# Math5345: Computational Methods III

**Instructor:** Long Lee (Ross Hall 212, 307-7664-368, `llee@uwyo.edu`)
**Class web page:** `http://www.uwyo.edu/llee/teaching/Fall2005`
**Office hours:** MWF 2:10-3:10pm
**Class meets:** MWF 1:10-2:00pm

**Prerequisites:** Computational Methods I, II

**Text:** R. J. LeVeque, "Finite Volume Methods for Hyperbolic Problems", Cambridge Texts in Applied Mathematics.

**Objectives:** In this course, we will explore the mathematics of hyperbolic problems and how it is used to develop numerical methods for solving them. We will study finite-volume methods, such as Godunov method and high-resolution extensions. We will study linear problems in details. The linear theory is simpler and is fundamental to understanding the nonlinear theory. Then we will turn to nonlinear hyperbolic conservation laws which admit shock wave solution, and a variety of new mathematical and computational difficulties.

**Topics:** We cover topics such as linear systems and the numerical solution of differential equations, in particular, numerical solutions to hyperbolic systems of partial differential equations arising from modeling phenomena involving wave propagation or advective flow. A few examples for the applications of such systems include:

1. acoustic waves in the atmosphere, the ocean, or solid,
2. elastic waves in solids, e.g. seismic waves in the earth,
3. shock waves and rarefaction waves in gas dynamics,
4. electromagnetic waves, including visible light, radar,
5. shallow water waves in ocean modeling,
6. porous media flow, e.g. water or petroleum under the earth.

**Programming:** Programming is part of the course; each student will be expected to learn Matlab or Fortran and use it on some of the homework assignments. Online tutorials are listed on the web page.

**Homework:** Homework and/or programming projects will be given approximately bi-weekly and posted on the course website. Collaboration on homework is allowed and encouraged but copying from another person is prohibited.

**Grading :** Based on homework and projects.