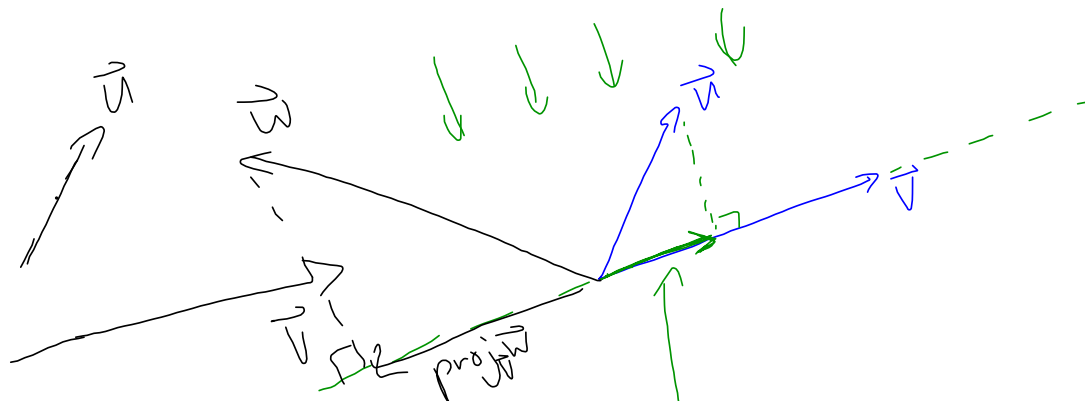


$$\vec{u} = \begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}$$

$$\vec{v} = \begin{bmatrix} -4 \\ 5 \\ 1 \end{bmatrix}$$

$$\begin{aligned} \vec{u} \cdot \vec{v} &= (1)(-4) + (2)(5) + (3)(1) \\ &= -4 + 10 + 3 \\ &= 9 \end{aligned}$$



Draw the projection of  $\vec{u}$  onto  $\vec{v}$ .

$$\text{proj}_{\vec{v}} \vec{u} = \frac{\vec{u} \cdot \vec{v}}{\vec{v} \cdot \vec{v}} \vec{v}$$

## Matrices

$$A = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix}$$

size  $2 \times 3$

$(i, j)$   
entry

scalars:  $a, b, c, s, t,$   
 $c_1, c_2, c_3$

vectors:  $\vec{u}, \vec{v}, \vec{x}$

matrices:  $A, B, C,$

# Types of matrices

Square  $\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$   
 # rows =  
 # columns

$$\begin{bmatrix} 4 & -1 & 0 \\ -1 & 4 & -1 \\ 0 & -1 & 4 \end{bmatrix}$$

Diagonal:  
(square)

non-zero entries can only be on diagonal

$$\begin{bmatrix} 3 & 0 & 0 \\ 0 & -2 & 0 \\ 0 & 0 & 5 \end{bmatrix}$$

$$\begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix} \text{ is diagonal}$$

$$\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \text{ 3x3 identity}$$

$$\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \text{ 2x2 identity}$$

Upper triangular matrix

$$\begin{bmatrix} 1 & 2 & 3 \\ 0 & 4 & 5 \\ 0 & 0 & 6 \end{bmatrix} \text{ all entries below diagonal are zero.}$$

$$A = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix}$$

$$f(x) = x^2$$

$$f'(x) = 2x$$

The transpose of A is

$$A^T = \begin{bmatrix} 1 & 4 \\ 2 & 5 \\ 3 & 6 \end{bmatrix}$$

$$A = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix} \quad \vec{X} = \begin{bmatrix} -2 \\ 1 \\ 3 \end{bmatrix}$$
$$A\vec{X} = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix} \begin{bmatrix} -2 \\ 1 \\ 3 \end{bmatrix} = \begin{bmatrix} -2 + 2 + 9 \\ -8 + 5 + 18 \end{bmatrix} = \begin{bmatrix} 9 \\ 15 \end{bmatrix}$$

$$B = \begin{bmatrix} 7 & -1 \\ 5 & 2 \end{bmatrix} \quad \vec{u} = \begin{bmatrix} 3 \\ 4 \end{bmatrix}$$

$$B\vec{u} = \begin{bmatrix} 7 & -1 \\ 5 & 2 \end{bmatrix} \begin{bmatrix} 3 \\ 4 \end{bmatrix} = \begin{bmatrix} 21-4 \\ 15+8 \end{bmatrix} = \begin{bmatrix} 17 \\ 23 \end{bmatrix}$$



