



- ★ Homework #11
 - ★ Systems of ODEs, *Trace-Determinant* plane
 - ★ Please prepare to present your solutions to class in the next meeting. Also, any question about past homework may be brought up.
 - ★ Students on path to a Ph.D. want to practice:
 - (a) typing up the answers and including graphs and matrices using \TeX .
 - (b) learning to use an appropriate software to aid in calculations.
 - (c) proving conceptual assertions.
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1- The coefficient matrix of several systems of ODEs are given. Use the (T, D) plane analysis to describe the type of trajectories of solutions in the phase plane for each system. Use all applicable adjectives such as spiral, node, saddle, hyperbola, center/ellipse, comb, stable, unstable, specify CW or CCW for spirals and centers.

$$\begin{pmatrix} 2 & 4 \\ 1 & 2 \end{pmatrix}, \begin{pmatrix} 3 & 5 \\ -8 & -3 \end{pmatrix}, \begin{pmatrix} -0.5 & 1 \\ -2.25 & -0.5 \end{pmatrix}, \begin{pmatrix} -2 & 7 \\ 3 & -2 \end{pmatrix}, \begin{pmatrix} -1 & 2 \\ 3 & -1 \end{pmatrix}, \begin{pmatrix} 2 & 4 \\ 3 & 2 \end{pmatrix}, \\ \begin{pmatrix} 3 & 2 \\ 6 & 4 \end{pmatrix}, \begin{pmatrix} 2 & -5 \\ 4 & -2 \end{pmatrix}, \begin{pmatrix} 2 & -3 \\ 4 & -6 \end{pmatrix}, \begin{pmatrix} 4 & 2 \\ 3 & -4 \end{pmatrix},$$

2- Describe the solution of the following parametric ODEs as its parameter ranges over real numbers

$$\begin{pmatrix} -1 & a \\ 2 & 3 \end{pmatrix}, \begin{pmatrix} a & 2 \\ -2 & 1 \end{pmatrix}, \begin{pmatrix} 3 & 2 \\ a & 1 \end{pmatrix}$$

3- Describe solution of ODEs with the following coefficient matrix

$$\begin{pmatrix} 3 & 1 \\ 0 & 3 \end{pmatrix}, \begin{pmatrix} b & 1 \\ 0 & b \end{pmatrix}$$
