

Gaussian Elimination

Solve using Gaussian Elimination

Write as augmented matrix



$$\begin{array}{l} x + y - z = -2 \\ 2x - y + z = 5 \\ -x + 2y + 2z = 1 \end{array}$$

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

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

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

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

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

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

$$\begin{array}{l} x + y - z = -2 \\ y - z = -3 \\ z = 2 \end{array}$$

Perform back substitution to get

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

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Variables

$$2x + 5y + 3z = -3$$

$$4x + 0y + 8z = 0$$

$$1x + 3y + 0z = 2$$

$$\rightarrow \left[\begin{array}{ccc|c} 2 & 5 & 3 & -3 \\ 4 & 0 & 8 & 0 \\ 1 & 3 & 0 & 2 \end{array} \right] \left[\begin{array}{c} x \\ y \\ z \end{array} \right] = \left[\begin{array}{c} -3 \\ 0 \\ 2 \end{array} \right]$$