

**Dynamical Systems (550.391)**  
**Homework 2 (Due Thursday, September 29, 2005)**

**General Directions:** You must show all work and document any assumptions to receive full credit on a problem.

Part I: Linear Stability Analysis

1. Strogatz, Problem 2.4.2
2. Strogatz, Problem 2.4.4

Part II: Existence and Uniqueness

1. Strogatz, Problem 2.5.1

Use the Existence and Uniqueness Theorem (see p.27 in the text) to discuss the existence and uniqueness of solutions to the following initial value problems (IVPs):

2.

$$\frac{dx}{dt} = \ln(1 + x^2) \quad x(0) = 0$$

3.

$$\frac{dx}{dt} = -\sqrt{1 - x^2} \quad x(0) = 1 \text{ on the interval } [0, \pi]$$

(*Note:* For a discussion of slope fields, see example 2.8.1.) By hand, create the slope field for the following differential equations. Augment your graphic by sketches of representative solution curves.

4.

$$\frac{dx}{dt} = -\sqrt{1 - x^2}$$

5. (See Section 2.1 for a discussion of this ODE.)

$$\frac{dx}{dt} = \sin x$$

Part III: Saddle-Node Bifurcations

1. Strogatz, Problem 3.1.4
2. Strogatz, Problem 3.1.5(a)

Part IV: Transcritical Bifurcations

1. Strogatz, Problem 3.2.2
2. Strogatz, Problem 3.2.3