> *restart*

> *Sistema := diff (x(t), t) = 2·x(t) + 3·y(t), diff (y(t), t) = x(t) + 4·y(t) : Sistema[1]; Sistema[2]*

$$\frac{d}{dt} x(t) = 2 x(t) + 3 y(t)$$

$$\frac{d}{dt} y(t) = x(t) + 4 y(t) \tag{1}$$

>

> *SolGral := dsolve([Sistema]) : SolGral[1]; SolGral[2]*

$$x(t) = \_C1 \, e^{5t} + \_C2 \, e^{t}$$

$$y(t) = \_C1 \, e^{5t} - \frac{1}{3} \_C2 \, e^{t} \tag{2}$$

> *Cond := x(0) = 3, y(0) = -4 : Cond[1]; Cond[2]*

$$x(0) = 3$$

$$y(0) = -4 \tag{3}$$

> *SolPart := dsolve([Sistema, Cond]) : SolPart[1]; SolPart[2]*

$$x(t) = -\frac{9}{4} e^{5t} + \frac{21}{4} e^{t}$$

$$y(t) = -\frac{9}{4} e^{5t} - \frac{7}{4} e^{t} \tag{4}$$

> *restart*

> *with(linalg)*

[*BlockDiagonal, GramSchmidt, JordanBlock, LUdecomp, QRdecomp, Wronskian, addcol,* (5)
  addrow, adj, adjoint, angle, augment, backsub, band, basis, bezout, blockmatrix, charmat,
  charpoly, cholesky, col, coldim, colspace, colspan, companion, concat, cond, copyinto,
  crossprod, curl, definite, delcols, delrows, det, diag, diverge, dotprod, eigenvals,
  eigenvalues, eigenvectors, eigenvects, entermatrix, equal, exponential, extend, ffgausselim,
  fibonacci, forwardsub, frobenius, gausselim, gaussjord, geneqns, genmatrix, grad,
  hadamard, hermite, hessian, hilbert, htranspose, ihermite, indexfunc, innerprod, intbasis,
  inverse, ismith, issimilar, iszero, jacobian, jordan, kernel, laplacian, leastsqrs, linsolve,
  matadd, matrix, minor, minpoly, mulcol, mulrow, multiply, norm, normalize, nullspace,
  orthog, permanent, pivot, potential, randmatrix, randvector, rank, ratform, row, rowdim,
  rowspace, rowspan, rref, scalarmul, singularvals, smith, stackmatrix, submatrix, subvector,
  sumbasis, swapcol, swaprow, sylvester, toeplitz, trace, transpose, vandermonde, vecpotent,
  vectdim, vector, wronskian]

> *A := array([[2, 3], [1, 4]])*

$$A := \begin{bmatrix} 2 & 3 \\ 1 & 4 \end{bmatrix} \tag{6}$$

> *MatExp := exponential(A, t)*

$$MatExp := \begin{bmatrix} \frac{3}{4} e^{t} + \frac{1}{4} e^{5t} & \frac{3}{4} e^{5t} - \frac{3}{4} e^{t} \\[2ex] \frac{1}{4} e^{5t} - \frac{1}{4} e^{t} & \frac{1}{4} e^{t} + \frac{3}{4} e^{5t} \end{bmatrix} \tag{7}$$

> $MatExpIndent := map(rcurry(eval, t = '0'), MatExp)$

$$MatExpIndent := \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \qquad (8)$$

> $MatExpInv := map(rcurry(eval, t = '-t'), MatExp)$

$$MatExpInv := \begin{bmatrix} \frac{3}{4}\,e^{-t} + \frac{1}{4}\,e^{-5t} & \frac{3}{4}\,e^{-5t} - \frac{3}{4}\,e^{-t} \\[2mm] \frac{1}{4}\,e^{-5t} - \frac{1}{4}\,e^{-t} & \frac{1}{4}\,e^{-t} + \frac{3}{4}\,e^{-5t} \end{bmatrix} \qquad (9)$$

> $Ident := simplify(evalm(MatExp \,\&^*\, MatExpInv))$

$$Ident := \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \qquad (10)$$

> $MatExpDer := map(diff, MatExp, t)$

$$MatExpDer := \begin{bmatrix} \frac{3}{4}\,e^{t} + \frac{5}{4}\,e^{5t} & \frac{15}{4}\,e^{5t} - \frac{3}{4}\,e^{t} \\[2mm] \frac{5}{4}\,e^{5t} - \frac{1}{4}\,e^{t} & \frac{1}{4}\,e^{t} + \frac{15}{4}\,e^{5t} \end{bmatrix} \qquad (11)$$

> $MatExpA := evalm(A \,\&^*\, MatExp)$

$$MatExpA := \begin{bmatrix} \frac{3}{4}\,e^{t} + \frac{5}{4}\,e^{5t} & \frac{15}{4}\,e^{5t} - \frac{3}{4}\,e^{t} \\[2mm] \frac{5}{4}\,e^{5t} - \frac{1}{4}\,e^{t} & \frac{1}{4}\,e^{t} + \frac{15}{4}\,e^{5t} \end{bmatrix} \qquad (12)$$

> $Comprob := evalm(MatExpDer - MatExpA)$

$$Comprob := \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix} \qquad (13)$$

> $Xcero := array([3, -4])$

$$Xcero := \begin{bmatrix} 3 & -4 \end{bmatrix} \qquad (14)$$

> $SolPart := evalm(MatExp \,\&^*\, Xcero) : x(t) = SolPart[1]; y(t) = SolPart[2]$

$$x(t) = \frac{21}{4}\,e^{t} - \frac{9}{4}\,e^{5t}$$

$$y(t) = -\frac{9}{4}\,e^{5t} - \frac{7}{4}\,e^{t} \qquad (15)$$

> $restart$
> $with(linalg) :$
> $A := array([[0, 1, 0], [0, 0, 1], [-1, -1, -1]])$

$$A := \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -1 & -1 & -1 \end{bmatrix} \qquad (16)$$

> $MatExp := exponential(A, t)$

$$MatExp := \begin{bmatrix} \dfrac{1}{2}\,e^{-t} + \dfrac{1}{2}\,\cos(t) + \dfrac{1}{2}\,\sin(t) & \sin(t) & \dfrac{1}{2}\,\sin(t) - \dfrac{1}{2}\,\cos(t) + \dfrac{1}{2}\,e^{-t} \\[2mm] -\dfrac{1}{2}\,\sin(t) + \dfrac{1}{2}\,\cos(t) - \dfrac{1}{2}\,e^{-t} & \cos(t) & \dfrac{1}{2}\,\cos(t) - \dfrac{1}{2}\,e^{-t} + \dfrac{1}{2}\,\sin(t) \\[2mm] -\dfrac{1}{2}\,\cos(t) + \dfrac{1}{2}\,e^{-t} - \dfrac{1}{2}\,\sin(t) & -\sin(t) & \dfrac{1}{2}\,e^{-t} - \dfrac{1}{2}\,\sin(t) + \dfrac{1}{2}\,\cos(t) \end{bmatrix} \qquad (17)$$

> $MatExp[1, 1]; MatExp[1, 2]; MatExp[1, 3]; MatExp[2, 1]; MatExp[2, 2]; MatExp[2, 3];$
  $MatExp[3, 1]; MatExp[3, 2]; MatExp[3, 3];$

$$\frac{1}{2}\,e^{-t} + \frac{1}{2}\,\cos(t) + \frac{1}{2}\,\sin(t)$$

$$\sin(t)$$

$$\frac{1}{2}\,\sin(t) - \frac{1}{2}\,\cos(t) + \frac{1}{2}\,e^{-t}$$

$$-\frac{1}{2}\,\sin(t) + \frac{1}{2}\,\cos(t) - \frac{1}{2}\,e^{-t}$$

$$\cos(t)$$

$$\frac{1}{2}\,\cos(t) - \frac{1}{2}\,e^{-t} + \frac{1}{2}\,\sin(t)$$

$$-\frac{1}{2}\,\cos(t) + \frac{1}{2}\,e^{-t} - \frac{1}{2}\,\sin(t)$$

$$-\sin(t)$$

$$\frac{1}{2}\,e^{-t} - \frac{1}{2}\,\sin(t) + \frac{1}{2}\,\cos(t) \qquad (18)$$

> $map(rcurry(eval, t = '0'), MatExp)$

$$\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \qquad (19)$$

> $Cond := array([1, 2, 3])$

$$Cond := \begin{bmatrix} 1 & 2 & 3 \end{bmatrix} \qquad (20)$$

> $SolPart := evalm(MatExp \,\&* \, Cond) : y[1](t) = SolPart[1]; y[2](t) = SolPart[2]; y[3](t)$
  $= SolPart[3];$

$$y_1(t) = 2\,e^{-t} - \cos(t) + 4\,\sin(t)$$

$$y_2(t) = \sin(t) + 4\,\cos(t) - 2\,e^{-t}$$

$$y_3(t) = \cos(t) + 2\,e^{-t} - 4\,\sin(t) \qquad (21)$$

> $Ecua := diff(y(t), t\$3) + diff(y(t), t\$2) + diff(y(t), t) + y(t) = 0$

$$Ecua := \frac{d^3}{dt^3}\,y(t) + \frac{d^2}{dt^2}\,y(t) + \frac{d}{dt}\,y(t) + y(t) = 0 \qquad (22)$$

> $Cond := y(0) = 1, D(y)(0) = 2, D(D(y))(0) = 3$

$$Cond := y(0) = 1, D(y)(0) = 2, D^{(2)}(y)(0) = 3 \qquad (23)$$

> $SolPartEcua := dsolve(\{Ecua, Cond\})$

$$SolPartEcua := y(t) = 2\,\mathrm{e}^{-t} - \cos(t) + 4\sin(t)$$

(24)

>