bmatrix}$$

Scalar

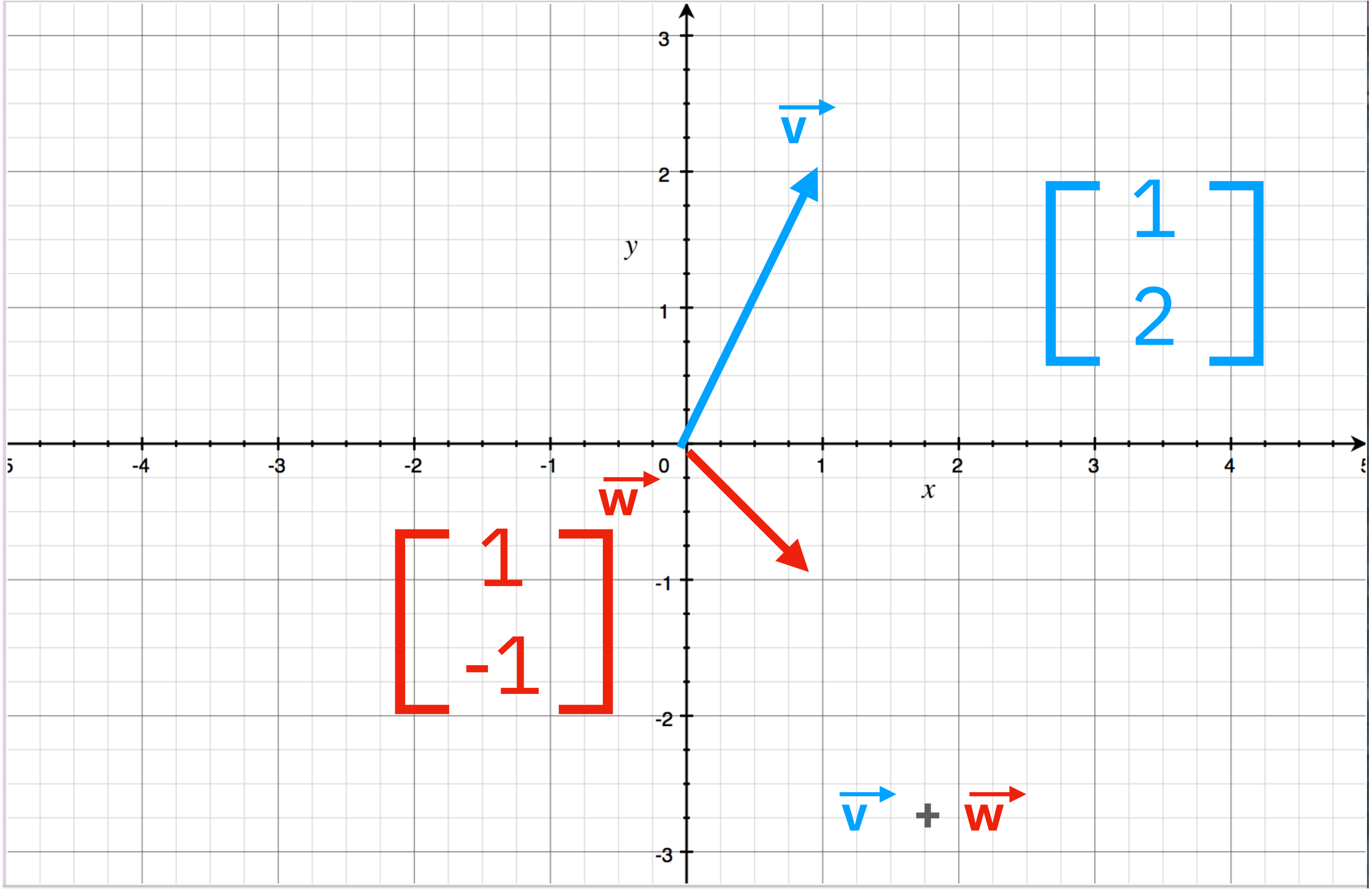
Vector

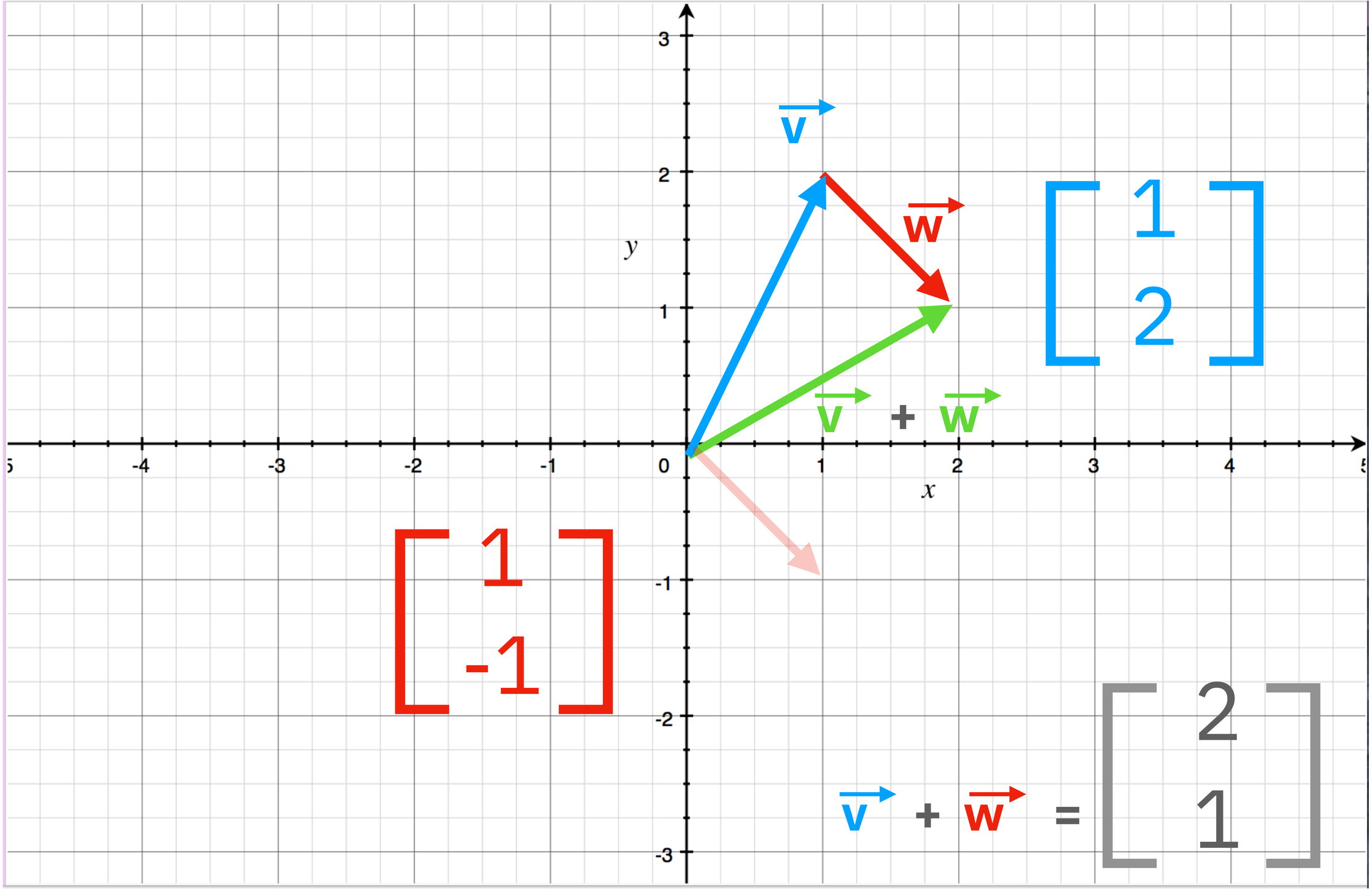
Matrix

Vectors are written with **lowercase** variable names

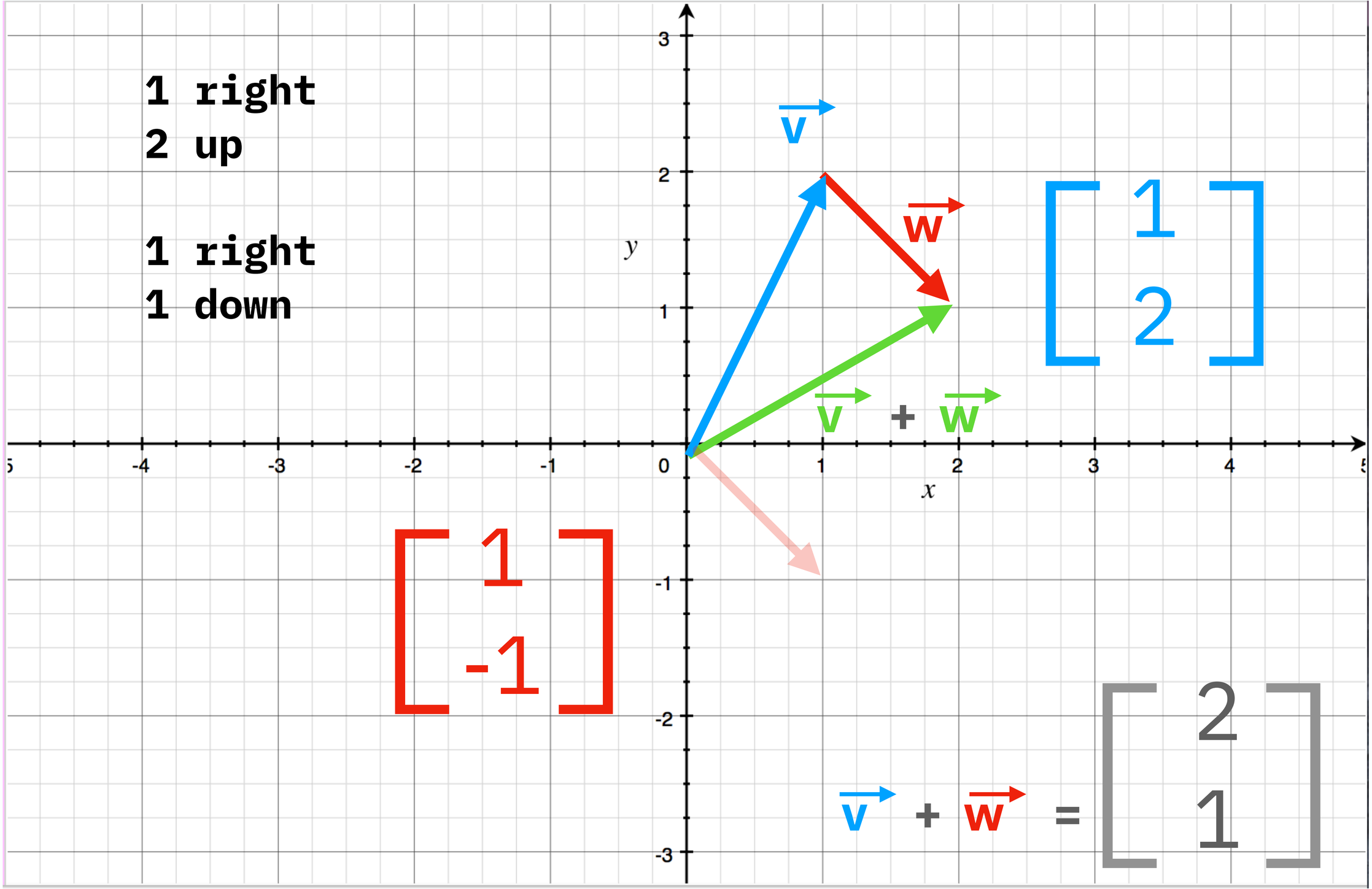
Matrices are written with **UPPERCASE** variable names

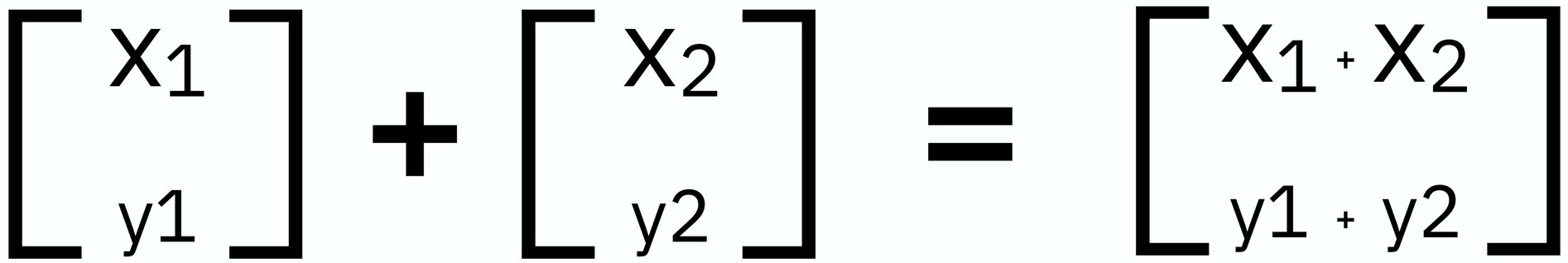
Vector Addition


v
w
y
x
1
2
1
-1
v + w

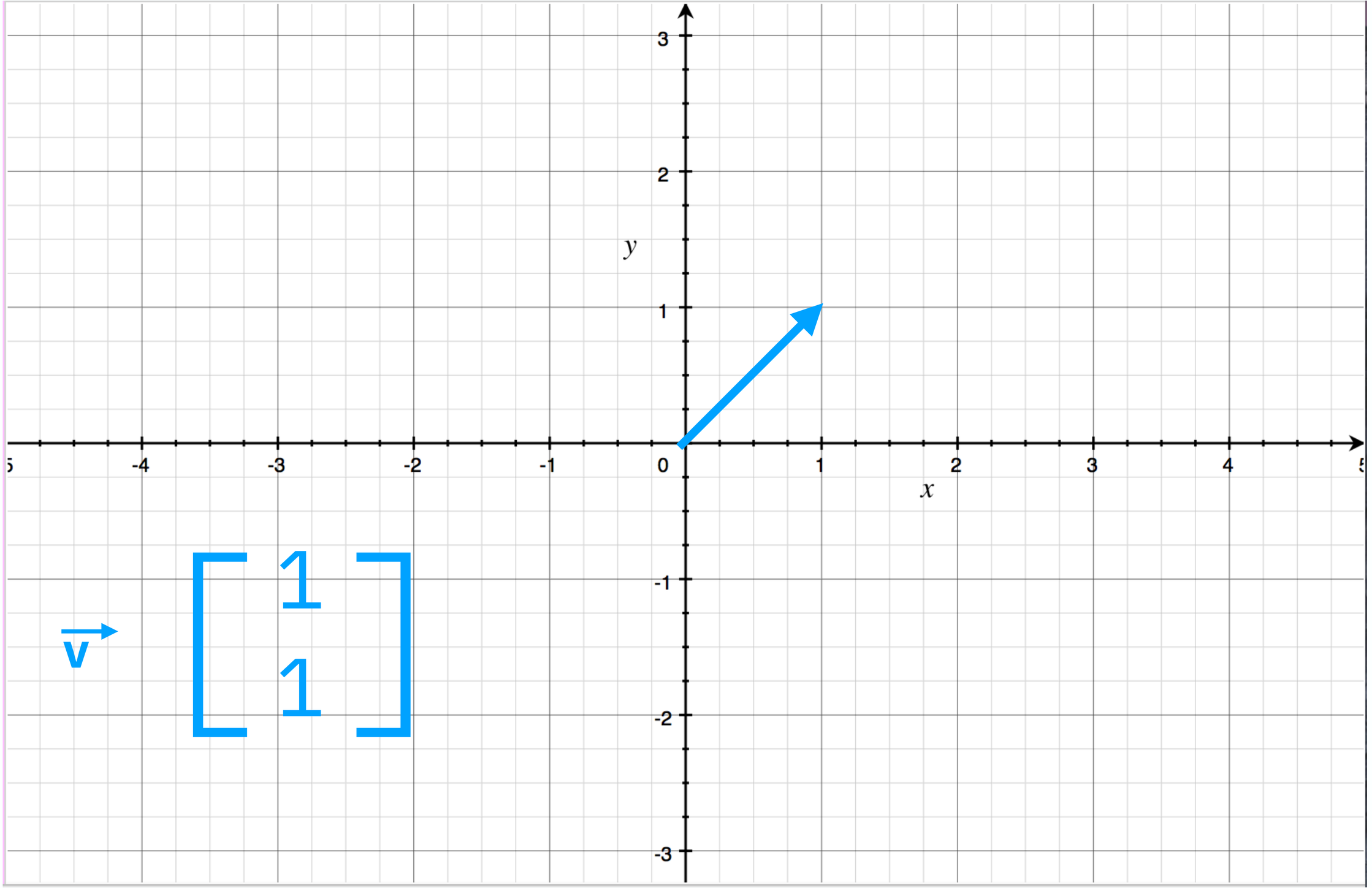

v
w
v + w
y
x
3
2
1
0
-1
-2
-3
-4
-3
-2
-1
1
2
3
4
1
2
1
-1
v + w = 2 1

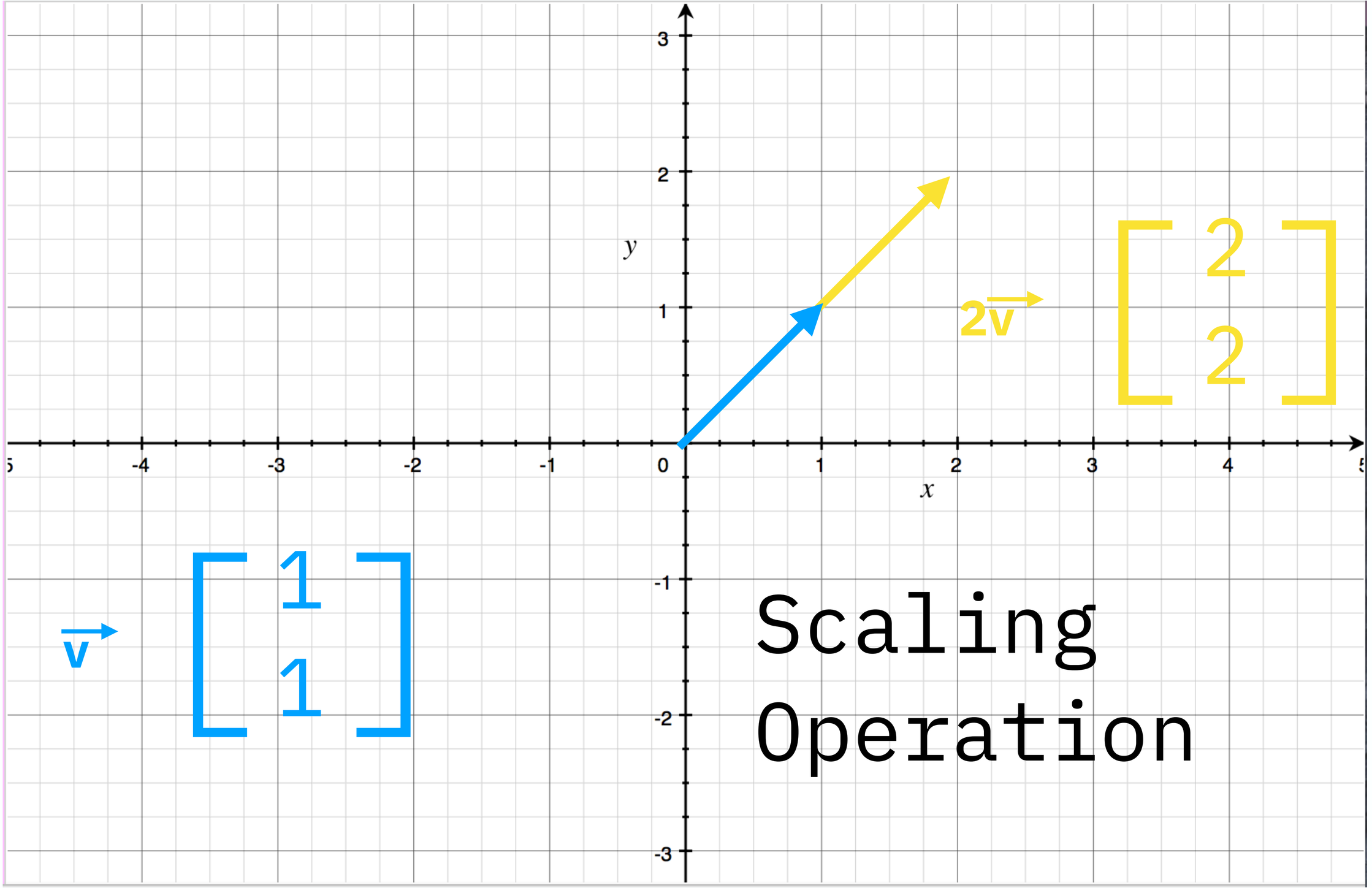
Think of the **vectors** as
instructions to **move** in space

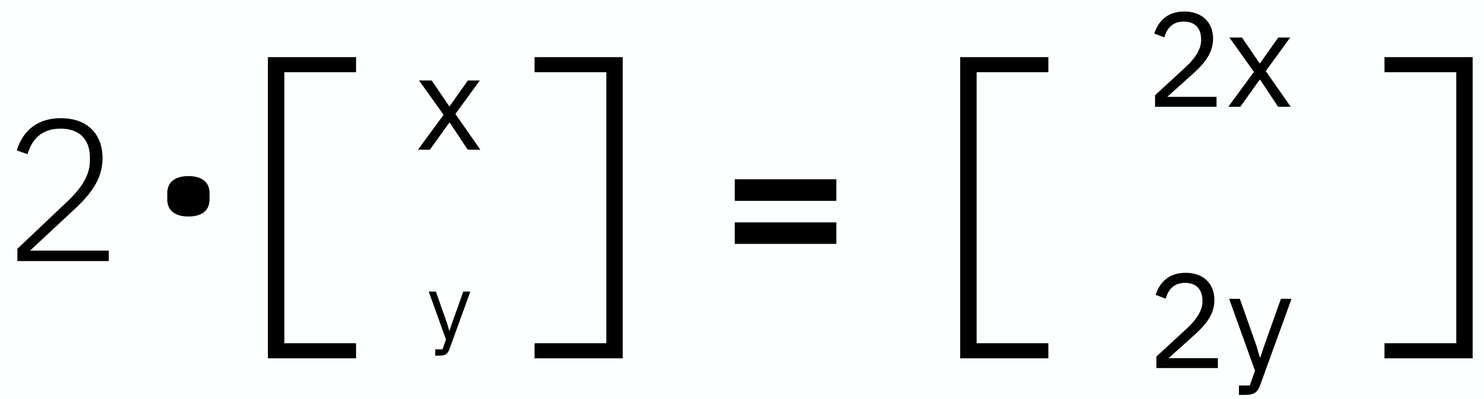

1 right
2 up
1 right
1 down
v
w
v + w
y
x
3
2
1
0
-1
-2
-3
-4
-3
-2
-1
1
2
3
4
[1]
[2]
[1]
[-1]
v + w = [2]
[1]


x1
y1
+
x2
y2
=
x1 + x2
y1 + y2

Scalar Vector Multiplication


3
2
y
1
-4
-3
-2
-1
0
1
2
3
4
x
-1
-2
-3
$\vec{v}$
$\begin{bmatrix} 1 \\ 1 \end{bmatrix}$


3
2
1
y
-4
-3
-2
-1
0
1
2
3
4
x
-1
-2
-3
$2\vec{v}$
$\begin{bmatrix} 2 \\ 2 \end{bmatrix}$
$\vec{v}$
$\begin{bmatrix} 1 \\ 1 \end{bmatrix}$
Scaling
Operation


2 • [x y] = [2x 2y]

Span, Basis, and Linear Dependence