Introduction to computational methods, with applications to planetary motion, numerical integration, chaotic oscillations, percolation, random walks, diffusion limited aggregation, molecular dynamics simulation, Monte Carlo methods, and Fourier transforms. 2 lectures, 2 one-hour laboratories.

Prereq: PHYS 251, MATH 166 and CSCI 160 or ECE 173. Coreq: PHYS 252.

Instructor: Alexander Wagner
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Meetings: 9:00-10:45 Tu & Th, South Engineering 221
Office Hours: Wednesday 11-12am and by arrangement

Texts: Alexander Wagner
Computational Physics lecture notes
Optional: Harvey Gould, Jan Tobochnik, Wolfgang Christian
An introduction to Computer Simulation Methods
Third Edition, Pearson/ Addison Wesley

Topics:

- week 01 Introduction to linux/ programing background/ graphics/ discrete examples/ writing L\TeX documents.
- week 02 Discrete dynamics, chaos, fractals
- week 03 Continuous motion: solving Newton’s equations, Euler and Verlet algorithms
- week 04 The 1/r^2 force law: Planetary dynamics, simulating the solar system, predicting eclipses etc.
- week 05 The Lenard Jones potential: periodic boundary conditions, Molecular Dynamics (MD). Measuring velocity distribution/pressure.
- week 06 The Monte Carlo algorithm: examining the Lennard Jones particle system again.
- week 07 Using MD to look at hydrodynamics.
- week 08 Lattice gases for hydrodynamics, viscosity, sound and shock waves.
- week 09 Boltzmann analysis of lattice gases
- week 10 Lattice Boltzmann methods
- week 11 Determining students projects
- week 12-14 Discussion of student project issues
- week 15 Finalizing student Project papers and presentations

Schedule: There will be a Midterm and a final. Student projects are very flexible and fully dependent on the student’s interests. Subjects of past projects include sound waves, turbulent flows, boiling simulations, phase-separation, evaporation, rocket launch simulations, predictions of transits of venus, and many others.

Grading: Problems 25%, Midterm 25%, Participation 10%, Projects 40%
A:90% – 100 %; B:80% – 89 %; C:60% – 79 %; D:40% – 59 %; F:0% – 40 %

- Any students with disabilities who need accommodation in this course are encouraged to speak with the instructor as soon as possible to make appropriate arrangements.
- All work done in this course must be completed in a manner consistent with NDSU University Senate Policy, section 355: Code of Academic Responsibility and Conduct (http://www.ndsu.nodak.edu/policy/355.htm)