AM147 11:30am

Class 09: 2D nonlinear systems

Goals for the day:

1. What is the value of linearizing about a fixed point?
2. When does linearizing yield information about the nonlinear system?
3. How do we piece together a more global phase portrait using locally linear phase portraits?

Team problems:

1. Consider the system

$$\begin{aligned}\dot{x} =& x(1-x-y)\\ \dot{y} =& x-y\end{aligned}$$

   (a) Find all fixed points.

   (b) Linearize about the fixed points and classify them as hyperbolic or nonhyperbolic fixed points.

   (c) For hyperbolic fixed points, classify them as stable, unstable, or saddles. If the fixed point has real eigenvalues, find the corresponding eigenvectors.

   (d) Sketch the neighboring trajectories of the fixed points, along with nullclines of the system, to try to sketch a plausible phase portrait.

2. (6.3.1) Follow the steps above for the system

$$\begin{aligned}\dot{x} =& x-y\\ \dot{y} =& x^2-4\end{aligned}$$

3. (6.3.2) Follow the steps above for the system

$$\begin{aligned}\dot{x} =& \sin y\\ \dot{y} =& x-x^3\end{aligned}$$