Step-1

Let P_1 = the projection of b onto the line through $a_1 = \frac{a_1^T b}{a_1^T a_1} a_1$

$$a_1^T b = \begin{pmatrix} 1 & 0 \end{pmatrix} \begin{pmatrix} 1 \\ 1 \end{pmatrix}$$
$$= 1 + 0$$
$$= 1$$

$$a_1^T a_1 = \begin{pmatrix} 1 & 0 \end{pmatrix} \begin{pmatrix} 1 \\ 0 \end{pmatrix}$$
$$= 1 + 0$$
$$= 1$$

$$P_1 = \frac{1}{1} \begin{pmatrix} 1 \\ 0 \end{pmatrix}$$
$$= \begin{pmatrix} 1 \\ 0 \end{pmatrix}$$

Step-2

Let P_2 = the projection of b onto the line through $a_2 = \frac{a_2^T b}{a_2^T a_2} a_2$

$$a_2^T b = \begin{pmatrix} 1 & 2 \end{pmatrix} \begin{pmatrix} 1 \\ 1 \end{pmatrix}$$
$$= 1 + 2$$
$$= 3$$

$$a_2^T a_2 = \begin{pmatrix} 1 & 2 \end{pmatrix} \begin{pmatrix} 1 \\ 2 \end{pmatrix}$$
$$= 1 + 4$$
$$= 5$$

$$P_2 = \frac{3}{5} \begin{pmatrix} 1 \\ 2 \end{pmatrix}$$
$$= \begin{pmatrix} 3/5 \\ 6/5 \end{pmatrix}$$

Step-3

$$P_1+P_2=\begin{pmatrix}1\\0\end{pmatrix}+\begin{pmatrix}3/5\\6/5\end{pmatrix}$$
$$=\begin{pmatrix}8/5\\6/5\end{pmatrix}$$

$P_1+P_2\neq b$ because a_1, a_2 are not orthogonal

This is established with the help of $a_1^T a_2=\begin{pmatrix}1 & 0\end{pmatrix}\begin{pmatrix}1\\2\end{pmatrix}$

$=1+0$
$=1\neq 0$