Math 240: Gaussian Elimination

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Outline

Echelon Forms

Definition

A matrix is in **row-echelon form** if

1. Any row consisting of all zeros is at the bottom of the matrix.
2. For all non-zero rows the leading entry must be a one. This is called the **leading 1**.
3. In consecutive rows the leading 1 in the lower row appears to the right of the leading 1 in the higher row.

Definition

A matrix is in **reduced row-echelon form** if it is in row-echelon form and every leading 1 is the only non-zero entry in its column.

The Row-Echelon Algorithm

Any matrix can be put in Row-Echelon form using row operations:

1. Put a leading one in the (1,1) position.
2. Use this leading one to put zeros beneath it in column 1.
3. Put a leading one in the (2,2) position.
4. So on and so forth.

The **rank** of a matrix is the number of leading ones it has when in Row-Echelon form.

Solving systems using row operations

We will be applying row operations to augmented matrices to find solutions to linear equations.

For **Gaussian** elimination we put the matrix into REF

For **Gauss-Jordan** elimination we put the matrix into RREF

Key Fact: If you alter an augmented matrix by row operations you preserve the set of solutions to the linear system.