

Week 13 Linear Algebra worksheet
MATH1014

Let $\mathbf{u}_1 = \begin{bmatrix} 0 \\ 0 \\ 1 \\ 1 \end{bmatrix}$ and $\mathbf{u}_2 = \begin{bmatrix} 1 \\ 1 \\ 0 \\ 0 \end{bmatrix}$. Define $W = \text{Span}\{\mathbf{u}_1, \mathbf{u}_2\}$ and

let $T : \mathbb{R}^4 \rightarrow \mathbb{R}^4$ be the linear transformation which is orthogonal projection onto W .

- (1) Find vectors \mathbf{u}_3 and \mathbf{u}_4 so that $\mathcal{U} = \{\mathbf{u}_1, \mathbf{u}_2, \mathbf{u}_3, \mathbf{u}_4\}$ is an orthogonal basis for \mathbb{R}^4 . (You will use this basis in subsequent parts of this problem.)

- (2) Express the vector $\begin{bmatrix} 1 \\ 1 \\ 1 \\ 1 \end{bmatrix}$ in \mathcal{U} coordinates. Why will everyone in the tutorial get the same answer?

- (3) What is $T(\mathbf{u}_1)$?
(4) What is $T(\mathbf{u}_3)$?
(5) Find the matrix M_T which represents T with respect to \mathcal{U} coordinates.