F14 8:40 Exam 2
Linear Algebra, Dave Bayer

[1] Find the 3×3 matrix which maps the vector $(0, 1, 1)$ to $(0, 2, 2)$, and maps each point on the plane $x + y = 0$ to the zero vector.

[2] Find a basis for the row space and a basis for the column space of the matrix

$$\begin{bmatrix} 1 & 1 & 1 & 0 & 0 & 0 \\ -2 & 0 & 0 & 1 & 1 & 0 \\ 0 & -2 & 0 & -1 & 0 & 1 \\ 0 & 0 & -2 & 0 & -1 & -1 \end{bmatrix}$$

[3] Find the 3×3 matrix that projects orthogonally onto the plane

$$x + 2y = 0$$

[4] Find an orthogonal basis for the subspace V of $\mathbb{R}^4$ spanned by the vectors

$$(1, -2, 0, 0) \qquad (1, 0, -2, 0) \qquad (1, 0, 0, -2) \qquad (0, 1, -1, 0) \qquad (0, 1, 0, -1) \qquad (0, 0, 1, -1)$$

Extend this basis to an orthogonal basis for $\mathbb{R}^4$.

[5] Let V be the vector space of all polynomials of degree $\leqslant 2$ in the variable x with coefficients in $\mathbb{R}$. Let W be the subspace of V consisting of those polynomials $f(x)$ such that the second derivative $f''(x) = 0$.

Find the orthogonal projection of the polynomial x^2 onto the subspace W, with respect to the inner product

$$\langle f, g \rangle \;=\; \int_0^1 f(x)g(x)\,dx$$