Introduction to Vectors

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Contents

1 Intro to vectors

$$cv + dw = c\begin{bmatrix}1\\1\end{bmatrix} + d\begin{bmatrix}2\\3\end{bmatrix} = \begin{bmatrix}c+2d\\c+3d\end{bmatrix} \tag{1.0}$$

1.1 Linear combinations

- A linear combination of $c = 1$ & $d = 1$ for the equation 1 will produce the following output:

$$v + w = \begin{bmatrix}1\\1\end{bmatrix} + \begin{bmatrix}2\\3\end{bmatrix} = \begin{bmatrix}3\\4\end{bmatrix} \tag{1.1}$$

- $\therefore$ a linear combination is the addition of vectors and multiplying their scalars

1.2 2-Dimensional Vectors

$$\textbf{Column Vector} \qquad v = \begin{bmatrix}v_1\\v_2\end{bmatrix} \tag{1.2.0}$$

- A column vector has 2 seperate numbers v_1 and v_2 which produces a 2-dimensional vector v
- Although v_1 and v_2 cannot be added, we can add other vectors together

$$\textbf{Vector Addition} \qquad v = \begin{bmatrix}v_1\\v_2\end{bmatrix} \text{ and } w = \begin{bmatrix}w_1\\w_2\end{bmatrix} \text{ add to } v + w = \begin{bmatrix}v_1+w_1\\v_2+w_2\end{bmatrix} \tag{1.2.1}$$

- Subtraction follows the same idea, such that $v - w$ is $v_1 - w_1$ and $v_2 - w_2$
- Scalar multiplication can be represented as:

$$\textbf{Scalar Multiplication} \qquad 2v = \begin{bmatrix}2v_1\\2v_2\end{bmatrix} = v + v \text{ and } -v = \begin{bmatrix}-v_1\\-v_2\end{bmatrix} \tag{1.2.2}$$

- In the above equation, 2 is the scalar, c , of the vector v
- The sum of $-v$ and v is the zero vector, 0 and has components 0 and 0

Thus, the sum of cv and wd is the <u>linear combination</u>, $cv + dw$.