Discrete Dynamical System

$\vec{x}_{k+1} = A\vec{x}_k$, $\vec{x}_0$ is known

Differential System

$\vec{x}'(t) = A\vec{x}(t)$, $\vec{x}(0) = \vec{x}_0$

$\lambda_1, \vec{v}_1$; $\lambda_2, \vec{v}_2$ (Eigenvalues & Eigenvectors)

$\vec{x}_0 = c_1\vec{v}_1 + c_2\vec{v}_2$

Solution Form:

$$\vec{x}_k = c_1\lambda_1^k\vec{v}_1 + c_2\lambda_2^k\vec{v}_2$$

$\{|\lambda_1|, |\lambda_2|\} < 1$ (an attractor)

$\{|\lambda_1|, |\lambda_2|\} > 1$ (a repeller)

$|\lambda_1| < 1, |\lambda_2| > 1$ (A saddle point)

c_1

$$\vec{x}(t) = e^{\lambda_1 t}\vec{v}_1 + c_2 e_2^{\lambda_1 t}\vec{v}_1$$

$\{\mathrm{Re}\,\lambda_1, \mathrm{Re}\,\lambda_2\} < 0$ (an attractor)

$\{\mathrm{Re}\,\lambda_1, \mathrm{Re}\,\lambda_2\} > 0$ (a repeller)

$\mathrm{Re}\,\lambda_1 < 0, \mathrm{Re}\,\lambda_2 > 0$ (a saddle point)