# A simple DE system example

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Here's how to solve $u' = A\,u$ with initial value $u(0) = u_0$. With this method, it's essential that $A$ is diagonalizable.

In[•]:=
```
A = {{7, -1}, {-1, 7}}
```

Out[•]=

$$\begin{pmatrix} 7 & -1 \\ -1 & 7 \end{pmatrix}$$

To write $u_0$ with the subscript, type u[CTRL]_0. Not sure if this is possible on the cloud version. If not, or if you don't want to bother with subscripts, just call the variable u0 instead of $u_0$.

In[•]:=
```
u₀ = {4, 2}
```

Out[•]=

$$\{4, 2\}$$

To make the capital lambda (Λ) symbol, type [ESC]L[ESC]. If your cloud version won't let you do this, just call the variable L instead of Λ.

In[•]:=
```
Λ = DiagonalMatrix[Eigenvalues[A]]
```

Out[•]=

$$\begin{pmatrix} 8 & 0 \\ 0 & 6 \end{pmatrix}$$

In[•]:=
```
V = Transpose[Eigenvectors[A]]
```

Out[•]=

$$\begin{pmatrix} -1 & 1 \\ 1 & 1 \end{pmatrix}$$

In[•]:=
```
c = LinearSolve[V, u₀]
```

Out[•]=

$$\{-1, 3\}$$

Important: put a space between Λ and t. If not, it will be treated as a single variable named "Λt" instead of the product Λ times t.

The underscore is important here. Trust me. I'll explain why later.

In[•]:=
```
decoupledSoln[t_] = MatrixExp[Λ t].c
```

Out[•]=

$$\{-e^{8t}, 3\,e^{6t}\}$$

In[ ]:=
```
uSoln[t_] = V . decoupledSoln[t]
```

Out[ ]=

$$\left\{3\, e^{6\, t} + e^{8\, t},\ 3\, e^{6\, t} - e^{8\, t}\right\}$$