$$A : \mathbb{R}^n \to \mathbb{R}^n$$

$$\dot{\vec{X}} = A X$$

$$A = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$$

$$\left| \begin{pmatrix} a & b \\ c & d \end{pmatrix} - \lambda \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} \right| = 0$$

$$\begin{vmatrix} a - \lambda & b \\ c & d - \lambda \end{vmatrix} = 0$$

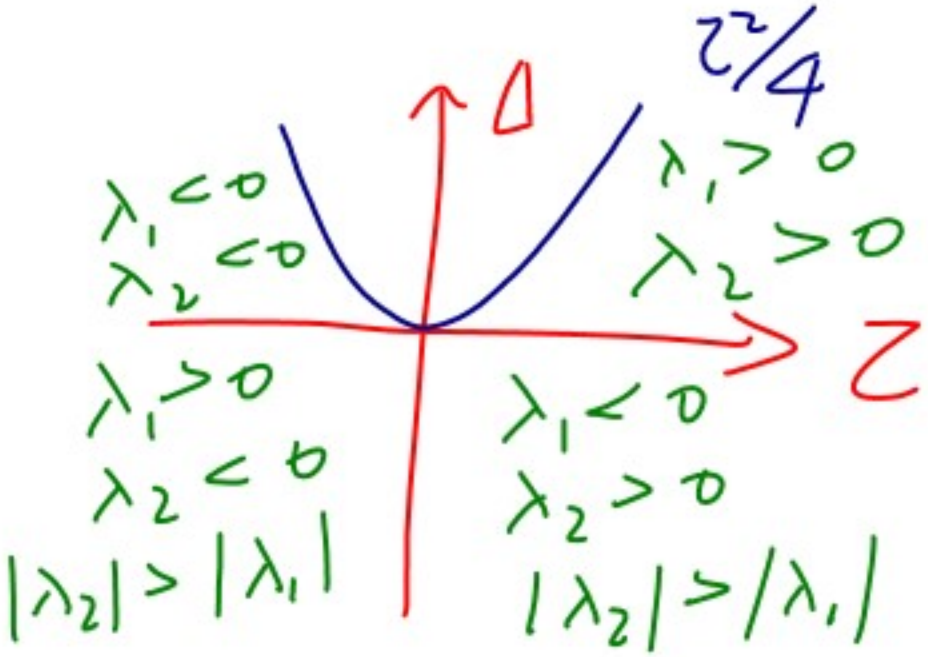
$$\boxed{\lambda^2 - \tau\lambda + \Delta = 0}$$

$$(a - \lambda)(d - \lambda) - cb = 0$$

$$\lambda^2 - \underbrace{(a+d)}_{\tau}\lambda + \underbrace{ad - cb}_{\Delta} = 0$$

$$\lambda^2 - \tau\lambda + \Delta = 0$$

$$\lambda_{1,2} = \frac{\tau}{2} \pm \frac{1}{2}\sqrt{\tau^2 - 4\Delta}$$



$\tau^2 - 4\Delta > 0$ $\quad$ $\lambda_1, \lambda_2 \in \mathbb{R}$ $\quad$ $\lambda_1 \neq \lambda_2$

$$A = P\begin{pmatrix}\lambda_1 & 0 \\ 0 & \lambda_2\end{pmatrix}P^{-1}$$

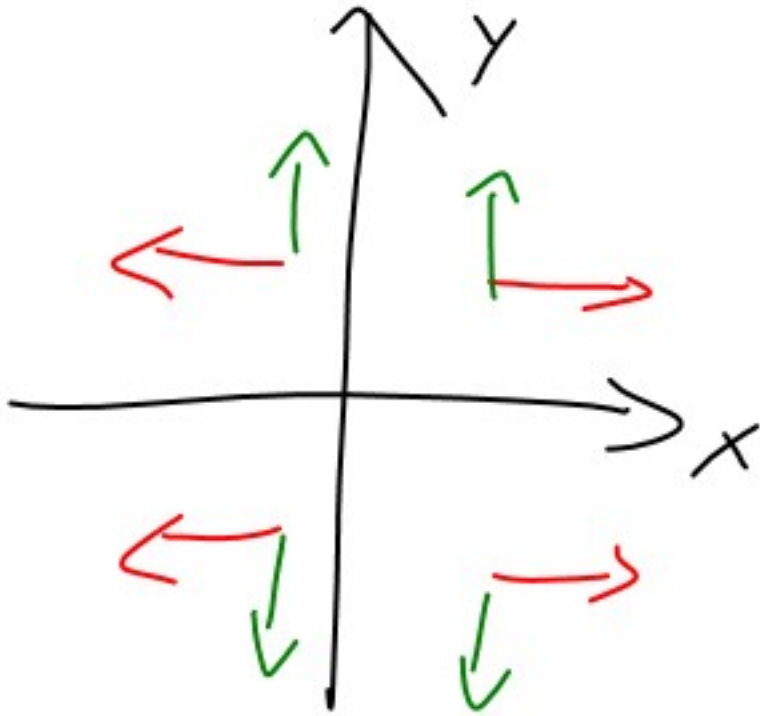
$$|A| = |P||P^{-1}|(\lambda_1\lambda_2) = \lambda_1\lambda_2 = \Delta$$

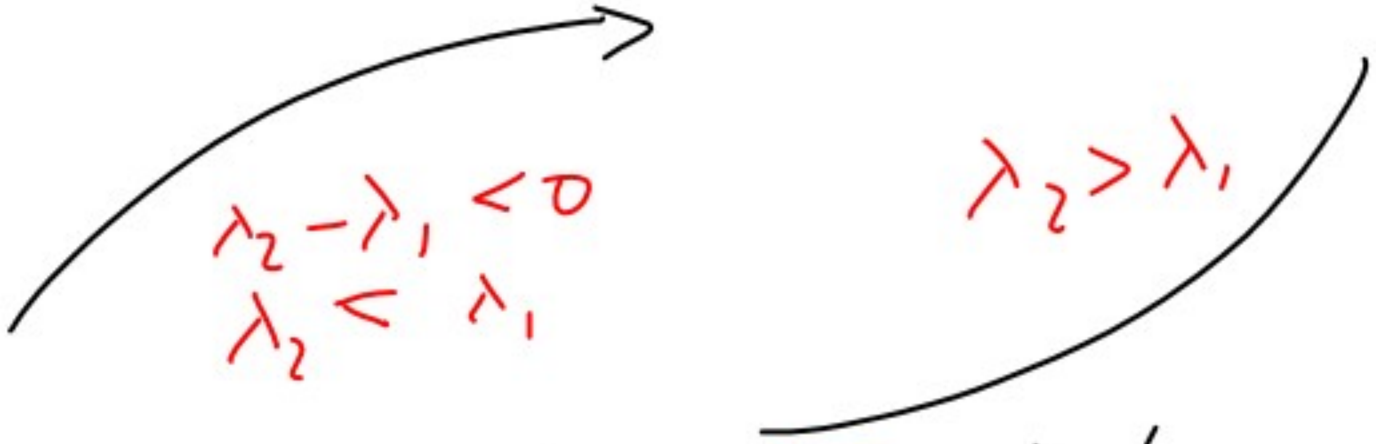
$$\tau = \lambda_1 + \lambda_2$$

$$\begin{pmatrix} \dot{x} \\ \dot{y} \end{pmatrix} = \begin{pmatrix} \lambda_1 & 0 \\ 0 & \lambda_2 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} \quad \lambda_1, \lambda_2 \in \mathbb{R} \quad \lambda_1 \neq \lambda_2$$

$$x_t = x_0 e^{\lambda_1 t}$$
$$y_t = y_0 e^{\lambda_2 t}$$

(1) $\lambda_1 > 0 \quad \lambda_2 > 0$





$$\frac{dy}{dx} = \frac{dy/dt}{dx/dt} = \frac{\lambda_2 y_0 e^{\lambda_2 t}}{\lambda_1 x_0 e^{\lambda_1 t}} = \frac{\lambda_2 y_0}{\lambda_1 x_0} e^{(\lambda_2 - \lambda_1)t}$$