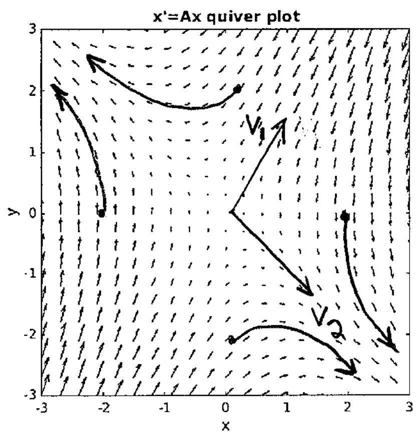
Ungraded homework **Math 527, UNH fall 2015**

Problems 1-6. The following plots show arrows $\mathbf{x}' = d\mathbf{x}/dt$ for linear systems. $\mathbf{x}' = A\mathbf{x}$. In each case, A has distinct eigenvalues and two eigenvectors.

- Say whether the eigenvalues are real or complex.
- If the eigenvalues are real, draw the eigenvectors, label them $\mathbf{v}_1$ and $\mathbf{v}_2$, and specify the signs of λ_1 and λ_2 (e.g Re $\lambda_1 < 0$, Re $\lambda_2 > 0$).
- If the eigenvalues are complex, specify the sign of their real part (e.g Re $\lambda < 0$).
- Draw trajectories starting from the points $(x, y) = (2, 0), (0, 2), (-2, 0)$, and $(0, -2)$.
- If $\mathbf{x}(t) \to 0$ for all choices of initial conditions, then the system $\mathbf{x}' = A\mathbf{x}$ is said to be *stable*. If $\mathbf{x}(t) \to \infty$ for all but very special choices of initial conditions (such as $\mathbf{x}(0)$ lying exactly on an eigenvector), then the system is said tp be *unstable*. Specify whether the system is stable or unstable.

(1)

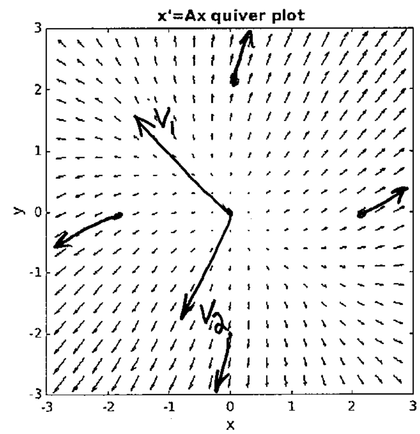


real eigenvalues

$\lambda_1 < 0$, $\lambda_2 > 0$

unstable

(2)



real eigenvalues

$\lambda_1 > 0$, $\lambda_2 > 0$

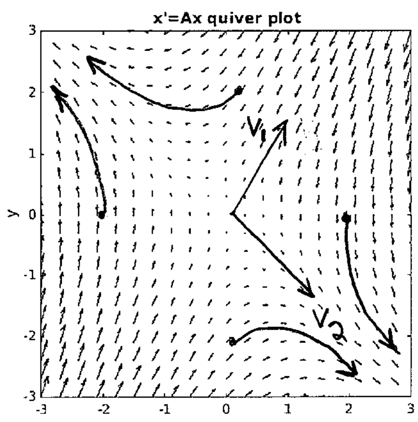
unstable

Note: The subscript labels are arbitrary + interchangeable What's important is that the eigvec pointing up + right has a negative eigval, and the other has a positive eigval.

Problems 1-6. The following plots show arrows $\mathbf{x}' = d\mathbf{x}/dt$ for linear systems. $\mathbf{x}' = A\mathbf{x}$. In each case, A has distinct eigenvalues and two eigenvectors.

- Say whether the eigenvalues are real or complex.
- If the eigenvalues are real, draw the eigenvectors, label them $\mathbf{v}_1$ and $\mathbf{v}_2$, and specify the signs of λ_1 and λ_2 (e.g Re $\lambda_1 < 0$, Re $\lambda_2 > 0$).
- If the eigenvalues are complex, specify the sign of their real part (e.g Re $\lambda < 0$).
- Draw trajectories starting from the points $(x, y) = (2, 0), (0, 2), (-2, 0)$, and $(0, -2)$.
- If $\mathbf{x}(t) \to 0$ for all choices of initial conditions, then the system $\mathbf{x}' = A\mathbf{x}$ is said to be *stable*. If $\mathbf{x}(t) \to \infty$ for all but very special choices of initial conditions (such as $\mathbf{x}(0)$ lying exactly on an eigenvector), then the system is said tp be *unstable*. Specify whether the system is stable or unstable.

(1)

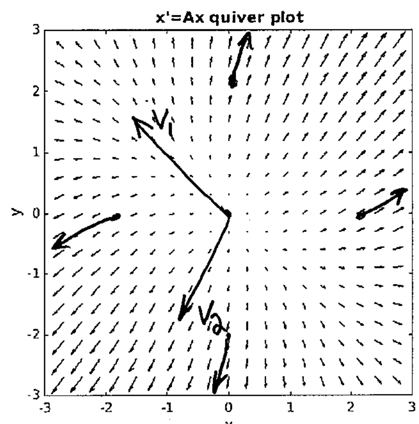


real eigenvalues

$\lambda_1 < 0$, $\lambda_2 > 0$

unstable

(2)

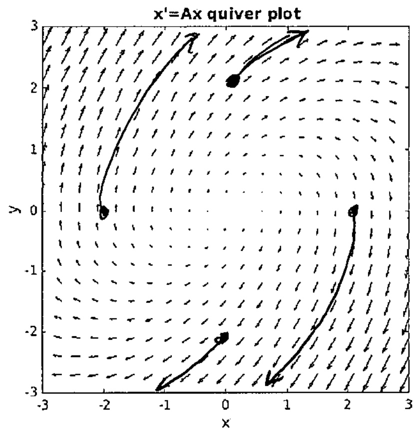


real eigenvalues

$\lambda_1 > 0$, $\lambda_2 > 0$

unstable

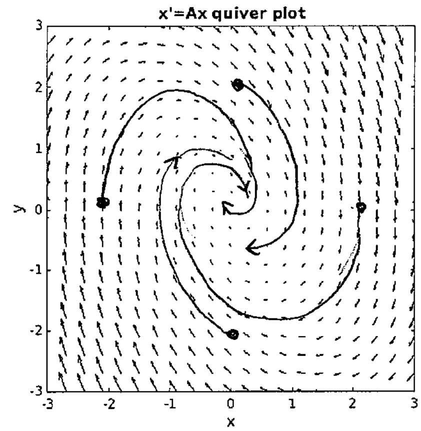
Note: The subscript labels are arbitrary + interchangeable. What's important is that the eigvec pointing up + right has a negative eigval, and the other has a positive eigval.

(3) 

complex eigvals

$Re\,\lambda > 0$

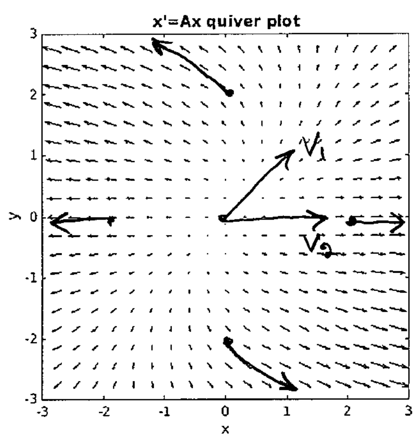
unstable

(4) 

complex eigenvalues

$Re\,\lambda < 0$

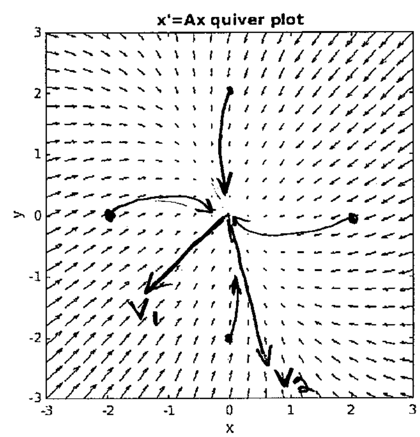
stable

(5) 

real eigenvalues

$\lambda_1 > 0, \ \lambda_2 > 0$

unstable

(6) 

real eigenvalues

$\lambda_1 < 0, \ \lambda_2 < 0$

stable