PHYS 440/640 Computational Physics

Dates and Location:
Th 2:30PM - 3:45PM Janet & Walter Sondheim 207
Mo 3:00PM - 4:15PM Physics 226A

INSTRUCTOR: Dr. Zhibo Zhang
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OFFICE HOURS: PHYS417: Friday 2:00~3:00PM or Through Email

TEXTS:
"Computational Physics: Problem Solving with Computers" (2nd edition) By R. H. Landau et al. Published by WILEY-VCH

GRADING:
Homework (30%), Midterm Project (20%), Final Project (30%), Participation/Discussion (20%)

COURSE OUTLINE:

- **Computer Setup And Programing Warm-Up (Week 1~2)**
  - Computer Setup
  - Python programming basics
  - Numpy and Matplotlib
- **Understanding Errors and Uncertainties In Numerical Computations**
  - Type of Errors
  - Tricks to control errors
- **Monte Carlo method**
  - 1-D random walk
  - 3-D random walk
  - Real-world Problem: Photon scattering in cloud
- **Numerical Integration**
  - Quadrature methods
  - Monte Carlo method

- Real-world Problem: Integrate Radiance to Flux

Project: 1)

- **Numerical Differentiation and Root Searching**
  - Bisect method
  - Newton-Raphson method
  - Real-world Problem: Cloud property remote sensing
- **Midterm Projects**
- **Linear algebra and matrix computing**
  - Matrix inversion and Eigenvalue
  - Singular value decomposition
  - Real-world problem: Greenhouse effect and atmospheric temperature profile
- **Data fitting**
  - Quadrature fitting
  - Lest-square fitting
  - Real-world problem: Satellite data analysis
- **Differential Equations: ODE and PDE (if time permits)**
  - Trajectory
  - Wave equation
  - Real-world problem: Maxwell Eq. and E&M wave propagation
- **Final Projects**