

$$\begin{bmatrix} 0.98 \\ -1.1 \\ 2.9 \end{bmatrix} \quad (9)$$

```
> A:= Matrix([ [4.0,1.0,2.0,9.0],
                [2.0,4.0,-1.0,-5.0],
                [1.0,1.0,-3.0,-9.0] ]);
```

$$A := \begin{bmatrix} 4.0 & 1.0 & 2.0 & 9.0 \\ 2.0 & 4.0 & -1.0 & -5.0 \\ 1.0 & 1.0 & -3.0 & -9.0 \end{bmatrix} \quad (10)$$

```
> A:=RowOperation(A,[2,1],-0.5);
```

$$A := \begin{bmatrix} 4.0 & 1.0 & 2.0 & 9.0 \\ 0. & 3.5 & -2.0 & -9.5 \\ 1.0 & 1.0 & -3.0 & -9.0 \end{bmatrix} \quad (11)$$

```
> A:=RowOperation(A,[3,1],-0.25);
```

$$A := \begin{bmatrix} 4.0 & 1.0 & 2.0 & 9.0 \\ 0. & 3.5 & -2.0 & -9.5 \\ 0. & 0.75 & -3.5 & -11. \end{bmatrix} \quad (12)$$

```
> A:=RowOperation(A,[3,2],-0.75/3.5);
```

$$A := \begin{bmatrix} 4.0 & 1.0 & 2.0 & 9.0 \\ 0. & 3.5 & -2.0 & -9.5 \\ 0. & 0.01 & -3.1 & -9.0 \end{bmatrix} \quad (13)$$

```
> A:=RowOperation(A,[1,2],-1.0/3.5);
```

$$A := \begin{bmatrix} 4.0 & 0. & 2.6 & 12. \\ 0. & 3.5 & -2.0 & -9.5 \\ 0. & 0.01 & -3.1 & -9.0 \end{bmatrix} \quad (14)$$

```
> A:=RowOperation(A,[2,3],-2.0/3.1);
```

$$A := \begin{bmatrix} 4.0 & 0. & 2.6 & 12. \\ 0. & 3.5 & 0. & -3.7 \\ 0. & 0.01 & -3.1 & -9.0 \end{bmatrix} \quad (15)$$

```
> A:=RowOperation(A,[1,3],2.6/3.1);
```

$$A := \begin{bmatrix} 4.0 & 0.0084 & 0. & 4.4 \\ 0. & 3.5 & 0. & -3.7 \\ 0. & 0.01 & -3.1 & -9.0 \end{bmatrix} \quad (16)$$

```
> 4.4/4.0; -3.7/3.5; -9.0/3.1;
```

$$\begin{bmatrix} 1.1 \\ -1.1 \\ -2.9 \end{bmatrix} \quad (17)$$

Problem 11a and 15a on pg 383

```
> Digits:=3;
                                     Digits := 3
```

```
> A:=Matrix([
    [0.03,58.9,59.2],
    [5.31,-6.10,47.0]]);
                                     A :=  $\begin{bmatrix} 0.03 & 58.9 & 59.2 \\ 5.31 & -6.10 & 47.0 \end{bmatrix}$ 
```

```
> A:=RowOperation(A,[2,1],-5.31/0.03);
                                     A :=  $\begin{bmatrix} 0.03 & 58.9 & 59.2 \\ 0. & -10400. & -10500. \end{bmatrix}$ 
```

```
> A:=RowOperation(A,[1,2],58.9/10400);
                                     A :=  $\begin{bmatrix} 0.03 & 0. & -0.2 \\ 0. & -10400. & -10500. \end{bmatrix}$ 
```

```
> -0.2/0.03; -10500.0/(-10500.0);
                                     -6.67
                                     1.00
```

```
> A:=Matrix([
    [0.03,58.9,59.2],
    [5.31,-6.10,47.0]]);
                                     A :=  $\begin{bmatrix} 0.03 & 58.9 & 59.2 \\ 5.31 & -6.10 & 47.0 \end{bmatrix}$ 
```

```
> A:=Matrix([
    [5.31,-6.10,47.0],
    [0.03,58.9,59.2]
]);
                                     A :=  $\begin{bmatrix} 5.31 & -6.10 & 47.0 \\ 0.03 & 58.9 & 59.2 \end{bmatrix}$ 
```

```
> A:=RowOperation(A,[2,1],-0.03/5.31);
                                     A :=  $\begin{bmatrix} 5.31 & -6.10 & 47.0 \\ 0. & 58.9 & 58.9 \end{bmatrix}$ 
```

```
> A:=RowOperation(A,[1,2],6.10/58.9);
                                     A :=  $\begin{bmatrix} 5.31 & 0.03 & 53.1 \\ 0. & 58.9 & 58.9 \end{bmatrix}$ 
```

```
> 53.1/5.31; 58.9/58.9;
                                     10.0
                                     1.00
```

Problem 4cd, 5b page 395

```
> restart;
with(LinearAlgebra):
> A:= Matrix([
```

```

[2,-3,-2],
[-3,4,1],
[-2,1,-4]]);
B:= Matrix([
[2,-3,4],
[-3,4,-1],
[4,-1,-2]]);

```

$$A := \begin{bmatrix} 2 & -3 & -2 \\ -3 & 4 & 1 \\ -2 & 1 & -4 \end{bmatrix}$$

$$B := \begin{bmatrix} 2 & -3 & 4 \\ -3 & 4 & -1 \\ 4 & -1 & -2 \end{bmatrix}$$

(28)

```
> A . B;
```

$$\begin{bmatrix} 5 & -16 & 15 \\ -14 & 24 & -18 \\ -23 & 14 & -1 \end{bmatrix}$$

(29)

```

> A:= Matrix([
[3,-1,0],
[2,-2,3],
[-2,1,4]]);
B:= Matrix([
[-1,-2],
[4,-1],
[3,-5]]);

```

$$A := \begin{bmatrix} 3 & -1 & 0 \\ 2 & -2 & 3 \\ -2 & 1 & 4 \end{bmatrix}$$

$$B := \begin{bmatrix} -1 & -2 \\ 4 & -1 \\ 3 & -5 \end{bmatrix}$$

(30)

```
> A . B;
```

$$\begin{bmatrix} -7 & -5 \\ -1 & -17 \\ 18 & -17 \end{bmatrix}$$

(31)

```

> A:= Matrix([
[1,2,0],
[2,1,-1],
[3,1,1]]);
Determinant(A);

```

$$A := \begin{bmatrix} 1 & 2 & 0 \\ 2 & 1 & -1 \\ 3 & 1 & 1 \\ -8 \end{bmatrix}$$

(32)

```
> A:= Matrix([
  [1,2,0,1,0,0],
  [2,1,-1,0,1,0],
  [3,1,1,0,0,1]]);
```

$$A := \begin{bmatrix} 1 & 2 & 0 & 1 & 0 & 0 \\ 2 & 1 & -1 & 0 & 1 & 0 \\ 3 & 1 & 1 & 0 & 0 & 1 \end{bmatrix}$$

(33)

```
> A:=RowOperation(A, [2,1], -2);
```

$$A := \begin{bmatrix} 1 & 2 & 0 & 1 & 0 & 0 \\ 0 & -3 & -1 & -2 & 1 & 0 \\ 3 & 1 & 1 & 0 & 0 & 1 \end{bmatrix}$$

(34)

```
> A:=RowOperation(A, [3,1], -3);
```

$$A := \begin{bmatrix} 1 & 2 & 0 & 1 & 0 & 0 \\ 0 & -3 & -1 & -2 & 1 & 0 \\ 0 & -5 & 1 & -3 & 0 & 1 \end{bmatrix}$$

(35)

```
> A:=RowOperation(A, [3,2], -5/3);
```

$$A := \begin{bmatrix} 1 & 2 & 0 & 1 & 0 & 0 \\ 0 & -3 & -1 & -2 & 1 & 0 \\ 0 & 0 & \frac{8}{3} & \frac{1}{3} & -\frac{5}{3} & 1 \end{bmatrix}$$

(36)

```
> A:=RowOperation(A, [1,2], 2/3);
```

$$A := \begin{bmatrix} 1 & 0 & -\frac{2}{3} & -\frac{1}{3} & \frac{2}{3} & 0 \\ 0 & -3 & -1 & -2 & 1 & 0 \\ 0 & 0 & \frac{8}{3} & \frac{1}{3} & -\frac{5}{3} & 1 \end{bmatrix}$$

(37)

```
> A:=RowOperation(A, [2,3], 3/8);
```

$$A := \begin{bmatrix} 1 & 0 & -\frac{2}{3} & -\frac{1}{3} & \frac{2}{3} & 0 \\ 0 & -3 & 0 & -\frac{15}{8} & \frac{3}{8} & \frac{3}{8} \\ 0 & 0 & \frac{8}{3} & \frac{1}{3} & -\frac{5}{3} & 1 \end{bmatrix}$$

(38)

```
> A:=RowOperation(A,[1,3],2/3*3/8);
```

$$A := \begin{bmatrix} 1 & 0 & 0 & -\frac{1}{4} & \frac{1}{4} & \frac{1}{4} \\ 0 & -3 & 0 & -\frac{15}{8} & \frac{3}{8} & \frac{3}{8} \\ 0 & 0 & \frac{8}{3} & \frac{1}{3} & -\frac{5}{3} & 1 \end{bmatrix}$$

(39)

```
> A:= RowOperation(A,2,-1/3);
A:= RowOperation(A,3,3/8);
```

$$A := \begin{bmatrix} 1 & 0 & 0 & -\frac{1}{4} & \frac{1}{4} & \frac{1}{4} \\ 0 & 1 & 0 & \frac{5}{8} & -\frac{1}{8} & -\frac{1}{8} \\ 0 & 0 & \frac{8}{3} & \frac{1}{3} & -\frac{5}{3} & 1 \end{bmatrix}$$

$$A := \begin{bmatrix} 1 & 0 & 0 & -\frac{1}{4} & \frac{1}{4} & \frac{1}{4} \\ 0 & 1 & 0 & \frac{5}{8} & -\frac{1}{8} & -\frac{1}{8} \\ 0 & 0 & 1 & \frac{1}{8} & -\frac{5}{8} & \frac{3}{8} \end{bmatrix}$$

(40)

```
> B:=DeleteColumn(A,[1,2,3]);
```

$$B := \begin{bmatrix} -\frac{1}{4} & \frac{1}{4} & \frac{1}{4} \\ \frac{5}{8} & -\frac{1}{8} & -\frac{1}{8} \\ \frac{1}{8} & -\frac{5}{8} & \frac{3}{8} \end{bmatrix}$$

(41)

```
> B . Matrix([
[1,2,0],
[2,1,-1],
[3,1,1]]);
```

$$\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

(42)

Problem 1a, 3a of page 403 : straightforward

Problems 1a on pg 465

Solve $Ax=b$

Writing A as $D-B$ with D the diagonal matrix with the diagonal of A , the iteration is

$v_{i+1} \rightarrow MB v_i + Mb$ where $M = D^{-1}$

```
> M:= Matrix([  
  [1/3,0,0],  
  [0,1/6,0],  
  [0,0,1/7]]);
```

$$M := \begin{bmatrix} \frac{1}{3} & 0 & 0 \\ 0 & \frac{1}{6} & 0 \\ 0 & 0 & \frac{1}{7} \end{bmatrix} \quad (43)$$

```
> B:= Matrix([  
  [0,1,-1],  
  [-3,0,-2],  
  [-3,-3,0]]);
```

$$B := \begin{bmatrix} 0 & 1 & -1 \\ -3 & 0 & -2 \\ -3 & -3 & 0 \end{bmatrix} \quad (44)$$

```
> b:= Vector([1,0,4]);
```

$$b := \begin{bmatrix} 1 \\ 0 \\ 4 \end{bmatrix} \quad (45)$$

```
> v:=Vector([0,0,0]);  
for j from 1 to 2 do  
v:= M . B . v +M . b;  
od;
```

$$v := \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$
$$v := \begin{bmatrix} \frac{1}{3} \\ -\frac{1}{6} \\ \frac{1}{2} \end{bmatrix}$$

(46)

$$v := \begin{bmatrix} \frac{1}{9} \\ -\frac{7}{18} \\ \frac{13}{21} \end{bmatrix} \quad (46)$$

Problems 3a on pg 465

Solve $Ax=b$

Writing A as L - U with L the lower triangular matrix with entries on and below the diagonal equal to the entries of A

the iteration is

$v_{i+1} \rightarrow MU v_i + Mb$ where $M = L^{-1}$

```
> M:= MatrixInverse(Matrix([
  [3,0,0],
  [3,6,0],
  [3,3,7]]));
U:= Matrix([
  [0,1,-1],
  [0,0,-2],
  [0,0,0]]);
```

$$M := \begin{bmatrix} \frac{1}{3} & 0 & 0 \\ -\frac{1}{6} & \frac{1}{6} & 0 \\ -\frac{1}{14} & -\frac{1}{14} & \frac{1}{7} \end{bmatrix}$$

$$U := \begin{bmatrix} 0 & 1 & -1 \\ 0 & 0 & -2 \\ 0 & 0 & 0 \end{bmatrix} \quad (47)$$

```
> b:= Vector([1,0,4]);
```

$$b := \begin{bmatrix} 1 \\ 0 \\ 4 \end{bmatrix} \quad (48)$$

```
> v:=Vector([0,0,0]);
for j from 1 to 2 do
v:= M . U . v + M . b;
od;
```

$$v := \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

[

$$v := \begin{bmatrix} \frac{1}{3} \\ -\frac{1}{6} \\ \frac{1}{2} \end{bmatrix}$$

$$v := \begin{bmatrix} \frac{1}{9} \\ -\frac{2}{9} \\ \frac{13}{21} \end{bmatrix}$$

(49)