Midterm Spring 2019 #5(c)
The matrix $\left(\begin{smallmatrix} 3 & 13 \\ 20 & 19 \end{smallmatrix}\right)$ can be written as LDU, where L is a vertical shear, D is diagonal, and U is a horizontal shear.

Quiz 1 #2(b)
Suppose T is a linear transformation from $\mathbb{R}^3$ to $\mathbb{R}^2$ such that

$$T\left(\begin{bmatrix}1\\2\\0\end{bmatrix}\right) = \begin{bmatrix}1\\0\end{bmatrix}, \quad T\left(\begin{bmatrix}1\\3\\5\end{bmatrix}\right) = \begin{bmatrix}0\\-1\end{bmatrix}, \quad T\left(\begin{bmatrix}1\\5\\14\end{bmatrix}\right) = \begin{bmatrix}-2\\1\end{bmatrix}$$

Find the matrix of T.

Midterm Spring 2017 #4(a)
Let $C_k = (A - kI_4)(B - kI_4)$, where

$$A = \begin{bmatrix}1 & 2 & 6 & 1\\ 0 & 3 & \sqrt{7} & 2\\ 0 & 0 & 4 & 7\\ 0 & 0 & 0 & 5\end{bmatrix}, \quad B = \begin{bmatrix}4 & 0 & 0 & 0\\ 10 & 1 & 0 & 0\\ 9 & 0 & 7 & 0\\ 0 & \sqrt{2} & 1 & 6\end{bmatrix}$$

Find all values of k such that C_k is *not* invertible.

Midterm Spring 2017 #5(b)
Given two distinct lines L_1 and L_2 in $\mathbb{R}^2$ passing through the origin, there exists a 2×2 matrix A such that $\text{Im}(A) = L_1$ and $\ker(A) = L_2$. Explicitly write down one such matrix if $L_1 : y = x$ and $L_2 : y = 2x$.

Midterm Spring 2018 #3(d)
Let V be the subspace of $\mathbb{R}^4$ spanned by the vectors

$$\vec{v}_1 = \begin{bmatrix}2\\1\\0\\0\end{bmatrix}, \quad \vec{v}_2 = \begin{bmatrix}3\\0\\4\\1\end{bmatrix}$$

Let W be the subspace of $\mathbb{R}^4$ spanned by the vectors

$$\vec{w}_1 = \begin{bmatrix}2\\4\\1\\1\end{bmatrix}, \quad \vec{w}_2 = \begin{bmatrix}1\\2\\2\\1\end{bmatrix}$$

Find a basis for $V \cap W$.

Midterm Spring 2019 #2(a)
In $\mathbb{R}^4$, let V be the hyperplane $x+2y-z-z = 0$, and let W be the hyperplane $-x-y+z-3w = 0$. Find a basis of $V \cap W$. Extend it to a basis of V.