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# Prof. Dr. Serkan Dağ
# ME 310 Numerical Methods
# File 5.1
# Naive Gauss Elimination
# Solves an n by n Linear System
restart :
with(LinearAlgebra) :
 Digits := 16 :
# Number of Equations
n := 5 :
# Define Coefficient Matrix
A := Matrix(n, n) :
 A[1, 1] := 2. :
 A[1, 2] := 3. :
 A[1, 3] := 7. :
 A[1, 4] := 4. :
 A[1, 5] := -10 :
 A[2, 1] := 3 :
 A[2, 2] := -1 :
 A[2, 3] := -6 :
 A[2, 4] := 4 :
 A[2, 5] := -11 :
 A[3, 1] := 1 :
 A[3, 2] := 1 :
 A[3, 3] := -3 :
 A[3, 4] := -1 :
 A[3, 5] := -1 :
 A[4, 1] := -1 :
 A[4, 2] := 8 :
 A[4, 3] := -11 :
 A[4, 4] := 1 :
 A[4, 5] := 6 :
 A[5, 1] := 7 :
 A[5, 2] := 1 :
 A[5, 3] := 1 :
 A[5, 4] := -2 :
 A[5, 5] := -5 :
A;
```

$$\begin{bmatrix} 2. & 3. & 7. & 4. & -10 \\ 3 & -1 & -6 & 4 & -11 \\ 1 & 1 & -3 & -1 & -1 \\ -1 & 8 & -11 & 1 & 6 \\ 7 & 1 & 1 & -2 & -5 \end{bmatrix} \quad (1)$$

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# Define Right Hand Side Vector
B := Matrix(n, 1) :
 B[1, 1] := 7 :
 B[2, 1] := 8 :
 B[3, 1] := -1 :
 B[4, 1] := 10 :
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B[5, 1] := 3 :
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> B;
```

$$\begin{bmatrix} 7 \\ 8 \\ -1 \\ 10 \\ 3 \end{bmatrix} \quad (2)$$

```
> # Invoke LinearSolve command for comparison
> LinearSolve(A, B);
```

$$\begin{bmatrix} 1.703258254974853 \\ 0.3888038486770168 \\ -0.1235512792477587 \\ 2.708506450907501 \\ 0.7542094904876455 \end{bmatrix} \quad (3)$$

```
> # Forward elimination
> for i from 1 by 1 to n − 1
  while true do
    for j from i + 1 by 1 to n
    while true do

      B[j, 1] := B[j, 1] − ( A[j, i] / A[i, i] ) · B[i, 1] :

       for k from i + 1 by 1 to n
       while true do

      A[j, k] := A[j, k] − ( A[j, i] / A[i, i] ) · A[i, k];

       end do;
    end do;
  end do;

> # Back substitution
> X[n, 1] := B[n, 1] / A[n, n] :

> for i from 1 by 1 to n − 1
   while true do
   X[i, 1] := B[i, 1] :
   end do:
> for i from 1 by 1 to n − 1
   while true do
    for j from 1 by 1 to i
    while true do
```

$X[n-i,1] := X[n-i,1] - A[n-i,n-j+1]\cdot X[n-j+1,1]$:

end do:

$X[n-i,1] := \frac{X[n-i,1]}{A[n-i,n-i]}$:

end do:

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> # Print the results
> for i from 1 by 1 to n
  while true do

  printf("\n %5.1f %15.10f", i, X[i, 1] );

  end do:
```

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 1.0    1.7032582550
 2.0    0.3888038487
 3.0   -0.1235512792
 4.0    2.7085064509
 5.0    0.7542094905
```

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