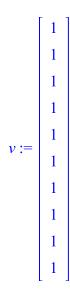> Opgave 1)
```
> MyHilbert:=proc(n)
    local i,j,m;
    m:=Matrix(n);
    for i from 1 to n do
      for j from 1 to n do
        m[i,j] := 1/(i+j-1);
      end do;
    end do;
    m;
> end proc:
```

> Opgave 2)
```
> MyHilbert(5);
```

$$\begin{bmatrix} 1 & \dfrac{1}{2} & \dfrac{1}{3} & \dfrac{1}{4} & \dfrac{1}{5} \\[2mm] \dfrac{1}{2} & \dfrac{1}{3} & \dfrac{1}{4} & \dfrac{1}{5} & \dfrac{1}{6} \\[2mm] \dfrac{1}{3} & \dfrac{1}{4} & \dfrac{1}{5} & \dfrac{1}{6} & \dfrac{1}{7} \\[2mm] \dfrac{1}{4} & \dfrac{1}{5} & \dfrac{1}{6} & \dfrac{1}{7} & \dfrac{1}{8} \\[2mm] \dfrac{1}{5} & \dfrac{1}{6} & \dfrac{1}{7} & \dfrac{1}{8} & \dfrac{1}{9} \end{bmatrix}$$

(1)

> Opgave 3)
```
> LinearAlgebra[HilbertMatrix](5);
```

$$\begin{bmatrix} 1 & \dfrac{1}{2} & \dfrac{1}{3} & \dfrac{1}{4} & \dfrac{1}{5} \\[2mm] \dfrac{1}{2} & \dfrac{1}{3} & \dfrac{1}{4} & \dfrac{1}{5} & \dfrac{1}{6} \\[2mm] \dfrac{1}{3} & \dfrac{1}{4} & \dfrac{1}{5} & \dfrac{1}{6} & \dfrac{1}{7} \\[2mm] \dfrac{1}{4} & \dfrac{1}{5} & \dfrac{1}{6} & \dfrac{1}{7} & \dfrac{1}{8} \\[2mm] \dfrac{1}{5} & \dfrac{1}{6} & \dfrac{1}{7} & \dfrac{1}{8} & \dfrac{1}{9} \end{bmatrix}$$

(2)

> Opgave 4)
```
> RHS:=proc(n)
    local v,m;
    m:=MyHilbert(n);
    v:=Vector(1..n,1);
    LinearAlgebra[MatrixVectorMultiply](m,v);
  end proc:
```

> Opgave 5)
```
> RHS(5);
```

$$\begin{bmatrix} \dfrac{137}{60} \\[6pt] \dfrac{29}{20} \\[6pt] \dfrac{153}{140} \\[6pt] \dfrac{743}{840} \\[6pt] \dfrac{1879}{2520} \end{bmatrix}$$

(3)

> Opgave 6)
```
> for n from 1 to 20 do
    v:=LinearAlgebra[LinearSolve](MyHilbert(n),RHS(n));
  end do;
```

$$v := \begin{bmatrix} 1 \end{bmatrix}$$

$$v := \begin{bmatrix} 1 \\ 1 \end{bmatrix}$$

$$v := \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}$$

$$v := \begin{bmatrix} 1 \\ 1 \\ 1 \\ 1 \end{bmatrix}$$

$$v := \begin{bmatrix} 1 \\ 1 \\ 1 \\ 1 \\ 1 \end{bmatrix}$$

$$v := \begin{bmatrix} 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \end{bmatrix}$$

$$v := \begin{bmatrix} 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \end{bmatrix}$$

$$v := \begin{bmatrix} 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \end{bmatrix}$$

$$v := \begin{bmatrix} 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \end{bmatrix}$$

$$v := \begin{bmatrix} 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \end{bmatrix}$$

$$v := \begin{bmatrix} \textit{1 .. 11 Vector}_{column} \\ \textit{Data Type: anything} \\ \textit{Storage: rectangular} \\ \textit{Order: Fortran\_order} \end{bmatrix}$$

$$v := \begin{bmatrix} \textit{1 .. 12 Vector}_{column} \\ \textit{Data Type: anything} \\ \textit{Storage: rectangular} \\ \textit{Order: Fortran\_order} \end{bmatrix}$$

$$v := \begin{bmatrix} \textit{1 .. 13 Vector}_{column} \\ \textit{Data Type: anything} \\ \textit{Storage: rectangular} \\ \textit{Order: Fortran\_order} \end{bmatrix}$$

$$v := \begin{bmatrix} \textit{1 .. 14 Vector}_{column} \\ \textit{Data Type: anything} \\ \textit{Storage: rectangular} \\ \textit{Order: Fortran\_order} \end{bmatrix}$$

$$v := \begin{bmatrix} \textit{1 .. 15 Vector}_{column} \\ \textit{Data Type: anything} \\ \textit{Storage: rectangular} \\ \textit{Order: Fortran\_order} \end{bmatrix}$$

$$v := \begin{bmatrix} 1 .. 16 \ Vector_{column} \\ Data \ Type: \ anything \\ Storage: \ rectangular \\ Order: \ Fortran\_order \end{bmatrix}$$

$$v := \begin{bmatrix} 1 .. 17 \ Vector_{column} \\ Data \ Type: \ anything \\ Storage: \ rectangular \\ Order: \ Fortran\_order \end{bmatrix}$$

$$v := \begin{bmatrix} 1 .. 18 \ Vector_{column} \\ Data \ Type: \ anything \\ Storage: \ rectangular \\ Order: \ Fortran\_order \end{bmatrix}$$

$$v := \begin{bmatrix} 1 .. 19 \ Vector_{column} \\ Data \ Type: \ anything \\ Storage: \ rectangular \\ Order: \ Fortran\_order \end{bmatrix}$$

$$v := \begin{bmatrix} 1 .. 20 \ Vector_{column} \\ Data \ Type: \ anything \\ Storage: \ rectangular \\ Order: \ Fortran\_order \end{bmatrix} \tag{4}$$

> Opgave 7)
  Vi ser at der ikke er noget output idet der ikke sker nogle errors grundet at Maple udregner symbolsk.

```
> for n from 1 to 10 do
      v:=LinearAlgebra[LinearSolve](MyHilbert(n),RHS(n));
      for i from 1 to n do
        if (v[i] <> 1) then print("Maple error",n,i); end if;
      end do;
  end do:
```

> Opgave 8)
  Benytter sig af den nye funktion hvor værdien bliver evalueret til en float.

```
> MyHilbert:=proc(n)
    local i,j,m;
    m:=Matrix(n);
    for i from 1 to n do
      for j from 1 to n do
```

```
        m[i,j] := evalf(1/(i+j-1));
      end do;
    end do;
    m;
> end proc:
```

> Som vi ser nedenfor resulterer det i en masse errors, da der er blevet regnet med approksimationer og derved er ikke alle koordinater blevet udregnet til værdien 1.

```
> for n from 1 to 10 do
    v:=LinearAlgebra[LinearSolve](MyHilbert(n),RHS(n));
    for i from 1 to n do
      if (v[i] <> 1) then print("Maple error",n,i); end if;
    end do;
  end do:
```

<div align="center">

"Maple error", 2, 1

"Maple error", 2, 2

"Maple error", 3, 1

"Maple error", 3, 2

"Maple error", 3, 3

"Maple error", 4, 1

"Maple error", 4, 2

"Maple error", 4, 3

"Maple error", 4, 4

"Maple error", 5, 1

"Maple error", 5, 2

"Maple error", 5, 3

"Maple error", 5, 4

"Maple error", 5, 5

"Maple error", 6, 1

"Maple error", 6, 2

"Maple error", 6, 3

"Maple error", 6, 4

"Maple error", 6, 5

"Maple error", 6, 6

"Maple error", 7, 1

"Maple error", 7, 2

"Maple error", 7, 3

"Maple error", 7, 4

"Maple error", 7, 5

"Maple error", 7, 6

"Maple error", 7, 7

"Maple error", 8, 1

"Maple error", 8, 2

"Maple error", 8, 3

"Maple error", 8, 4

"Maple error", 8, 5

</div>

$$\text{"Maple error"}, 8, 6$$
$$\text{"Maple error"}, 8, 7$$
$$\text{"Maple error"}, 8, 8$$
$$\text{"Maple error"}, 9, 1$$
$$\text{"Maple error"}, 9, 2$$
$$\text{"Maple error"}, 9, 3$$
$$\text{"Maple error"}, 9, 4$$
$$\text{"Maple error"}, 9, 5$$
$$\text{"Maple error"}, 9, 6$$
$$\text{"Maple error"}, 9, 7$$
$$\text{"Maple error"}, 9, 8$$
$$\text{"Maple error"}, 9, 9$$
$$\text{"Maple error"}, 10, 1$$
$$\text{"Maple error"}, 10, 2$$
$$\text{"Maple error"}, 10, 3$$
$$\text{"Maple error"}, 10, 4$$
$$\text{"Maple error"}, 10, 5$$
$$\text{"Maple error"}, 10, 6$$
$$\text{"Maple error"}, 10, 7$$
$$\text{"Maple error"}, 10, 8$$
$$\text{"Maple error"}, 10, 9$$
$$\text{"Maple error"}, 10, 10$$

(5)

> Opgave 9)
  Vi ser at der ikke er lige så mange errors, da værdierne er mere præcise.

```
> Digits:=100:
> for n from 1 to 10 do
      v:=LinearAlgebra[LinearSolve](MyHilbert(n),RHS(n));
      for i from 1 to n do
        if (v[i] <> 1) then print("Maple error",n,i); end if;
      end do;
   end do;
```

$v :=$

[
1.000000000000000000000000000000000000000000000000000000000000000000000\
0000000000000000000000000000]

$v := [$

[1.000000000000000000000000000000000000000000000000000000000000000000000\
0000000000000000000000000000],
[1.000000000000000000000000000000000000000000000000000000000000000000000\
0000000000000000000000000000]]

$v := [$

[1.000000000000000000000000000000000000000000000000000000000000000000000\
0000000000000000000000000010],

$$[0.99999999999999999999999999999999999999999999999999999999999999999999999\\
99999999999999999999999414],$$
$$[1.00000000000000000000000000000000000000000000000000000000000000000000000\\
0000000000000000000000000056]]$$

                              "Maple error", 3, 1
                              "Maple error", 3, 2
                              "Maple error", 3, 3

$v := [$
$$[0.99999999999999999999999999999999999999999999999999999999999999999999999\\
99999999999999999999999470],$$
$$[1.00000000000000000000000000000000000000000000000000000000000000000000000\\
0000000000000000000000000558],$$
$$[0.99999999999999999999999999999999999999999999999999999999999999999999999\\
99999999999999999999986869],$$
$$[1.00000000000000000000000000000000000000000000000000000000000000000000000\\
0000000000000000000000000843]]$$

                              "Maple error", 4, 1
                              "Maple error", 4, 2
                              "Maple error", 4, 3
                              "Maple error", 4, 4

$v := [$
$$[0.99999999999999999999999999999999999999999999999999999999999999999999999\\
99999999999999999999998135],$$
$$[1.00000000000000000000000000000000000000000000000000000000000000000000000\\
0000000000000000000000003217],$$
$$[0.99999999999999999999999999999999999999999999999999999999999999999999999\\
99999999999999999999866652],$$
$$[1.00000000000000000000000000000000000000000000000000000000000000000000000\\
0000000000000000000000019685],$$
$$[0.99999999999999999999999999999999999999999999999999999999999999999999999\\
99999999999999999999905097]]$$

                              "Maple error", 5, 1
                              "Maple error", 5, 2
                              "Maple error", 5, 3
                              "Maple error", 5, 4
                              "Maple error", 5, 5

$v := [$
$$[0.99999999999999999999999999999999999999999999999999999999999999999999999\\
99999999999999999999997405],$$
$$[1.00000000000000000000000000000000000000000000000000000000000000000000000\\
0000000000000000000000007131],$$
$$[0.99999999999999999999999999999999999999999999999999999999999999999999999\\$$

$$9999999999999999999999528532\,],$$
$$[\,1.0000000000000000000000000000000000000000000000000000000000000000000000000000\backslash$$
$$00000000000000000000000120507\,],$$
$$[\,0.9999999999999999999999999999999999999999999999999999999999999999999999999999\backslash$$
$$99999999999999999999998688285\,],$$
$$[\,1.0000000000000000000000000000000000000000000000000000000000000000000000000000\backslash$$
$$00000000000000000000000051098\,]\,]$$

$$\text{"Maple error", 6, 1}$$
$$\text{"Maple error", 6, 2}$$
$$\text{"Maple error", 6, 3}$$
$$\text{"Maple error", 6, 4}$$
$$\text{"Maple error", 6, 5}$$
$$\text{"Maple error", 6, 6}$$

$v := [$
$$[\,0.9999999999999999999999999999999999999999999999999999999999999999999999999999\backslash$$
$$9999999999999999999999935895\,],$$
$$[\,1.0000000000000000000000000000000000000000000000000000000000000000000000000000\backslash$$
$$00000000000000000000000244767\,],$$
$$[\,0.9999999999999999999999999999999999999999999999999999999999999999999999999999\backslash$$
$$99999999999999999999977216018\,],$$
$$[\,1.0000000000000000000000000000000000000000000000000000000000000000000000000000\backslash$$
$$00000000000000000008624070\,],$$
$$[\,0.9999999999999999999999999999999999999999999999999999999999999999999999999999\backslash$$
$$99999999999999999999845211481\,],$$
$$[\,1.0000000000000000000000000000000000000000000000000000000000000000000000000000\backslash$$
$$00000000000000000013147782\,],$$
$$[\,0.9999999999999999999999999999999999999999999999999999999999999999999999999999\backslash$$
$$99999999999999999999957436440\,]\,]$$

$$\text{"Maple error", 7, 1}$$
$$\text{"Maple error", 7, 2}$$
$$\text{"Maple error", 7, 3}$$
$$\text{"Maple error", 7, 4}$$
$$\text{"Maple error", 7, 5}$$
$$\text{"Maple error", 7, 6}$$
$$\text{"Maple error", 7, 7}$$

$v := [$
$$[\,0.9999999999999999999999999999999999999999999999999999999999999999999999999999\backslash$$
$$9999999999999999999999943435\,],$$
$$[\,1.0000000000000000000000000000000000000000000000000000000000000000000000000000\backslash$$
$$00000000000000000000000237889\,],$$
$$[\,0.9999999999999999999999999999999999999999999999999999999999999999999999999999\backslash$$
$$99999999999999999999974726565\,],$$

$$[1.0000000000000000000000000000000000000000000000000000000000000000000000000 \backslash$$
$$0000000000000000000011440669],$$
$$[0.9999999999999999999999999999999999999999999999999999999999999999999999999 \backslash$$
$$99999999999999999999736899179],$$
$$[1.0000000000000000000000000000000000000000000000000000000000000000000000000 \backslash$$
$$0000000000000000000032318479],$$
$$[0.9999999999999999999999999999999999999999999999999999999999999999999999999 \backslash$$
$$99999999999999999999797768205],$$
$$[1.0000000000000000000000000000000000000000000000000000000000000000000000000 \backslash$$
$$0000000000000000000005068966]]$$

<div align="center">

"Maple error", 8, 1

"Maple error", 8, 2

"Maple error", 8, 3

"Maple error", 8, 4

"Maple error", 8, 5

"Maple error", 8, 6

"Maple error", 8, 7

"Maple error", 8, 8

</div>

$v := [$
$$[1.0000000000000000000000000000000000000000000000000000000000000000000000000 \backslash$$
$$0000000000000000000000217853],$$
$$[0.9999999999999999999999999999999999999999999999999999999999999999999999999 \backslash$$
$$99999999999999999999852347649],$$
$$[1.0000000000000000000000000000000000000000000000000000000000000000000000000 \backslash$$
$$0000000000000000000246561754],$$
$$[0.9999999999999999999999999999999999999999999999999999999999999999999999999 \backslash$$
$$99999999999999999982582822086],$$
$$[1.0000000000000000000000000000000000000000000000000000000000000000000000000 \backslash$$
$$0000000000000000006334767730],$$
$$[0.9999999999999999999999999999999999999999999999999999999999999999999999999 \backslash$$
$$99999999999999999871549110395],$$
$$[1.0000000000000000000000000000000000000000000000000000000000000000000000000 \backslash$$
$$0000000000000000014666690948],$$
$$[0.9999999999999999999999999999999999999999999999999999999999999999999999999 \backslash$$
$$99999999999999999911845743510],$$
$$[1.0000000000000000000000000000000000000000000000000000000000000000000000000 \backslash$$
$$0000000000000000002168893955]]$$

<div align="center">

"Maple error", 9, 1

"Maple error", 9, 2

"Maple error", 9, 3

"Maple error", 9, 4

"Maple error", 9, 5

</div>

$v :=$ [

[0.99999999999999999999999999999999999999999999999999999999999999999999\
9999999999999999999988195635],

[1.00000000000000000000000000000000000000000000000000000000000000000000\
0000000000000000000095714419],

[0.99999999999999999999999999999999999999999999999999999999999999999999\
9999999999999999980587252566],

[1.00000000000000000000000000000000000000000000000000000000000000000000\
0000000000000000016971621637],

[0.99999999999999999999999999999999999999999999999999999999999999999999\
9999999999999999216003221275],

[1.00000000000000000000000000000000000000000000000000000000000000000000\
0000000000000000209826333882],

[0.99999999999999999999999999999999999999999999999999999999999999999999\
9999999999999996634804778296],

[1.00000000000000000000000000000000000000000000000000000000000000000000\
0000000000000000318902974612],

[0.99999999999999999999999999999999999999999999999999999999999999999999\
9999999999999998354066229054],

[1.00000000000000000000000000000000000000000000000000000000000000000000\
0000000000000000035658879616]]

(6)

> Opgave 10)
Dette giver det samme antal errors, da der stadig bliver regnet med 100 digits - dog bliver kun 10 vist.

```
> interface(displayprecision=10):
> for n from 1 to 10 do
    v:=LinearAlgebra[LinearSolve](MyHilbert(n),RHS(n));
    for i from 1 to n do
      if (v[i] <> 1) then print("Maple error",n,i); end if;
```

```
    end do;
end do;
```

$$v := \begin{bmatrix} 1.0000000000 \end{bmatrix}$$

$$v := \begin{bmatrix} 1.0000000000 \\ 1.0000000000 \end{bmatrix}$$

$$v := \begin{bmatrix} 1.0000000000 \\ 1.0000000000 \\ 1.0000000000 \end{bmatrix}$$

"Maple error", 3, 1
"Maple error", 3, 2
"Maple error", 3, 3

$$v := \begin{bmatrix} 1.0000000000 \\ 1.0000000000 \\ 1.0000000000 \\ 1.0000000000 \end{bmatrix}$$

"Maple error", 4, 1
"Maple error", 4, 2
"Maple error", 4, 3
"Maple error", 4, 4

$$v := \begin{bmatrix} 1.0000000000 \\ 1.0000000000 \\ 1.0000000000 \\ 1.0000000000 \\ 1.0000000000 \end{bmatrix}$$

"Maple error", 5, 1
"Maple error", 5, 2
"Maple error", 5, 3
"Maple error", 5, 4
"Maple error", 5, 5

$$v := \begin{bmatrix} 1.0000000000 \\ 1.0000000000 \\ 1.0000000000 \\ 1.0000000000 \\ 1.0000000000 \\ 1.0000000000 \end{bmatrix}$$

"Maple error", 6, 1

"Maple error", 6, 2

"Maple error", 6, 3

"Maple error", 6, 4

"Maple error", 6, 5

"Maple error", 6, 6

$$v := \begin{bmatrix} 1.0000000000 \\ 1.0000000000 \\ 1.0000000000 \\ 1.0000000000 \\ 1.0000000000 \\ 1.0000000000 \\ 1.0000000000 \end{bmatrix}$$

"Maple error", 7, 1

"Maple error", 7, 2

"Maple error", 7, 3

"Maple error", 7, 4

"Maple error", 7, 5

"Maple error", 7, 6

"Maple error", 7, 7

$$v := \begin{bmatrix} 1.0000000000 \\ 1.0000000000 \\ 1.0000000000 \\ 1.0000000000 \\ 1.0000000000 \\ 1.0000000000 \\ 1.0000000000 \\ 1.0000000000 \end{bmatrix}$$

"Maple error", 8, 1

"Maple error", 8, 2

"Maple error", 8, 3

"Maple error", 8, 4

"Maple error", 8, 5

"Maple error", 8, 6

"Maple error", 8, 7

"Maple error", 8, 8

$$v := \begin{bmatrix} 1.0000000000 \\ 1.0000000000 \\ 1.0000000000 \\ 1.0000000000 \\ 1.0000000000 \\ 1.0000000000 \\ 1.0000000000 \\ 1.0000000000 \\ 1.0000000000 \end{bmatrix}$$

"Maple error", 9, 1
"Maple error", 9, 2
"Maple error", 9, 3
"Maple error", 9, 4
"Maple error", 9, 5
"Maple error", 9, 6
"Maple error", 9, 7
"Maple error", 9, 8
"Maple error", 9, 9

$$v := \begin{bmatrix} 1.0000000000 \\ 1.0000000000 \\ 1.0000000000 \\ 1.0000000000 \\ 1.0000000000 \\ 1.0000000000 \\ 1.0000000000 \\ 1.0000000000 \\ 1.0000000000 \\ 1.0000000000 \end{bmatrix}$$

"Maple error", 10, 1
"Maple error", 10, 2
"Maple error", 10, 3
"Maple error", 10, 4
"Maple error", 10, 5
"Maple error", 10, 6
"Maple error", 10, 7
"Maple error", 10, 8
"Maple error", 10, 9

(7)