Two First Order Equations Stability

A third lecture about stability for second order constant coefficient equations. But we will move on to matrices here. So this is a rather special lecture.

So this is our familiar equation.

$$y'' + By' + Cy = 0$$

So that's one second order equation. But we know how to convert it to two first order equations. And here they are

$$\frac{d}{dt}\begin{bmatrix} y \\ y' \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -c & -B \end{bmatrix}\begin{bmatrix} y \\ y' \end{bmatrix}$$

It's first equation said that $dy/dt = y'$. Uh. so that equation is a triviality. And the second one is exactly the previous equation. And this matrix with $0, 1$ is call the **companion matrix**. Our new language is the eigenvalue and the eigenvectors. And our new language for the stable condition would be real part of the eigenvalue less than zero. Stable matrix is real part of the eigenvalues, less zero.

Eigenvalues and eigenvectors are the key to a system of equations.