linear independence

- Given 3 vectors $\overrightarrow{v_1}, \overrightarrow{v_2}, \overrightarrow{v_3}$, they are called linearly independent if and only if none of them is a linear combination of the others:

$$\overrightarrow{v_1} \neq a\overrightarrow{v_2} + b\overrightarrow{v_3} \text{ for any } a, b \in \mathbb{R}$$

$$\overrightarrow{v_2} \neq a\overrightarrow{v_1} + b\overrightarrow{v_3} \text{ for any } a, b \in \mathbb{R}$$

$$\overrightarrow{v_3} \neq a\overrightarrow{v_1} + b\overrightarrow{v_2} \text{ for any } a, b \in \mathbb{R}$$

- This is equivalent to saying that:

$$a\overrightarrow{v_1} + b\overrightarrow{v_2} + c\overrightarrow{v_3} = 0 \quad \textit{iff} \quad a = b = c = 0$$

linear independence and spanning vectors

- $\vec{w}$ is in $span(\vec{u}, \vec{v})$or the plane spanned by $(\vec{u}, \vec{v})$
- $\vec{w}$ is a linear combination of $(\vec{u}, \vec{v})$, so $(\vec{u}, \vec{v}, \vec{w})$ is not linear independent.