HAND IN MODULE 3

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1. Task 1:

a)

S = standard basis $\begin{pmatrix}1\\0\end{pmatrix}, \begin{pmatrix}0\\1\end{pmatrix} for \mathbb{R}^2$

B = the two vectors $\begin{pmatrix}1\\-1\end{pmatrix}, \begin{pmatrix}1\\0\end{pmatrix}$

Gaussian Elimination: $\begin{pmatrix}1 & 1 & 0\\-1 & 0 & 0\end{pmatrix} -> \begin{pmatrix}1 & 1 & 0\\0 & 1 & 0\end{pmatrix} -> \underline{\underline{\begin{pmatrix}1 & 0 & 0\\0 & 1 & 0\end{pmatrix}}}$

From the Gaussian Elimination we can see that it is linear independent and has unique solution.

b)

$$\begin{pmatrix}1 & 1 & 1\\-1 & 0 & 2\end{pmatrix} -> \begin{pmatrix}1 & 1 & 1\\0 & 1 & 3\end{pmatrix} -> \underline{\begin{pmatrix}1 & 0 & -2\\0 & 1 & 3\end{pmatrix}}$$

$$\begin{pmatrix}1\\2\end{pmatrix} -> \underline{\underline{(-2)\cdot\begin{pmatrix}1\\-1\end{pmatrix} + 3\cdot\begin{pmatrix}1\\0\end{pmatrix}}}$$

c)

d)

$$Projection_{\binom{1}{-1}}\begin{pmatrix}1\\4\end{pmatrix} = \begin{pmatrix}1\\4\end{pmatrix}\cdot\frac{1}{\sqrt{1^2\cdot(-1)^2}}\cdot\begin{pmatrix}1\\-1\end{pmatrix}\cdot w$$

$$= \tfrac{1}{\sqrt{2}}\cdot w\cdot(1\cdot 1 + 4\cdot(-1))$$

$$= -\tfrac{3}{\sqrt{2}}\cdot\tfrac{1}{\sqrt{2}}\cdot\begin{pmatrix}1\\-1\end{pmatrix}$$

$$= \tfrac{3}{2}\cdot\begin{pmatrix}1\\-1\end{pmatrix} = \tfrac{3}{2}\cdot 1\cdot\begin{pmatrix}1\\0\end{pmatrix} + \tfrac{3}{2}\cdot(-1)\cdot\begin{pmatrix}0\\1\end{pmatrix}$$