

Motivation

Have you seen some Linear Algebra in earlier classes? Yes!

$$\text{Solve } \begin{cases} x + 2y - z = 3 \\ x - 3y + z = 2 \\ 2x - y - z = 3 \end{cases}$$

Write $\begin{cases} x + 2y - z = 3 \\ x - 3y + z = 2 \\ 2x - y - z = 3 \end{cases}$ using matrices and vectors and solve the problem again with an "augmented" matrix.

Solve $Ax=b$ where

$$A = \begin{bmatrix} 1 & 2 & -1 \\ 1 & -3 & 1 \\ 2 & -1 & -1 \end{bmatrix}, \quad b = \begin{bmatrix} 3 \\ 2 \\ 3 \end{bmatrix}'$$

$$A = 3 \times 3$$
$$\begin{bmatrix} 1 & 2 & -1 \\ 1 & -3 & 1 \\ 2 & -1 & -1 \end{bmatrix}$$
$$b = 3 \times 1$$
$$\begin{bmatrix} 3 \\ 2 \\ 3 \end{bmatrix}$$

$$x = A \backslash b$$

$$x = 3 \times 1$$
$$\begin{bmatrix} 3 \\ 1 \\ 2 \end{bmatrix}$$

If we add a column for another variable to this system, we would have a general solution consisting of an infinite amount of solutions. MatLab uses projection (chapter 4) to give just one solution.

$$c = \begin{bmatrix} 1 & 1 & 1 \end{bmatrix}', \quad K = \begin{bmatrix} A & c \end{bmatrix}, \quad y = K \backslash b$$

$$c = 3 \times 1$$
$$\begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}$$
$$K = 3 \times 4$$
$$\begin{bmatrix} 1 & 2 & -1 & 1 \\ 1 & -3 & 1 & 1 \\ 2 & -1 & -1 & 1 \end{bmatrix}$$
$$y = 4 \times 1$$
$$\begin{bmatrix} 3.0000 \\ 1.0000 \\ 2.0000 \\ 0 \end{bmatrix}$$

Why are there decimals in this answer, but not the first one? $(3, 1, 2, 0)$ is also a solution of the next system, but the program gives a different answer:

$$P = \begin{bmatrix} A & b \end{bmatrix}, \quad m = P \backslash b$$

$$P = 3 \times 4$$
$$\begin{bmatrix} 1 & 2 & -1 & 3 \\ 1 & -3 & 1 & 2 \\ 2 & -1 & -1 & 3 \end{bmatrix}$$
$$m = 4 \times 1$$
$$\begin{bmatrix} 0 \\ -0.0000 \\ -0.0000 \\ 1.0000 \end{bmatrix}$$