

Eigenvalues and Eigenvectors	Stability and Type of the origin		Long term behavior of solution ( $\lim_{t \rightarrow \infty} \mathbf{X}(t)$ )
2 real-valued evals of opposite sign	Semi-stable	Saddle point	If the initial condition is on the direction of the eigenvector corresponding to the negative eigenvalue, then the solution goes to the origin (0,0). Otherwise, solutions diverge to infinity along the direction of the eigenvector that corresponds to the positive eigenvalue.
2 real-valued evals that are both positive	Unstable	Source node	If the initial condition is (0,0) then solution stays at the origin. Otherwise, they diverge to infinity along the direction of the eigenvector that is more positive.
2 real-valued evals that are both negative	Stable	Sink node	Solutions converge to the origin along the direction of the eigenvector that is less negative.
2 complex evals that with positive real part	Unstable	Spiral	Solutions diverge to infinity along spirals.
2 complex evals that with negative real part	Stable	Spiral	Solutions converge to the origin along spirals.
2 complex evals that are pure-imaginary (real part = 0)	N/A	Center (of circles)	In terms of $t$ , the function $x_1(t)$ and $x_2(t)$ oscillate along the sine and/or cosine curves. On the phase plane, the solutions form circular orbits around the origin.
1 real-value eval that is positive and two linearly independent eigenvectors	Unstable	Star	Solutions emanates from the origin to infinity along straight lines on the phase plane. $x_1(t)$ and $x_2(t)$ are scalar multiple of one another.
1 real-value eval that is negative and two linearly independent eigenvectors	Stable	Star	Solutions converge to the origin along straight lines on the phase plane. $x_1(t)$ and $x_2(t)$ are scalar multiple of one another.
1 real-value eval that is positive and one eigenvector	Unstable	Improper node	Solutions diverge to infinity – either along the direction of the eigenvalue (if the initial conditions start on this direction) or a long some “half-spiral” motion.
1 real-value eval that is negative and one eigenvector	Stable	Improper node	Solutions converge to the origin – either along the direction of the eigenvalue (if the initial conditions start on this direction) or a long some “half-spiral” motion.