PHYSICS 3510
Physics, Computation and Software Applications
Fall 2026

Lecture, Phys 311, TTh 9:35 – 10:55am

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Office Hours:	Thursday 11am–12pm, and by appointment

Required Text: *None*

Optional Reading:

Computational Physics, by Mark Newman, CreateSpace Independent Publishing (2012)

Computational modeling and visualization of physical systems with Python, by Jianyi Wang, Wiley (2016)

A Primer on Scientific Programming with Python, by Hans Petter Langtangen, Springer (2009)

Computational Physics, by Rubin H. Landau and Manuel J. Paez, Wiley (2015)

A student's guide to Python for physical modeling, by Jesse M. Kinder and Philip Nelson, Princeton Press.

Python Crash Course: A Hands-on, Project-based Introduction to Programming, by Eric Matthes, No Starch Press (2022)

Topics and General Information:

The course provides a basic survey of selected topics at the intersection of computer science, engineering, and physics. So far in your coursework, you may have focused mostly on approaching and solving physics problems analytically, such as solving for projectile motion or planet orbitals. But take away all the idealized assumptions and restrictions – now including air drag for a projectile or considering the coupled motion of three planets and more – and suddenly an elegant analytical solution is no longer tractable! In this course you will learn numerical techniques to simulate more realistic physical processes and learn how to program a computer to achieve that. The course will be cover:

Python Basics. Overview of computer languages and tools: variable declaration and assignment, input/output, conditional statements, loops, introduction to numerical methods (finite differences, integration, series, differential equations). Debugging.

Modeling of physical problems. Setup and implementation of basic physical models, including classical mechanical systems and nonlinear dynamics, population dynamics, planetary motion, projectile motion, random walk and diffusion models, molecular dynamics, and cellular automata. Introduction to advanced topics of Python programming: arrays and linear algebra methods; derived types/classes and basics of object-oriented programming, visualization in two and three dimensions, error analysis, and curve fitting.

By the end of the course, you should be able to:

- Understand basics data types in Python 3
- Use Python to read and write data
- Use numerical methods for solving ordinary differential equations
- Use simulations to model random physical processes, e.g. random walk and percolation

- Visualize numerical results using plots and animations
- Perform basic statistical operations and error analysis on data
- Numerically model mechanical and statistical problems in physics, e.g. projectile motion, planetary motion, harmonic oscillators, ideal gas, and viral outbreaks.
- Establish a toolset and mindset of a computational scientist that will be useful for all your other coursework and future opportunities in research.

Grading: There will be no exam. Grades will consist of completed modules (80%) and class participation (20%, for attendance and discussions). Modules will be submitted as jupyter notebooks. The module with the lowest score will be dropped at the end. If you cannot attend a lecture, please let me know ahead of time.

A note on LLM use: This course does not prohibit the use of LLMs. However, I do not encourage you in using them extensively in this intro course to help you code. Everyone learns through struggling, and using LLMs for your coding homework is like lifting weights with a forklift, a really resource-intensive (energy and water) forklift. When something doesn't work, test run your code, simplify it, experiment with it, look for tutorials or documentation online at the source. If you are really using LLMs (e.g. for something truly obscure or something you have already done many times), always make sure you can validate the results yourself.
Do I use LLMs? Yes. This course was designed before LLMs were born. For this semester I will be using LLMs in expanding course materials by 5–10%, where I will always disclose how I use them – I expect the same from you. In accordance with the UNT Honor Code, unauthorized use of LLM tools is prohibited. Using them without proper credit or substituting your own work with LLM results undermines the learning process and violates academic integrity. If you're unsure whether something is allowed, please seek clarification with me.

Other Information

Canvas. The Canvas module section will be used to post course materials, lecture notes, announcements, grades, and the most up-to-date version of this syllabus.

Course Evaluation – Student Perceptions of Teaching (SPOT). Student feedback is an essential part of participation in this course. Providing the student evaluation of instruction instrument is a requirement for all organized classes at UNT.

A short SPOT survey will provide you with an opportunity to evaluate how this course is taught. You will receive an email from "UNT SPOT Course Evaluations via IASystem Notification" (no-reply@iasystem.org) with the survey link. Simply click on the link and complete your survey. Once you complete the survey you will receive a confirmation email. For additional information, please email spot@unt.edu.

Office hours. Connect with me through attending office hours on Thursday 11am–12pm right after class! During busy times my inbox may be rather full - if you contact me and don't receive a response within two business days, please send a follow-up email. A gentle nudge is always appreciated.

ADA Policy. UNT makes reasonable academic accommodation for students with disabilities. Students seeking accommodation must first register with the Office of Disability Access (ODA) to verify their eligibility. If a disability is verified, the ODA will provide a student with an accommodation letter to be delivered to faculty to begin a private discussion regarding one's specific course needs. Students may request accommodations at any time; however, ODA notices of accommodation should be provided as early as possible in the semester to avoid any delay in implementation. Note that students must obtain a new letter of accommodation for every semester and must meet with each faculty member prior to implementation in each class. For additional information see the ODA website at disability.unt.edu .

Academic Integrity: UNT policy on Academic Dishonesty can be found at https://vpaa.unt.edu/ss/integrity

Unauthorized Aids During Examinations and Assessments. Students may use only those materials and resources that are expressly authorized by the instructor for a particular examination or assessment. Touching, holding, or accessing any unauthorized aid during the examination period constitutes a violation of the Student Code of Conduct, regardless of whether the aid is used.

Any item that may be considered an unauthorized aid must be kept out of view and in a closed container (e.g. zipped backpack, buttoned purse, etc.) during the entirety of the examination or assessment.

Unless specifically authorized in writing by the instructor, prohibited aids include, but are not limited to:

- Mobile phones and smartphones
- Smartwatches and fitness trackers with communication, recording, or internet capabilities
- Earbuds, headphones, and other audio devices
- Smart glasses, cameras, recording devices, and wearable technology
- Artificial intelligence (AI) tools, chatbots, and other generative AI technologies
- Notes, textbooks, study guides, formula sheets, or reference materials
- Any other device, material, or resource not expressly permitted by the instructor

Students are responsible for clarifying any questions about permitted materials before the examination begins.