$\frac{8}{2} = 4$ because $2 \cdot 4 = 8$

$\frac{a}{b} = c$ $\quad c \cdot b = a$

$\frac{0}{5} = 0$ because $5 \cdot 0 = 0$

$\frac{7}{0} = a \iff 0 \cdot a = 7$ no solution

$\frac{7}{0}$ DNE

$\frac{0}{0} = a \iff 0 \cdot a = 0$ true for all a

$\frac{0}{0}$ is undefined

$$X' = \begin{bmatrix} -\frac{3}{2} & -\frac{1}{4} \\ -1 & -\frac{3}{2} \end{bmatrix} \vec{X}$$

A

$$\begin{bmatrix} x_1' \\ x_2' \end{bmatrix} \qquad \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

$\lambda = -2, -1$

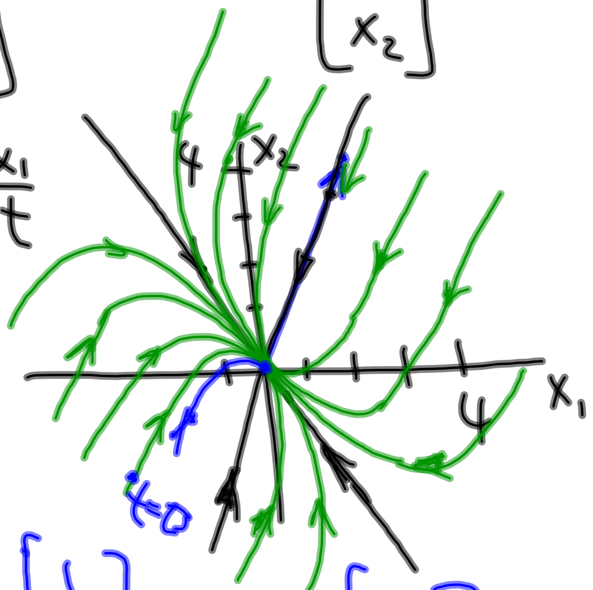
λ_1, λ_2

$\vec{k} = \begin{bmatrix} 1 \\ 2 \end{bmatrix}, \begin{bmatrix} -1 \\ 2 \end{bmatrix}$

$\vec{k}_1 \quad \vec{k}_2$

$A(c\vec{k}_1) = \lambda_1 c \vec{k}_1$

$x_1' = \dfrac{dx_1}{dt}$



At some time, $x_1 = 2$, $x_2 = 4$ and $\dfrac{dx_1}{dt} = -4$, $\dfrac{dx_2}{dt} = -8$

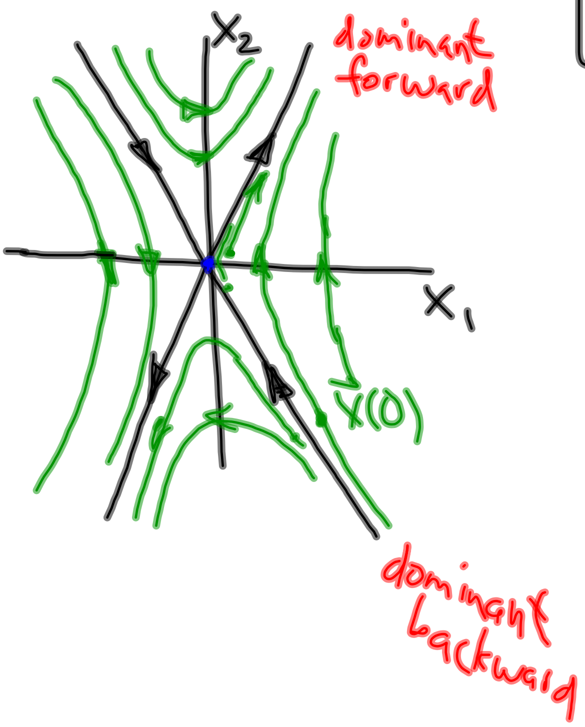
$$\vec{X} = c_1 \begin{bmatrix} 1 \\ 2 \end{bmatrix} e^{-2t} + c_2 \begin{bmatrix} -1 \\ 2 \end{bmatrix} e^{-t}$$

As we go backward in time, t is neg, so first term is dominant. Going forward, $e^{-t} > e^{-2t}$, so second term is dominant.

May 13-9:05 AM

$$\vec{X}' = \begin{bmatrix} 1 & 1 \\ 4 & 1 \end{bmatrix} \vec{X} \qquad \lambda = 3, -1 \qquad \vec{K} = \begin{bmatrix} 1 \\ 2 \end{bmatrix}, \begin{bmatrix} 1 \\ -2 \end{bmatrix}$$

$$\begin{bmatrix} 1 \\ 2 \end{bmatrix} e^{3t} \qquad \begin{bmatrix} 1 \\ -2 \end{bmatrix} e^{-t}$$



....0

$$\vec{X}' = \begin{bmatrix} -\frac{1}{2} & 1 \\ -1 & -\frac{1}{2} \end{bmatrix} \vec{X} \quad \lambda = -\frac{1}{2} \pm i \quad \vec{k} = \begin{bmatrix} 1 \\ \pm i \end{bmatrix}$$

$$e^{\lambda_1 t} = e^{-\frac{1}{2}t}(\cos t + i \sin t)$$

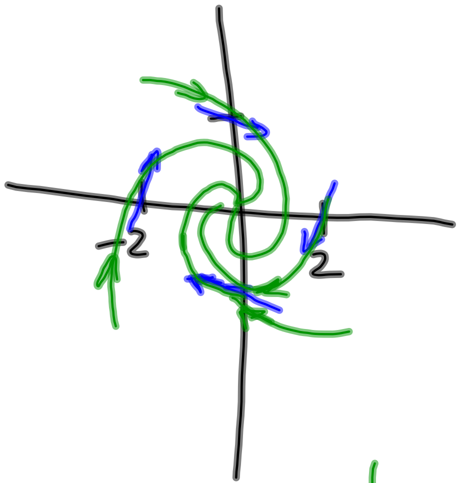
no straight line trajectories

$$\vec{X} = \begin{bmatrix} c_1 \cos t + c_2 \sin t \\ d_1 \cos t + d_2 \sin t \end{bmatrix} e^{-\frac{1}{2}t}$$

causes everything to go into the origin

causes circular or elliptical motion about origin

spiralling inward



Determining spiral:

$$\vec{X}' = \begin{bmatrix} -\frac{1}{2} & 1 \\ -1 & -\frac{1}{2} \end{bmatrix} \begin{bmatrix} 0 \\ 2 \end{bmatrix} = \begin{bmatrix} 2 \\ -1 \end{bmatrix}$$

$$\vec{X}' = \begin{bmatrix} -\frac{1}{2} & 1 \\ -1 & -\frac{1}{2} \end{bmatrix} \begin{bmatrix} 2 \\ 0 \end{bmatrix} = \begin{bmatrix} -1 \\ -2 \end{bmatrix}$$

$$\vec{X}' = \begin{bmatrix} -\frac{1}{2} & 1 \\ -1 & -\frac{1}{2} \end{bmatrix} \begin{bmatrix} -2 \\ 0 \end{bmatrix} = \begin{bmatrix} 1 \\ 2 \end{bmatrix}$$

May 13-9:50 AM