

# Numerical methods in Biomedical Engineering

## Tutorial IV

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### 1 Gaussian Elimination using partial pivoting method

Gaussian elimination is used for solving systems of linear equation. In this method, the augmented matrix of coefficients is transformed using elementary row transformations to get an upper triangular matrix. This method is also used to find the rank of a matrix, to calculate the determinant of a matrix, and to calculate the inverse of an invertible square matrix.

It is absolutely necessary to understand how to select the pivot. Here are few suggestions:

1. It is advised, although not necessary, to select a pivot on the diagonal of the original coefficient matrix.
2. Pivot should be selected once per column or row.
3. Column with more number of zeros should be selected, as the whole point of this is to make the column elements below the pivot to be zero.
4. Select a pivot only once.
5. Do not pivot on a zero.
6. Do not pivot on the right hand side.

## 1.1 *The Gauss-Elimination Algorithm:*

```
n  $\leftarrow$  NumberOfVariables
matrix  $\leftarrow$  CoefficientsOfTheLinearEquations
if Matrixii == 0 then
    Swap rows until Matrixii  $\neq$  0.
else
    Proceed.
end if
for i = 1 to n do
    pivot  $\leftarrow$  Matrixii
    for j = i + 1 to n do
        if Matrixji == 0 then
            Proceed.
        else
            ratio = pivot/Matrixji
            Rowj = ratio * Rowi - Rowj
        end if
    end for
    Rowi = Rowi/pivot
end for
if Matrixlastrow == NaN then
    Print the linear equations are unsolvable.
else
    for i = n to 1 do
        Solution = Matrixi,n+1 -  $\sum_{j=1}^n$  Matrixi<n,1:n
    end for
end if
Print the Solution.
```

**Algorithm 1:** Gauss-Elimination with partial pivoting.