AM 115 Workshop 2
Equilibrium Stability for Two Dimensional Dynamic Systems

In this workshop, we are going to analyze the stability of a system dynamical model of love affairs. After we fully characterize and solve the linear model, you are going to develop a new *non-linear* model of love affairs by improving on the existing model.

Modeling Romeo's love for Juliet

R = Romeo's love for Juliet
J = Juliet's love for Romeo
(NOTE: positive means love, negative means hate)

$dR(t)/dt = a*R + b*J$

$dJ(t)/dt = c*R + d*J$

a, b, c, and d are proportionality constants that can be either > or < zero.

1) Find the fixed points and analyze the stability of those fixed points.
2) Write a matlab code that uses ode45 to solve the system with for a variety of values of a, b, c, & d. The relative signs of a, b, c, & d dictate what kind of lovers you are modeling.
    a. As an initial example, consider $b > 0$, $c < 0$, and $a = d = 0$. What kind of lovers are we modeling??
    b. Plot the phase plane of Romio's love and Juliet's love
    c. Change the parameter values to model a pair of "Cautious Lovers."
3) Now, improve the model of some particular pair of lovers by making it *non-linear*.
    a. Find the fixed points and stability of the new non-linear model
    b. Solve the new model with ode45
    c. FOR TF: one option:
    $dR/dt = J$
    $dJ/dt = -a*(R^2 - 1)*J - R$
4) Write a script to use the matlab function quiver to plot the stability of the fixed points of the new model.