This Lecture Activity is designed to have you actively work with the lecture notes presented in class and available on my website. This activity is meant to keep you engaged and current with the class, so there is a fairly rapid turn around (due by **Sat. Mar 19 by noon**). There are 3 problems that require written answers, which are entered into **Gradescope**.

Note: For full credit you must show intermediate steps in your calculations.

For the following 1^{st} order systems of differential equations, find the general solution (real). Include your calculations of eigenvalues and eigenvectors. Sketch the phase portrait for typical solutions. When the eigenvectors are real, show the eigenvectors in the phase portrait. State the **type of node** for each of these 3 problems.

1. (5pts) Consider

$$\dot{\mathbf{x}} = \begin{pmatrix} 0 & 1 \\ -4 & 5 \end{pmatrix} \mathbf{x}, \qquad \mathbf{x}(0) = \begin{pmatrix} 1 \\ 10 \end{pmatrix}$$

Give the specific solution to the initial value problem and show its trajectory in your phase portrait. (Slides LinSysB 15–48)

2. (5pts) Consider

$$\dot{\mathbf{x}} = \begin{pmatrix} -3 & 5 \\ -2 & -1 \end{pmatrix} \mathbf{x}, \qquad \mathbf{x}(0) = \begin{pmatrix} -2 \\ 2 \end{pmatrix}$$

Give the specific solution to the initial value problem and show its trajectory in your phase portrait. (Slides LinSysB 15–48)

3. (6pts) Consider:

$$\begin{aligned} \frac{dx_1}{dt} &= -2\,x_1 + 4\,x_2 + 2, \\ \frac{dx_2}{dt} &= x_1 + x_2 - 4. \end{aligned}$$

Find the equilibrium and include this in your phase portrait.
(Slides LinSysA 10–17, LinSysB 15–48)