Section 3.1: Vectors and lines in 2D and nD

Definition: \textit{a vector}

Example 1: Graph $\vec{u} = (2, 3)$. 

\grid
Example 2: (Vector Addition.) Let $\vec{k} = (-3, 2, 3)$ and $\vec{m} = (4, -4, 2)$. Find $\vec{k} + \vec{m}$.

Example 3: Let $\vec{u} = (2, 3)$ and $\vec{v} = (4, 1)$. Find $\vec{u} + \vec{v}$ and represent the sum geometrically in $\mathbb{R}^2$.

Example 4: (Scalar Multiples.)
**Definition:** parallel

**Example 5:** (The difference of two vectors.) Let \( \vec{k} = (-3, 2, 3) \) and \( \vec{m} = (4, -4, 2) \). Find \( \vec{k} - \vec{m} \).

**Example 6:** Let \( \vec{u} = (2, 3) \) and \( \vec{v} = (3, 1) \). Find \( \vec{u} - \vec{v} \) and represent it geometrically in \( \mathbb{R}^2 \).
Definition: length of a vector

Example 7: Let \( \vec{u} = (3, 4, 5) \). Find \(|\vec{u}|\).

Definition: the position vector

Example 8: Let \( \vec{u} = (2, 3) \) and \( \vec{v} = (3, 1) \). Sketch \( \vec{u} \), \( \vec{v} \), and \( \vec{u} - \vec{v} \) as position vectors.

NOTE: We have now given all the points in the space \( \mathbb{R}^n \) “dual” meanings:

Old: a point

New: a vector from zero (the origin) to the point
Example 9: Find the vector $\vec{v}$ that starts at the point $(3, 2)$ and ends at the point $(6, 7)$ and find its length.
Example 10: Consistent $\mathbb{R}^2$ linear system with a parametric solution. (See 2.3.)
Example 10 (Continued):

Three Ways to Describe a Line Mathematically:
**Definition:** the vector equation for a line in $\mathbb{R}^n$

**Example 11:** Find a vector equation for the line through the points $P_1 = (8, -3, 4)$ and $P_2 = (5, -5, -3)$. 