PHYSICS 3510
Physics, Computation and Software Applications
Fall 2022

Lecture, GAB 550A, TTh 9:30 – 10:50am

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Office Hours: Mon 3 – 4pm, Tues 11 – 12 pm, and by appointment

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Required Text:

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

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 the motion of a projectile or two planets orbiting each other. 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 long 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 organized in three modules.

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.

Statistics and error analysis. Distributions and descriptive statistics, sample and population, distribution functions (Binomial, Normal, Poisson), elemental sampling theory and central limit theorem, statistical estimation theory, curve fitting and the method of the least squares, error analysis.

Modeling of physical problems. Setup and implementation of basic games and physical models, e.g. as related to evolution of populations, statistical growth, dynamics of classical systems. Conway's Game of life and cellular automata. Possible applications include Monte Carlo or molecular dynamics simulations. Introduction of advanced topics of Python programming: arrays and linear algebra methods; derived types/classes and basics of object-oriented programming; visualization of dynamic simulations in two- and three-dimensions using python.

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, oscillators, and chaotic systems
- Use Github for version control
- Establish a toolset and mindset of a computational scientist that will be useful for all your other coursework and future opportunities in research.

Homework: Problem sets will be posted on Canvas, and generally due Tuesday the week after assigned at 5 pm, unless specified otherwise. The set with the lowest score will be dropped at the end of the semester.

Exams: There will be three take-home projects and a final take-home project. All projects will be based on material covered in the lecture, contained in the text, and in the homework assignments.

Quizzes: There will be 6 quizzes where the one with the lowest score will be dropped.

3 Take-home projects	3 × 15 points
1 Take-home final project	30 points
In-class quizzes	5 × 2 points = 10 points
Homework	15 points
Total	**100 points**

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 (https://unt.instructure.com/). You may use your UNT EUID and password to log on and select this course.

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 be made available **Nov 21 – Dec 8** to 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 Tuesday and Thursday 11–12 am 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: The University of North Texas makes reasonable academic accommodation for students with disabilities. Students seeking reasonable accommodation must first register with the Office of Disability Access (ODA) to verify their eligibility. If a disability is verified, the ODA will provide you with a reasonable accommodation letter to be delivered to faculty to begin a private discussion regarding your specific needs in a course. You may request reasonable accommodations at any time, however, ODA notices of reasonable 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 reasonable accommodation for every semester and must meet with each faculty member prior to implementation in each class. Students are strongly encouraged to deliver letters of reasonable accommodation during faculty office hours or by appointment. Faculty members have the authority to ask students to discuss such letters during their designated office hours to protect the privacy of the studentFor additional information, refer to the Office of Disability Access website at https://studentaffairs.unt.edu/office-disability-access. You may also contact ODA by phone at (940) 565-4323.

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

COVID Impact: Please inform me if you are unable to attend class meetings because you are ill, in mindfulness of the health and safety of everyone in our community. If you are experiencing any symptoms of COVID (https://www.cdc.gov/coronavirus/2019-ncov/symptoms testing/symptoms.html) please seek medical attention from the Student Health and Wellness Center (940-565-2333 or askSHWC@unt.edu) or your health care provider prior to coming to campus. UNT also requires you to contact the UNT COVID Team at COVID@unt.edu for guidance on actions to take due to symptoms, pending or positive test results, or potential exposure.