EG $\begin{bmatrix} 4 & 1 \\ 0 & 4 \end{bmatrix}$ diagonalizable? NO

$\det\begin{pmatrix} 4-\lambda & 1 \\ 0 & 4-\lambda \end{pmatrix} = (4-\lambda)^2$

$\Rightarrow$ eigenvalues : $\lambda = 4, 4$

4-eigenspace = $\text{null}\begin{pmatrix} 0 & 1 \\ 0 & 0 \end{pmatrix}$

only 1-dimensional

$\lambda$-Jordan block : $\begin{bmatrix} \lambda & 1 & & \\ & \lambda & 1 & \\ & & \ddots & 1 \\ & & & \lambda \end{bmatrix}$ $m \times m$

eigenvalue $\lambda$ $m$ times repeated

$\lambda$-eigenspace only 1-dimensional

**THM** Every $n \times n$ matrix $A$ can be written as $A = PJP^{-1}$ where

$$J = \begin{bmatrix} J_1 & & \\ & J_2 & \\ & & \ddots \end{bmatrix}$$

with each $J_i$ being a Jordan block

unique up to ordering of $J_i$

$J$ Jordan normal form of $A$