```
> restart
> AA := array([[2, 3], [1, 4]])
```

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

```
> with(linalg) :
> MatExpAA := exponential(AA, t)
```

$$MatExpAA := \begin{bmatrix} \frac{3\,e^{t}}{4} + \frac{e^{5\,t}}{4} & \frac{3\,e^{5\,t}}{4} - \frac{3\,e^{t}}{4} \\ \frac{e^{5\,t}}{4} - \frac{e^{t}}{4} & \frac{e^{t}}{4} + \frac{3\,e^{5\,t}}{4} \end{bmatrix} \tag{2}$$

```
> Identidad := map(rcurry(eval, t = '0'), MatExpAA)
```

$$Identidad := \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \tag{3}$$

```
> DerMatExp := map(diff, MatExpAA, t)
```

$$DerMatExp := \begin{bmatrix} \frac{3\,e^{t}}{4} + \frac{5\,e^{5\,t}}{4} & \frac{15\,e^{5\,t}}{4} - \frac{3\,e^{t}}{4} \\ \frac{5\,e^{5\,t}}{4} - \frac{e^{t}}{4} & \frac{e^{t}}{4} + \frac{15\,e^{5\,t}}{4} \end{bmatrix} \tag{4}$$

```
> ProAAMateExp := evalm(AA &* MatExpAA)
```

$$ProAAMateExp := \begin{bmatrix} \frac{3\,e^{t}}{4} + \frac{5\,e^{5\,t}}{4} & \frac{15\,e^{5\,t}}{4} - \frac{3\,e^{t}}{4} \\ \frac{5\,e^{5\,t}}{4} - \frac{e^{t}}{4} & \frac{e^{t}}{4} + \frac{15\,e^{5\,t}}{4} \end{bmatrix} \tag{5}$$

```
> Comprobar := evalm(ProAAMateExp - DerMatExp)
```

$$Comprobar := \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix} \tag{6}$$

```
> InversaMatExp := simplify(inverse(MatExpAA))
```

$$InversaMatExp := \begin{bmatrix} \frac{e^{-5\,t}\,(3\,e^{4\,t}+1)}{4} & -\frac{3\,e^{-5\,t}\,(e^{4\,t}-1)}{4} \\ -\frac{e^{-5\,t}\,(e^{4\,t}-1)}{4} & \frac{e^{-5\,t}\,(e^{4\,t}+3)}{4} \end{bmatrix} \tag{7}$$

```
> InversDosMatExp := map(rcurry(eval, t = '-t'), MatExpAA)
```

(8)

$$InversDosMatExp := \begin{bmatrix} \frac{3\,e^{-t}}{4} + \frac{e^{-5t}}{4} & \frac{3\,e^{-5t}}{4} - \frac{3\,e^{-t}}{4} \\ \frac{e^{-5t}}{4} - \frac{e^{-t}}{4} & \frac{e^{-t}}{4} + \frac{3\,e^{-5t}}{4} \end{bmatrix} \quad (8)$$

> `ProdUno := simplify(evalm(MatExpAA &* InversDosMatExp))`

$$ProdUno := \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \quad (9)$$

> `ProDos := simplify(evalm(MatExpAA &* InversaMatExp))`

$$ProDos := \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \quad (10)$$

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

$$\frac{d}{dt}x_1(t) = 2\,x_1(t) + 3\,x_2(t)$$

$$\frac{d}{dt}x_2(t) = x_1(t) + 4\,x_2(t) \quad (11)$$

> `CondIni := x[1](0) = 4, x[2](0) = -6`

$$CondIni := x_1(0) = 4, x_2(0) = -6 \quad (12)$$

> `evalm(MatExpAA)`

$$\begin{bmatrix} \frac{3\,e^{t}}{4} + \frac{e^{5t}}{4} & \frac{3\,e^{5t}}{4} - \frac{3\,e^{t}}{4} \\ \frac{e^{5t}}{4} - \frac{e^{t}}{4} & \frac{e^{t}}{4} + \frac{3\,e^{5t}}{4} \end{bmatrix} \quad (13)$$

> `Xcero := array([4, -6])`

$$Xcero := \begin{bmatrix} 4 & -6 \end{bmatrix} \quad (14)$$

> `SolPart := evalm(MatExpAA &* Xcero): x[1](t) = SolPart[1]; x[2](t) = SolPart[2]`

$$\frac{15\,e^{t}}{2} - \frac{7\,e^{5t}}{2} = \frac{15\,e^{t}}{2} - \frac{7\,e^{5t}}{2}$$

$$-\frac{7\,e^{5t}}{2} - \frac{5\,e^{t}}{2} = -\frac{7\,e^{5t}}{2} - \frac{5\,e^{t}}{2} \quad (15)$$

> `Sistema[1]; Sistema[2]`

$$\frac{15\,e^{t}}{2} - \frac{35\,e^{5t}}{2} = \frac{15\,e^{t}}{2} - \frac{35\,e^{5t}}{2}$$

$$-\frac{35\,e^{5t}}{2} - \frac{5\,e^{t}}{2} = -\frac{35\,e^{5t}}{2} - \frac{5\,e^{t}}{2} \quad (16)$$

> `ComprobarUno := simplify(eval(subs(x[1](t) = SolPart[1], x[2](t) = SolPart[2], Sistema[1])))`

$$ComprobarUno := \frac{15\,e^{t}}{2} - \frac{35\,e^{5\,t}}{2} = \frac{15\,e^{t}}{2} - \frac{35\,e^{5\,t}}{2} \tag{17}$$

> $ComprobarDos := simplify(eval(subs(x[1](t) = SolPart[1], x[2](t) = SolPart[2], Sistema[2])))$

$$ComprobarDos := -\frac{35\,e^{5\,t}}{2} - \frac{5\,e^{t}}{2} = -\frac{35\,e^{5\,t}}{2} - \frac{5\,e^{t}}{2} \tag{18}$$

> $ComprobarTres := simplify(subs(t = 0, x[1](t) = SolPart[1]))$

$$ComprobarTres := 4 = 4 \tag{19}$$

> $ComprobarCuatro := simplify(subs(t = 0, x[2](t) = SolPart[2]))$

$$ComprobarCuatro := -6 = -6 \tag{20}$$

> $CondIni$

$$\frac{15\,e^{t}}{2} - \frac{7\,e^{5\,t}}{2} = 4,\ -\frac{7\,e^{5\,t}}{2} - \frac{5\,e^{t}}{2} = -6 \tag{21}$$

> $restart$

> $Sistema := diff(x[1](t), t) = -x[2](t), diff(x[2](t), t) = x[1](t) : Sistema[1]; Sistema[2]$

$$\frac{d}{dt}\,x_1(t) = -x_2(t)$$

$$\frac{d}{dt}\,x_2(t) = x_1(t) \tag{22}$$

> $AA := array([[0, -1], [1, 0]])$

$$AA := \begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix} \tag{23}$$

> $with(linalg) :$

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

$$MatExp := \begin{bmatrix} \cos(t) & -\sin(t) \\ \sin(t) & \cos(t) \end{bmatrix} \tag{24}$$

> $Xcero := array([\_C1, \_C2])$

$$Xcero := \begin{bmatrix} \_C1 & \_C2 \end{bmatrix} \tag{25}$$

> $SolGral := evalm(MatExp \&* Xcero) : x[1](t) = SolGral[1]; x[2](t) = SolGral[2]$

$$x_1(t) = \cos(t)\ \_C1 - \sin(t)\ \_C2$$

$$x_2(t) = \sin(t)\ \_C1 + \cos(t)\ \_C2 \tag{26}$$

> $ComprobarUno := simplify(eval(subs(x[1](t) = SolGral[1], x[2](t) = SolGral[2], lhs(Sistema[1]) - rhs(Sistema[1]) = 0)))$

$$ComprobarUno := 0 = 0 \tag{27}$$

> $ComprobarDos := simplify(eval(subs(x[1](t) = SolGral[1], x[2](t) = SolGral[2], lhs(Sistema[2]) - rhs(Sistema[2]) = 0)))$

$$ComprobarDos := 0 = 0 \tag{28}$$

>