Carleton University
Department Of Physics

Phys 2801: Computational Methods in Physics

Fall 2025

Course aim

This course introduces students to the use of computers and computational methods in physics. This includes use of operating systems, programming, code repositories, data structures, numerical methods, statistical data analysis and machine learning relevant for physics.

Scheduled lectures

Tuesdays and Thursdays, 16:05-17:25

Student hour: Fridays 13:00-14:00

Instructor and TA

Instructor: Dag Gillberg, dag@physics.carleton.ca, HP 2404
Teaching assistant: Cyrus Robertson Orkish, CYRUSROBERTSONORKISH@cmail.carleton.ca

Textbooks

No required textbook. Slides and example interactive Python notebooks will be provided on the course Brightspace page.

Supplementary material

Numerical methods in physics with Python, second edition

Learning outcomes

1. Students will be introduced to standard operating systems, commands, shell scripts, and programming languages used in physics data analysis
2. Students will learn to utilize a variety of data formats and structures and be able to implement visualization techniques
3. Students will review probability concepts and commonly used distributions and learn to apply these in the context of analysis of physics data including error estimation
4. Students will learn to apply function fitting techniques for parameter estimation using function minimization and be able to evaluate the reliability of the fit and error estimation.
5. Students will gain an introductory level understanding of the mechanism behind, and practical use of machine learning/artificial intelligence techniques in the context of physics, including critical evaluation of AI generated output

Prerequisites

PHYS 1001 **or** PHYS 1003 **or** PHYS 1007; and COMP 1005; **or** permission of the Department.

Learning assessment

The course has lectures in the standard lecture hall on Tuesdays and Thursdays, but also five (or six?) tutorials in a separate hall on certain Thursdays. This will be announced clearly both via email and on the Brightspace page. You need to **attend and complete each tutorial**. The assignments will often build on the tutorial and be due at a later point.

Assignments

There will be six assignments. They will require data analysis. Due on Fridays.

In-class evaluation

The lectures will contain Wooclap questions relating to the course material. You are allowed (and encouraged!) to discuss with your neighbour to try to figure out the answer on questions that most commonly are multiple choice but also sometimes numerical. Worth 5% of the mark in total, attendance is the most important. You need to provide an answer to 50% of the questions to get a non-zero mark. Then 3%, 4% or 5% depending on the fraction of correct answers (<33%, <67% or >67%).

Midterm and final examination

The midterm will be an 80 minute written exam taken during a lecture slot.
The final exam will be a 3 hour written exam scheduled by the university.
You need to complete the 5 tutorials to pass the class

Marking scheme

- In-class evaluation: 5%
- Assignments 30%
- Midterm exam 25%
- Final exam 40%
- Need to attend and complete each tutorial

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Jupyter accounts

Each student will get a Jupyter account that will allow you to access the Carleton physics Jupyter hub: https://jupyterhub.physics.carleton.ca. You will use this during tutorials and for assignments.

If you have any technical issues, please contact: computersupport@physics.carleton.ca

Lecture plan

See intro slides on Brightspace. In short:
1. Basics of numerical analysis (Python, plotting, Jupyter), 2. Basic computing (bash, git, data structures), 3. Probability and statistics, 4. Data analysis, techniques and pitfalls, 5. ML (NN and AI), use and critically evaluate AI generated output

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Plagiarism and other forms of cheating

Working through problems is essential in developing understanding of thermal physics. Students are permitted to discuss concepts and strategies related to solving the homework assignments. All work handed in, however, **must be their own**.

For more information, see:
https://calendar.carleton.ca/undergrad/regulations/academicregulationsoftheuniversity/