

The course website will be at <https://www.albany.edu/physics/phy577/>

## APHY 477 / 477Y / 577 Class Numbers 8973, 6651, & 6652: Computational Methods, Spring 2024 (3 units course credit)

Tu - Th 10:30 - 11:50 AM Physics Building, Room 224

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<https://www.albany.edu/physics/faculty/matthew-szydagis> ; TA Shane Carney, [sdcarney@albany.edu](mailto:sdcarney@albany.edu)

Office Hours: 4:30-6:30pm Tuesdays, Thursdays Physics 312 (or- by appt.)

Shane's (TA's) Office Hours: time and location TBD

**Text: None req. All needed information / documentation will be provided during class and on the course website, which will also include links to other websites, serving as refs for computer programming samples, additional explanations of algorithms, and vocabulary. E-mail communication is also key. However, 2 texts recommended - Schaum's Outline of Programming w/ C++ (any ed.: bookstore may have) +A Student's Guide to Python for Physical Modeling (for python users)**

**Course Description & Prerequisites:** (577) Applications of modern computational methods to current topics in physics. Basics of coding and use of standard software packages. Prerequisites 527, & 509 or permission of instructor. (477/477Y) Only 1 version may be taken for credit. Prerequisites: PHY 235, & 277 or instructor permission.

**The primary Course Objective** is for students who have completed this course to be able to write functioning code in C / C++ (OR python) to accomplish a wide variety of goals, e.g. numerical solutions to problems unsolvable analytically in closed form, and Monte Carlo simulations for making predictions of the outcome in stochastic processes

Grades (A-E in 15% blocks w/ +/- in 5% sub-blocks) will be calculated according to this:  
*Homework (coding) 60% programming projects: must work (lowest 2 scores dropped)*  
*Final Project 25% As class computer-based, no exam. Self-chosen code project ONLY for 477Y (oral) or 577 (written). For 477, the rest of the percentage is HW, 85%!*  
*Class participation 15% Regular attendance + participation (2 absences are allowed)*

Homework is comprised of code and reports which must be e-mailed to the TA AND the instructor. It is due on the date specified in class and/or on the course website when assigned, typically a week later. It is not accepted late under any circumstances (remember: lowest 2 dropped) and, though discussion with your fellow students for help is not only permissible but encouraged, the final product must be your own work\*. The program must compile, run, and produce the result(s) specified in the HW. There is a 0-tolerance policy for plagiarism ('E' result) which for this type of class would mean turning in (near-)identical code if comparing line by line, with names of variables, etc.

Prior knowledge of **ANY** programming language is **REQUIRED**, but not necessarily in the same languages I cover. The necessary knowledge/skills to write code in C and C++ will be imparted via in-class lectures and group discussions. HW can be accepted in other, different languages, e.g. python, however, via prior arrangements with the instructor and the TA, as long as one/both of them know it. The focus of this course is on learning various algorithms/techniques, not on the language. If following along in our official languages, then you'll need a (free) gcc or g++ compiler installed on your OS

\* This includes a prohibition against downloading complete programs from the Internet, which should be a source of help not of full answers, use of old 4/577 solutions, & chat bots

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**All students are required to have their own personal computers (laptops must be brought to class) they can use for in-class work and homework, as well as a C compiler (or the software for compiling or interpreting their alternative code of choice) and access to the internet to be able to see and use the course materials. If you don't have your own laptop, you'll have to follow along as best you can with a school-provided desktop computer (provided in Rm 224). Come & see me.**

**Extra Credit:** You can earn bonus points by adding optional features considered to be particularly challenging to implement into your code and program as specified in the homework assignments. The max possible credit to earn =5% added to your final grade.

I understand a medical emergency and personal or family difficulties can sometimes prevent you from attending class. Unless something occurs literally on the day of class, please speak with me ahead of time, if at all possible. The University policy: [http://www.albany.edu/health\\_center/medicalexcuse.shtml](http://www.albany.edu/health_center/medicalexcuse.shtml) Also, New York State's Education Law (<https://www.nysenate.gov/legislation/laws/EDN/224-A>) allows for absences due to religious observances. Students absent because of religious beliefs will be given equivalent opportunities for make-up examinations and assignments. Students are requested and strongly encouraged to report the religious holidays (that one plans to observe) to the instructor during the first week of classes.

Title IX of the Education Amendments of 1972 is a federal civil rights law that prohibits discrimination on the basis of sex in federally funded education programs and activities. The University at Albany Sexual Violence Prevention & Response and Title IX Grievance policies prohibit offenses defined as sexual harassment, sexual assault, intimate partner violence (dating or domestic violence), sexual exploitation, and stalking. These policies apply to the entire University at Albany community, including students, faculty, and staff of all gender identities. The University at Albany provides a variety of resources for support and advocacy to assist individuals who have experienced sexual offenses. Confidential support and guidance can be found through [Counseling & Psychological Services \(518-442-5800\)](#), [Student Health Services \(518-442-5454\)](#), and [Interfaith Services \(518-442-5565\)](#). Individuals at these locations will not report crimes to law enforcement or university officials without permission, except for in extreme circumstances, such as a health and/or safety emergency. Sexual offenses can be reported non-confidentially to the Title IX Coordinator within the [Office of Equity & Compliance \(518-442-3800\)](#), Hudson Building, Room 117) and/or the [University Police Department \(518-442-3131\)](#). Please note, faculty members are considered "responsible employees" at the University at Albany, meaning that they are required to report all known relevant details about a complaint of sexual violence to the University's Title IX Coordinator, including names of anyone involved or present, date, time, and location. In an emergency, please call 911.

At right is a tentative chronological list of topics that will be covered in this course. I'll also count on those with more programming experience to help fellow students with less; the largest roadblock will be getting set up to program while well-versed in a word processor in which to compose code.

|            | Tuesday Lecture Topic         | Thursday Lecture Topic       | Homework Assignment          |
|------------|-------------------------------|------------------------------|------------------------------|
| 1/18       |                               | Writing and Compiling Code   |                              |
| 1/23, 1/25 | Input/Output; Conditionals    | Var Types, Math, Functions   | Finding the Golden Ratio Phi |
| 1/30, 2/1  | Random Number Generation      | Example: Monty Hall 3 Doors  | The Drake Equation (SETI)    |
| 2/6, 2/8   | Monte Carlo Simulations       | History and Applications     | Nuclear (Fission) Reactor    |
| 2/13, 2/15 | Numerical Integration: pi & e | Von Neumann MC Integrals     | calculating sqrt(2) with VN  |
| 2/20, 2/22 | Differential Equation: Euler  | The Large-Angle Pendulum     | A Rocket Trip to Mars        |
| 2/27, 2/29 | Differential Equations: RK4   | Modeling Cosmic Expansion    | The Classical Wave Eqn in 1D |
| 3/5, 3/7   | Diff Eq: Leapfrog Integration | The Earth-Moon System        | The Stable Lagrange Points   |
| 3/12, 3/14 | Chaos Theory vs. Quantum      | The Three-Body Problem       | Predicting the Temperature   |
| 3/19, 3/21 | Spring Break [NO CLASSES]     | Spring Break [NO CLASSES]    |                              |
| 3/26, 3/28 | Cellular Automata             | Conway's Game of Life        | Living in a Stochastic Life  |
| 4/2, 4/4   | Hypothesis Testing            | Goodness of Fit: Gauss Peaks | The Cosmic-Ray Power Law     |
| 4/9, 4/11  | Image Processing              | Motion Detection             | Find Objects Within Noise    |
| 4/16, 4/18 | Artificial Intelligence       | Adversarial AI: Tic Tac Toe  | Pick Another Game Example    |
| 4/23, 4/25 | Special Topic (vote)          | Final Project Presentations  | NONE: Work on Final Project  |
| 4/30, 5/2  | Showcase Day [NO CLASS]       | Final Exams [NO CLASS]       |                              |

(usually, but not always, due at 11:59 P.M. on Thursday nights)