```
Quit[];

(* METODO DI JACOBI *)

(* Esempio 1. *)

Clear[a, x]
n = 4;
a = {{10, 5, 0, 0}, {5, 10, -4, 0}, {0, -4, 8, -1}, {0, 0, -1, 5}};
b = {6, 25, -11, -11};
x = Table[xx[i], {i, 1, n}];
Det[a];

(* Matrici D ed R *)
d = DiagonalMatrix[Diagonal[a]];
r = a - d;
t = -Dot[Inverse[d], r];
MatrixForm[a]
MatrixForm[b]
MatrixForm[d]
MatrixForm[r]
MatrixForm[t]
Eigenvalues[t] // N
```

$$\begin{pmatrix} 10 & 5 & 0 & 0 \\ 5 & 10 & -4 & 0 \\ 0 & -4 & 8 & -1 \\ 0 & 0 & -1 & 5 \end{pmatrix}$$

$$\begin{pmatrix} 6 \\ 25 \\ -11 \\ -11 \end{pmatrix}$$

$$\begin{pmatrix} 10 & 0 & 0 & 0 \\ 0 & 10 & 0 & 0 \\ 0 & 0 & 8 & 0 \\ 0 & 0 & 0 & 5 \end{pmatrix}$$

$$\begin{pmatrix} 0 & 5 & 0 & 0 \\ 5 & 0 & -4 & 0 \\ 0 & -4 & 0 & -1 \\ 0 & 0 & -1 & 0 \end{pmatrix}$$

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

{-0.679305, 0.679305, -0.116379, 0.116379}

```
sys = Thread[Dot[a, x] == b];
xsol = x /. Solve[sys, x][[1]] // N
Clear[eq, f, ff]
Do[eq[i] = Reduce[sys[[i]], xx[i]], {i, 1, n}];
Do[ff[i] = eq[i][[2]], {i, 1, n}];
f = Table[ff[i], {i, 1, n}];
xk[0] = Table[0.0, {i, 1, n}];
kmax = 100; tol = 1.0 × 10^(-4);
k = 0;
While[k < kmax, sys1 = Table[xx[i] == xk[k][[i]], {i, 1, n}];
sol1 = Solve[sys1, x][[1]]; xk[k + 1] = f /. sol1 // N;
 norm = Max[Abs[xk[k + 1] - xk[k]]]; Print[k, "   ", norm]; If[norm ≤ tol, Break[]];
 k++]
Print[xk[k]]
```

```
{-0.797647, 2.79529, -0.258824, -2.25176}
```

```
0  2.5
1  1.25
2  1.015
3  0.531875
4  0.4665
5  0.246547
6  0.215244
7  0.113786
8  0.0993252
9  0.0525072
10  0.0458342
11  0.0242298
12  0.0211505
13  0.011181
14  0.00976
15  0.00515952
16  0.00450381
17  0.00238089
18  0.00207831
19  0.00109868
20  0.000959048
21  0.000506991
22  0.000442559
23  0.000233954
24  0.000204221
25  0.000107959
26  0.0000942391
{-0.797634, 2.79519, -0.258837, -2.25179}
```

```
(* Esempio 2. *)
Clear[a, x]
n = 3;
a = {{1, 5, 0}, {5, -1, -4}, {0, -4, 0.5}};
b = {6, 25, -11};
x = Table[xx[i], {i, 1, n}];
```

```
(* Matrici D ed R *)
d = DiagonalMatrix[Diagonal[a]];
r = a - d;
t = -Dot[Inverse[d], r];
MatrixForm[a]
MatrixForm[b]
MatrixForm[d];
MatrixForm[r];
MatrixForm[t];
Eigenvalues[t] // N
```

$$\begin{pmatrix} 1 & 5 & 0 \\ 5 & -1 & -4 \\ 0 & -4 & 0.5 \end{pmatrix}$$

$$\begin{pmatrix} 6 \\ 25 \\ -11 \end{pmatrix}$$

$\{-6.66134\times10^{-16} + 7.54983\,i,\ -6.66134\times10^{-16} - 7.54983\,i,\ -8.09641\times10^{-79}\}$

```
sys = Thread[Dot[a, x] == b];
xsol = x /. Solve[sys, x][[1]] // N
Clear[eq, f, ff]
Do[eq[i] = Reduce[sys[[i]], xx[i]], {i, 1, n}];
Do[ff[i] = eq[i][[2]], {i, 1, n}];
f = Table[ff[i], {i, 1, n}];
xk[0] = {-2., 1.6, -9.1};
xk[0] = Table[0.0, {i, 1, n}];
kmax = 10; tol = 1.0×10^(-6);
k = 0;
While[k < kmax, sys1 = Table[xx[i] == xk[k][[i]], {i, 1, n}];
sol1 = Solve[sys1, x][[1]]; xk[k + 1] = f /. sol1 // N;
 norm = Max[Abs[xk[k + 1] - xk[k]]]; Print[k, "  ", norm]; If[norm ≤ tol, Break[]];
 k++]
Print[xk[k]]
```

{-2.01724, 1.60345, -9.17241}

0 25.

1 200.

2 1425.

3 11 400.

4 81 225.

5 649 800.

6 4.62983×10^{6}

7 3.70386×10^{7}

8 2.639×10^{8}

9 2.1112×10^{9}

$\{1.40413\times10^{9},\ 9.64782\times10^{8},\ -2.24661\times10^{9}\}$

```
(* METODO DI GAUSS-SEIDEL *)
```

```
(* Esempio 1. *)
Clear[a, x]
n = 4;
a = {{10, 5, 0, 0}, {5, 10, -4, 0}, {0, -4, 8, -1}, {0, 0, -1, 5}};
b = {6, 25, -11, -11};
x = Table[xx[i], {i, 1, n}];
Det[a]
```

2125

```
(* Matrici D, L ed U *)
d = DiagonalMatrix[Diagonal[a]];
Clear[l, u];
l = Table[0.0, {i, 1, n}, {j, 1, n}];
u = Table[0.0, {i, 1, n}, {j, 1, n}];
Do[l[[i, j]] = a[[i]][[j]], {i, 1, n}, {j, 1, i - 1}];
Do[u[[i, j]] = a[[i]][[j]], {i, 1, n}, {j, i + 1, n}];
t = Dot[Inverse[d - l], u];
```

```
MatrixForm[a]
MatrixForm[b]
MatrixForm[d]
MatrixForm[l]
MatrixForm[u]
MatrixForm[t]
Eigenvalues[t] // N
```

$$\begin{pmatrix} 10 & 5 & 0 & 0 \\ 5 & 10 & -4 & 0 \\ 0 & -4 & 8 & -1 \\ 0 & 0 & -1 & 5 \end{pmatrix}$$

$$\begin{pmatrix} 6 \\ 25 \\ -11 \\ -11 \end{pmatrix}$$

$$\begin{pmatrix} 10 & 0 & 0 & 0 \\ 0 & 10 & 0 & 0 \\ 0 & 0 & 8 & 0 \\ 0 & 0 & 0 & 5 \end{pmatrix}$$

$$\begin{pmatrix} 0. & 0. & 0. & 0. \\ 5 & 0. & 0. & 0. \\ 0 & -4 & 0. & 0. \\ 0 & 0 & -1 & 0. \end{pmatrix}$$

$$\begin{pmatrix} 0. & 5 & 0 & 0 \\ 0. & 0. & -4 & 0 \\ 0. & 0. & 0. & -1 \\ 0. & 0. & 0. & 0. \end{pmatrix}$$

$$\begin{pmatrix} 0. & 0.5 & 0. & 0. \\ 0. & 0.25 & -0.4 & 0. \\ 0. & -0.125 & 0.2 & -0.125 \\ 0. & 0.025 & -0.04 & 0.025 \end{pmatrix}$$

$\{0.461456, 0.0135441, 3.1225 \times 10^{-17}, 0.\}$

```
sys = Thread[Dot[a, x] == b];
xsol = x /. Solve[sys, x][[1]] // N
Clear[eq, f, ff]
Do[eq[i] = Reduce[sys[[i]], xx[i]], {i, 1, n}];
Do[ff[i] = eq[i][[2]], {i, 1, n}];
f = Table[ff[i], {i, 1, n}];
xk[0] = Table[0.0, {i, 1, n}];
kmax = 100; tol = 1.0 × 10^(-4);
k = 0;
While[k < kmax,
 Do[
  sysold = Table[xx[j] == xk[k][[j]], {j, i + 1, n}];
  sysnew = Table[xx[j] == xtemp[j], {j, 1, i - 1}];
  sys1 = Join[sysnew, sysold];
  sol1 = Solve[sys1, x][[1]];
  (*Print[i,sysold,sysnew,sys1,sol1];*)
  xtemp[i] = f[[i]] /. sol1 // N;
  , {i, 1, n}];
 xk[k + 1] = Table[xtemp[i], {i, 1, n}];
 norm = Max[Abs[xk[k + 1] - xk[k]]]; Print[k, "  ", norm]; If[norm ≤ tol, Break[]];
 k++]
Print[xk[k]]
```

{-0.797647, 2.79529, -0.258824, -2.25176}

Solve::svars : Equations may not give solutions for all "solve" variables. ≫

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General::stop : Further output of Solve::svars will be suppressed during this calculation. ≫

0 2.255

1 1.1

2 0.22

3 0.042625

4 0.0188719

5 0.00869773

6 0.00401347

7 0.00185204

8 0.000854635

9 0.000394376

10 0.000181987

11 0.0000839791

{-0.797491, 2.79515, -0.2589, -2.25178}

```
(* Esempio 2. *)
Clear[a, x]
n = 3;
a = {{1, 5, 0}, {5, -1, -4}, {0, -4, 0.5}};
b = {6, 25, -11};
x = Table[xx[i], {i, 1, n}];

(* Matrici D, L ed U *)
d = DiagonalMatrix[Diagonal[a]];
Clear[l, u];
l = Table[0.0, {i, 1, n}, {j, 1, n}];
u = Table[0.0, {i, 1, n}, {j, 1, n}];
Do[l[[i, j]] = a[[i]][[j]], {i, 1, n}, {j, 1, i - 1}];
Do[u[[i, j]] = a[[i]][[j]], {i, 1, n}, {j, i + 1, n}];
t = Dot[Inverse[d - l], u];

MatrixForm[a]
MatrixForm[b]
MatrixForm[d];
MatrixForm[l];
MatrixForm[u];
MatrixForm[t];
Eigenvalues[t] // N
```

$$\begin{pmatrix} 1 & 5 & 0 \\ 5 & -1 & -4 \\ 0 & -4 & 0.5 \end{pmatrix}$$

$$\begin{pmatrix} 6 \\ 25 \\ -11 \end{pmatrix}$$

{-57., 0., 0.}

```
sys = Thread[Dot[a, x] == b];
xsol = x /. Solve[sys, x][[1]] // N
Clear[eq, f, ff]
Do[eq[i] = Reduce[sys[[i]], xx[i]], {i, 1, n}];
Do[ff[i] = eq[i][[2]], {i, 1, n}];
f = Table[ff[i], {i, 1, n}];
xk[0] = Table[0.0, {i, 1, n}];
kmax = 10; tol = 1.0 × 10^(-4);
k = 0;
While[k < kmax,
 Do[
  sysold = Table[xx[j] == xk[k][[j]], {j, i + 1, n}];
  sysnew = Table[xx[j] == xtemp[j], {j, 1, i - 1}];
  sys1 = Join[sysnew, sysold];
  sol1 = Solve[sys1, x][[1]];
  (*Print[i,sysold,sysnew,sys1,sol1];*)
  xtemp[i] = f[[i]] /. sol1 // N;
  , {i, 1, n}];
 xk[k + 1] = Table[xtemp[i], {i, 1, n}];
 norm = Max[Abs[xk[k + 1] - xk[k]]]; Print[k, "  ", norm]; If[norm ≤ tol, Break[]];
 k++]
Print[xk[k]]
```

{-2.01724, 1.60345, -9.17241}

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Solve::svars : Equations may not give solutions for all "solve" variables. ≫

General::stop : Further output of Solve::svars will be suppressed during this calculation. ≫

0 18.

1 1576.

2 89 832.

3 5.12042×10^{6}

4 2.91864×10^{8}

5 1.66363×10^{10}

6 9.48267×10^{11}

7 5.40512×10^{13}

8 3.08092×10^{15}

9 1.75612×10^{17}

$\{-1.89237 \times 10^{15}, -2.15731 \times 10^{16}, -1.72585 \times 10^{17}\}$