

Gaussian Elimination

Solve using Gaussian Elimination

Write as augmented matrix



$$\begin{aligned}x + y - z &= -2 \\2x - y + z &= 5 \\-x + 2y + 2z &= 1\end{aligned}$$

$$\left[\begin{array}{ccc|c} 1 & 1 & -1 & -2 \\ 2 & -1 & 1 & 5 \\ -1 & 2 & 2 & 1 \end{array} \right] \quad R_3 + R_1 \rightarrow R_3$$



$$\left[\begin{array}{ccc|c} 1 & 1 & -1 & -2 \\ 2 & -1 & 1 & 5 \\ 0 & 3 & 1 & -1 \end{array} \right] \quad -2R_1 + R_2 \rightarrow R_2$$



$$\left[\begin{array}{ccc|c} 1 & 1 & -1 & -2 \\ 0 & -3 & 3 & 9 \\ 0 & 3 & 1 & -1 \end{array} \right] \quad R_2 + R_3 \rightarrow R_3$$



$$\left[\begin{array}{ccc|c} 1 & 1 & -1 & -2 \\ 0 & -3 & 3 & 9 \\ 0 & 0 & 4 & 8 \end{array} \right] \quad \begin{aligned} \frac{-R_2}{3} &\rightarrow R_2 \\ \frac{R_3}{4} &\rightarrow R_3 \end{aligned}$$

$$\left[\begin{array}{ccc|c} 1 & 1 & -1 & 2 \\ 0 & 1 & -1 & -3 \\ 0 & 0 & 1 & 2 \end{array} \right] \quad -R_3 \rightarrow R_3$$

The matrix is now in row-echelon form.
Convert back to systems of equation to get

$$\begin{aligned}x + y - z &= -2 \\y - z &= -3 \\z &= 2\end{aligned}$$

Perform back substitution to get

$$x = 1, y = -1, z = 2$$

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Variables

$$\begin{aligned}2x + 5y + 3z &= -3 \\4x + 0y + 8z &= 0 \\1x + 3y + 0z &= 2\end{aligned} \quad \longrightarrow \quad \begin{bmatrix} 2 & 5 & 3 \\ 4 & 0 & 8 \\ 1 & 3 & 0 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} -3 \\ 0 \\ 2 \end{bmatrix}$$