Linear Algebra Study Guide

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0.1 Systems of Linear Equations

A system of linear equations has

1. no solution, or
2. exactly one solution, or
3. infinitely many solutions.

A system of linear equations is said to be consistent if it has either one solution or infinitely many solutions; a system is inconsistent if it has no solution.

Given an example System of Equations:

$$\begin{aligned} x_1 - 2x_2 + x3 &= 0 && (1)\\ 2x_2 - 8x_3 &= 8 && (2)\\ 5x_1 \quad - 5x_3 &= 10 && (3) \end{aligned}$$

The matrix of coefficients is:

$$\begin{bmatrix} 1 & 2 & 1 \\ 0 & 2 & -8 \\ 5 & 0 & -5 \end{bmatrix}$$

The augmented matrix is:

$$\left[\begin{array}{ccc|c} 1 & 2 & 1 & 0 \\ 0 & 2 & -8 & 8 \\ 5 & 0 & -5 & 10 \end{array}\right]$$

A system of linear equations can be solved using elementary row operations. Elementary row operations are:

1. (Replacement) Replace one row by the sum of itself and a multiple of another row.
2. (Interchange) Interchange two rows.
3. (Scaling) Multiply all entries in a row by a nonzero constant.