

# Lecture 1, Sep 13, 2021

## Introduction to Vectors

- Vectors: direction, magnitude, units; scalars: magnitude, sign
- Core of linear algebra involves 2 operations: Adding vectors and scaling vectors
- Course notation: vector from  $p$  (tail) to  $q$  (head) is expressed as  $\vec{v} = \overrightarrow{PQ} = \begin{bmatrix} v_1 \\ v_2 \end{bmatrix}$  (arrowhead is complete)
  - Row vectors are not equal to column vectors:  $\begin{bmatrix} v_1 \\ v_2 \end{bmatrix} \neq [v_1 \ v_2]$
- Standard position for vectors is tail at the origin

## Vector Operations

- Adding vectors:  $\begin{bmatrix} v_1 \\ v_2 \end{bmatrix} + \begin{bmatrix} w_1 \\ w_2 \end{bmatrix} = \begin{bmatrix} v_1 + w_1 \\ v_2 + w_2 \end{bmatrix}$ 
  - Geometrically this puts the tail of one vector at the head of another
- Scaling vectors:  $c \begin{bmatrix} v_1 \\ v_2 \end{bmatrix} = \begin{bmatrix} cv_1 \\ cv_2 \end{bmatrix}$ 
  - This makes the vector longer or shorter/flips it
- When one vector is a scalar multiple of another, they're parallel  $\vec{v} \parallel \vec{w}$
- The zero vector is  $\vec{v} - \vec{v} = \vec{0}$
- A linear combination of two vectors  $\vec{v}$  and  $\vec{w}$  is  $c\vec{v} + d\vec{w}$  for any  $c$  and  $d$

## Vector Properties

1.  $\vec{v} + \vec{w} = \vec{w} + \vec{v}$  (commutative)