and
$$\frac{1}{\|\overrightarrow{AB}\|}\overrightarrow{AB} = \frac{1}{3}(-1,2,-2) = \left(-\frac{1}{3}, \frac{2}{3}, -\frac{2}{3}\right)$$
and $$\frac{-1}{\|\overrightarrow{AB}\|}\overrightarrow{AB} = -\frac{1}{3}(-1,2,-2) = \left(\frac{1}{3}, -\frac{2}{3}, \frac{2}{3}\right)$$
are unit vectors parallel to $\overrightarrow{AB}$.

through the origin
in the direction containing $\vec{u}$.
Then $\mathrm{proj}_{\vec{u}}(\vec{v})$ is the closest point to $\vec{v}$ on the line L.

$\{(1,1),(2,3)\}$.

In fact $(1,1)-\frac{1}{2}(2,3)=(0,-\frac{1}{2})$ so $-2(1,1)+(2,3)=(0,1)$

and $(1,1)-\frac{1}{3}(2,3)=(\frac{1}{3},0)$ so $3\cdot(1,1)-(2,3)=(1,0)$.

So $(1,0)$ and $(0,1)$ are in $\text{span}\{(1,1),(2,3)\}$.

So $\text{span}\{(1,0),(0,1)\}=\mathbb{R}^2$ is a subset of $\text{span}\{(1,1),(2,3)\}$.

$= 5\hat{i} + 2\hat{j} + \hat{k}.$

Perpendicular vectors: $\vec{u}$ and $\vec{v}$ are perpendicular if $\theta(\vec{u},\vec{v}) = \frac{\pi}{2}$ i.e. if $\cos(\theta(\vec{u},\vec{v})) = \cos(\frac{\pi}{2}) = 0$

i.e. if $0 = \dfrac{\langle \vec{u},\vec{v} \rangle}{\|\vec{u}\| \cdot \|\vec{v}\|}$ i.e. if $\langle \vec{u},\vec{v} \rangle = 0$