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> restart
> Sistema := diff(x(t), t) = 2·x(t) + 3·y(t), diff(y(t), t) = x(t) + 4·y(t) : Sistema1; Sistema2;

$$\begin{aligned}\frac{d}{dt} x(t) &= 2 x(t) + 3 y(t) \\ \frac{d}{dt} y(t) &= x(t) + 4 y(t)\end{aligned}\tag{1}$$

> Solucion := dsolve( {Sistema} ) : Solucion1; Solucion2

$$\begin{aligned}x(t) &= \_C1 e^{5t} + \_C2 e^t \\ y(t) &= \_C1 e^{5t} - \frac{1}{3} \_C2 e^t\end{aligned}\tag{2}$$

> Incognita := isolate( Sistema2, x(t) )

$$Incognita := x(t) = \frac{d}{dt} y(t) - 4 y(t)\tag{3}$$

> DerivadaIncognita := diff( Incognita, t )

$$DerivadaIncognita := \frac{d}{dt} x(t) = \frac{d^2}{dt^2} y(t) - 4 \left( \frac{d}{dt} y(t) \right)\tag{4}$$

> EcuacionUnica := expand( subs( x(t) = rhs( Incognita ), lhs( Sistema1 ) - rhs( Sistema1 ) = 0 ) )

$$EcuacionUnica := \frac{d^2}{dt^2} y(t) - 6 \left( \frac{d}{dt} y(t) \right) + 5 y(t) = 0\tag{5}$$

> EcuaCarac := m·2 - 6·m + 5 = 0

$$EcuaCarac := m^2 - 6 m + 5 = 0\tag{6}$$

> Raiz := solve( EcuaCarac )

$$Raiz := 5, 1\tag{7}$$

> SolucionY := y(t) = C1·exp( Raiz1·t ) + C2·exp( Raiz2·t )

$$SolucionY := y(t) = C_1 e^{5t} + C_2 e^t\tag{8}$$

> SolucionX := eval( subs( y(t) = rhs( SolucionY ), Incognita ) )

$$SolucionX := x(t) = C_1 e^{5t} - 3 C_2 e^t\tag{9}$$

> Solucion1; Solucion2

$$\begin{aligned}x(t) &= \_C1 e^{5t} + \_C2 e^t \\ y(t) &= \_C1 e^{5t} - \frac{1}{3} \_C2 e^t\end{aligned}\tag{10}$$

> Sistema1; Sistema2

$$\begin{aligned}\frac{d}{dt} x(t) &= 2 x(t) + 3 y(t) \\ \frac{d}{dt} y(t) &= x(t) + 4 y(t)\end{aligned}\tag{11}$$

> Comprobacion1 := simplify( eval( subs( x(t) = rhs( SolucionX ), y(t) = rhs( SolucionY ), lhs( Sistema1 ) - rhs( Sistema1 ) = 0 ) ) )

$$Comprobacion_1 := 0 = 0\tag{12}$$


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$$\begin{aligned} &> \text{Comprobacion}_2 := \text{simplify}(\text{eval}(\text{subs}(x(t) = \text{rhs}(\text{SolucionX}), y(t) = \text{rhs}(\text{SolucionY}), \\ &\quad \text{lhs}(\text{Sistema}_2) - \text{rhs}(\text{Sistema}_2) = 0))) \\ &\quad \text{Comprobacion}_2 := 0 = 0 \end{aligned} \quad (13)$$

$$\begin{aligned} &> \text{Comprobacion}_3 := \text{simplify}(\text{eval}(\text{subs}(x(t) = \text{rhs}(\text{Solucion}_1), y(t) = \text{rhs}(\text{Solucion}_2), \\ &\quad \text{lhs}(\text{Sistema}_1) - \text{rhs}(\text{Sistema}_1) = 0))) \\ &\quad \text{Comprobacion}_3 := 0 = 0 \end{aligned} \quad (14)$$

$$\begin{aligned} &> \text{Comprobacion}_4 := \text{simplify}(\text{eval}(\text{subs}(x(t) = \text{rhs}(\text{Solucion}_1), y(t) = \text{rhs}(\text{Solucion}_2), \\ &\quad \text{lhs}(\text{Sistema}_2) - \text{rhs}(\text{Sistema}_2) = 0))) \\ &\quad \text{Comprobacion}_4 := 0 = 0 \end{aligned} \quad (15)$$

> restart

$$\begin{aligned} &> AA := \text{array}([ [2, 3], [1, 4] ]) \\ &\quad AA := \begin{bmatrix} 2 & 3 \\ 1 & 4 \end{bmatrix} \end{aligned} \quad (16)$$

> with(linalg) :

$$\begin{aligned} &> \text{MatrizExponencial} := \text{exponential}(AA, t) \\ &\quad \text{MatrizExponencial} := \begin{bmatrix} \frac{3}{4} e^t + \frac{1}{4} e^{5t} & \frac{3}{4} e^{5t} - \frac{3}{4} e^t \\ \frac{1}{4} e^{5t} - \frac{1}{4} e^t & \frac{1}{4} e^t + \frac{3}{4} e^{5t} \end{bmatrix} \end{aligned} \quad (17)$$

$$\begin{aligned} &> \text{MatrizExponencial}[1, 2] \\ &\quad \frac{3}{4} e^{5t} - \frac{3}{4} e^t \end{aligned} \quad (18)$$

$$\begin{aligned} &> \text{DerivadaMatExp} := \text{map}(\text{diff}, \text{MatrizExponencial}, t) \\ &\quad \text{DerivadaMatExp} := \begin{bmatrix} \frac{3}{4} e^t + \frac{5}{4} e^{5t} & \frac{15}{4} e^{5t} - \frac{3}{4} e^t \\ \frac{5}{4} e^{5t} - \frac{1}{4} e^t & \frac{1}{4} e^t + \frac{15}{4} e^{5t} \end{bmatrix} \end{aligned} \quad (19)$$

$$\begin{aligned} &> \text{ProdAAporMatExp} := \text{evalm}(AA \&* \text{MatrizExponencial}) \\ &\quad \text{ProdAAporMatExp} := \begin{bmatrix} \frac{3}{4} e^t + \frac{5}{4} e^{5t} & \frac{15}{4} e^{5t} - \frac{3}{4} e^t \\ \frac{5}{4} e^{5t} - \frac{1}{4} e^t & \frac{1}{4} e^t + \frac{15}{4} e^{5t} \end{bmatrix} \end{aligned} \quad (20)$$

$$\begin{aligned} &> \text{Resta} := \text{evalm}(\text{DerivadaMatExp} - \text{ProdAAporMatExp}) \\ &\quad \text{Resta} := \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix} \end{aligned} \quad (21)$$

$$\begin{aligned} &> \text{Identidad} := \text{map}(\text{rcurry}(\text{eval}, t=0'), \text{MatrizExponencial}) \\ &\quad \text{Identidad} := \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \end{aligned} \quad (22)$$

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> Inversa := map(rcurry(eval, t=-t'), MatrizExponencial)
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$$Inversa := \begin{bmatrix} \frac{3}{4} e^{-t} + \frac{1}{4} e^{-5t} & \frac{3}{4} e^{-5t} - \frac{3}{4} e^{-t} \\ \frac{1}{4} e^{-5t} - \frac{1}{4} e^{-t} & \frac{1}{4} e^{-t} + \frac{3}{4} e^{-5t} \end{bmatrix}$$

(23)

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> IdentidadSegunda := simplify(evalm( MatrizExponencial &* Inversa ) )
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$$IdentidadSegunda := \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

(24)

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