Welcome to:

Physics 320, *Mathematical Methods in Physics*

Course overview

Monday, August 28, 2023

Your instructor: Dr. Nicola Lanatà

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Office: CAR-3140

My research:

- Investigating quantum-mechanical electronic, energetic, chemical, dynamical and spectral properties of quantum matter.

- Development and application of theoretical, mathematical, computational methods (including machine-learning and quantum computers).

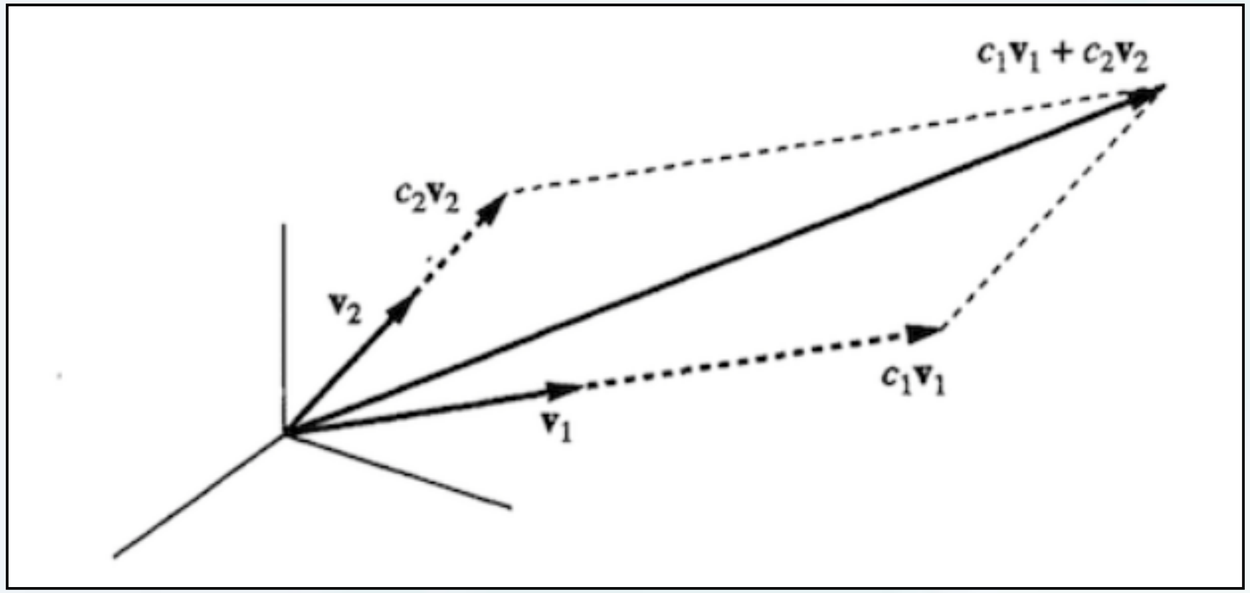
Topics Covered in Physics 320

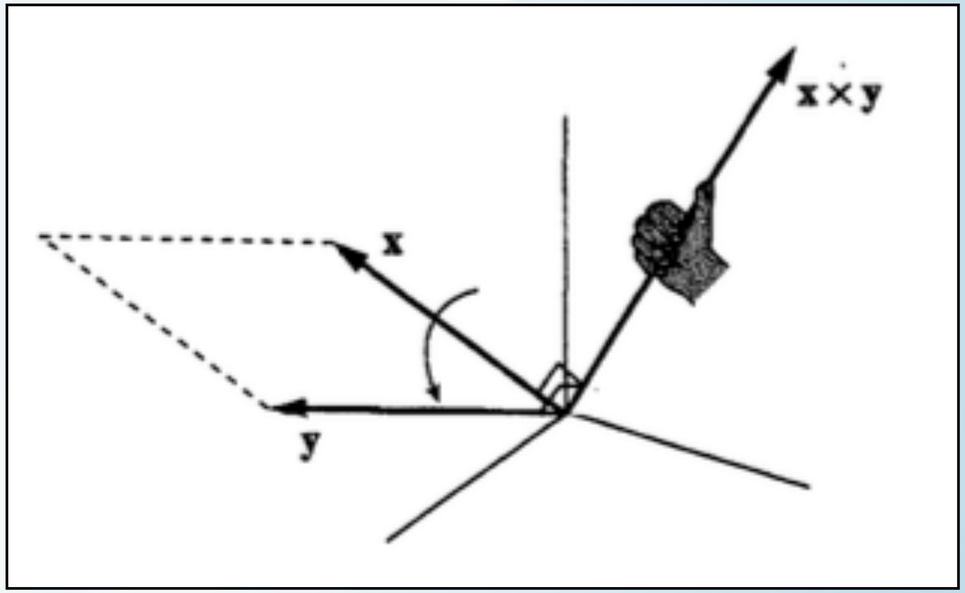
Introduction to some of the main mathematical tools needed for your intermediate & upper-level physics studies.

- **Linear algebra 1** (preparation for vector calculus)
- **Vector calculus** (differential operators, integrals on curved spaces)
- **Linear algebra 2** (preparation for functional analysis)
- **Functional analysis** (Fourier Series and differential equations)

Topics Covered in Physics 320

- Linear algebra 1 (preparation for vector calculus)

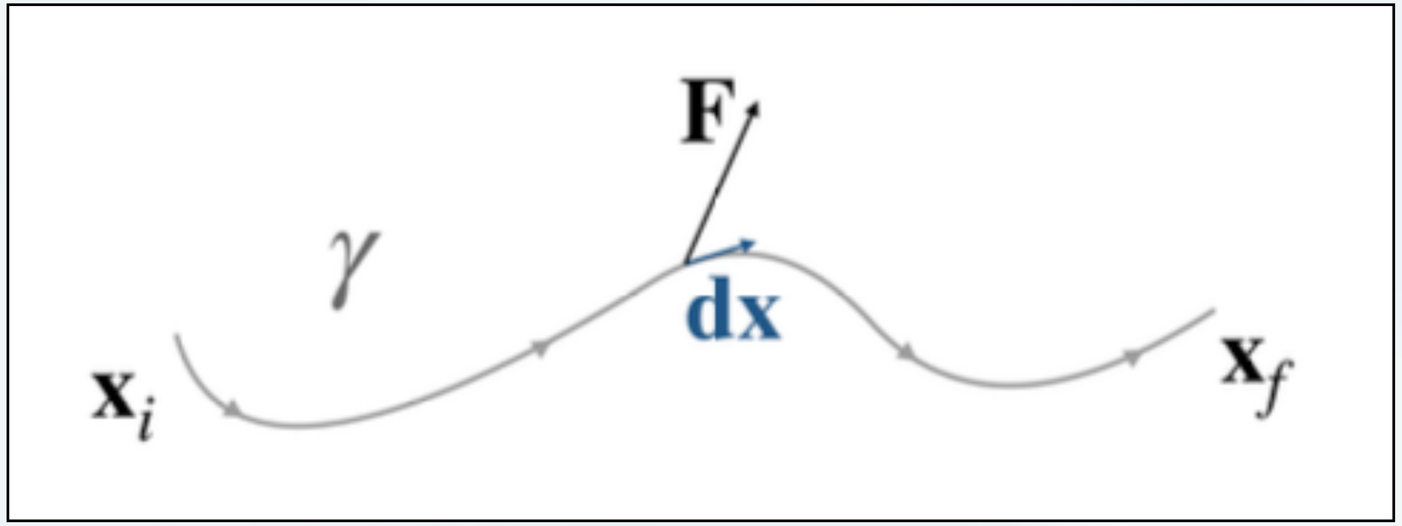


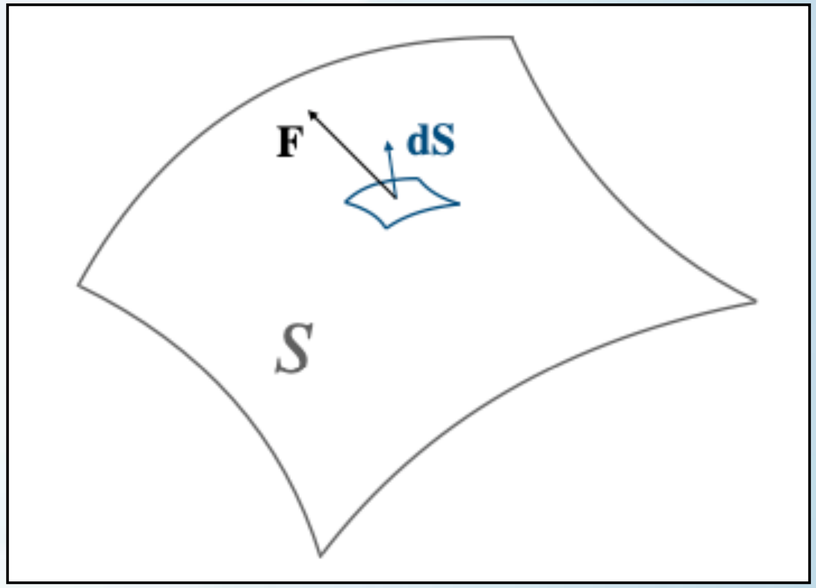


Physical applications: Motion of masses in classical mechanics, fields, fluids

Topics Covered in Physics 320

- **Vector calculus** (differential operators, integrals on curved spaces)

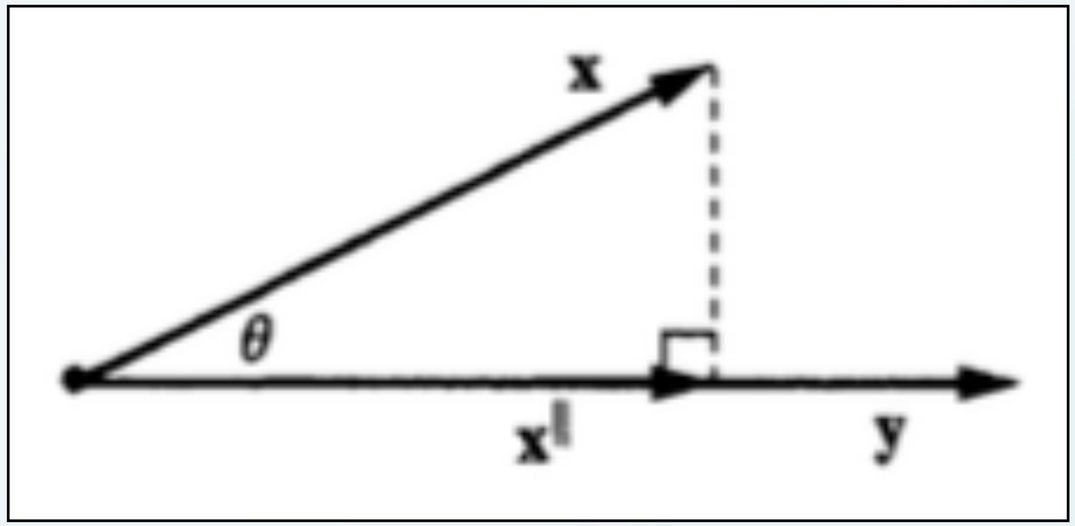


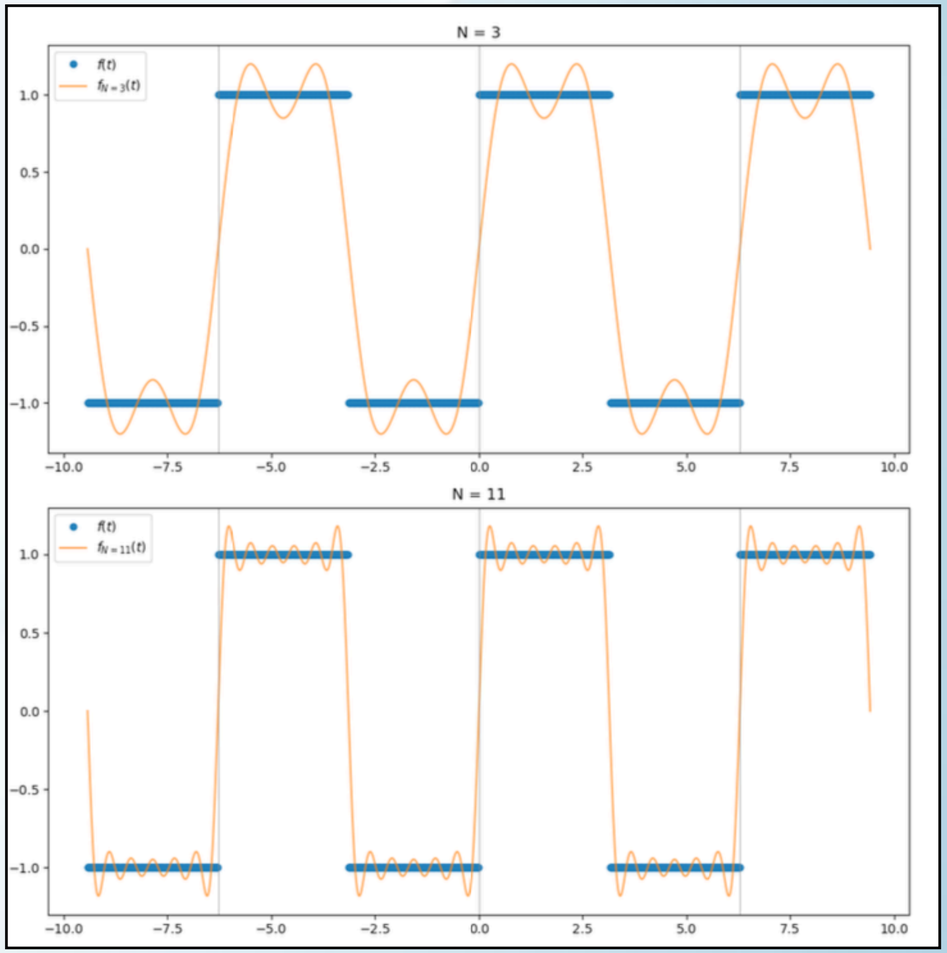


Physical applications: Conservative fields, heat conduction, incompressible fluids, electromagnetic fields, Ampere's law, rotation of a rigid body.

Topics Covered in Physics 320

- Linear algebra 2 (preparation for functional analysis)

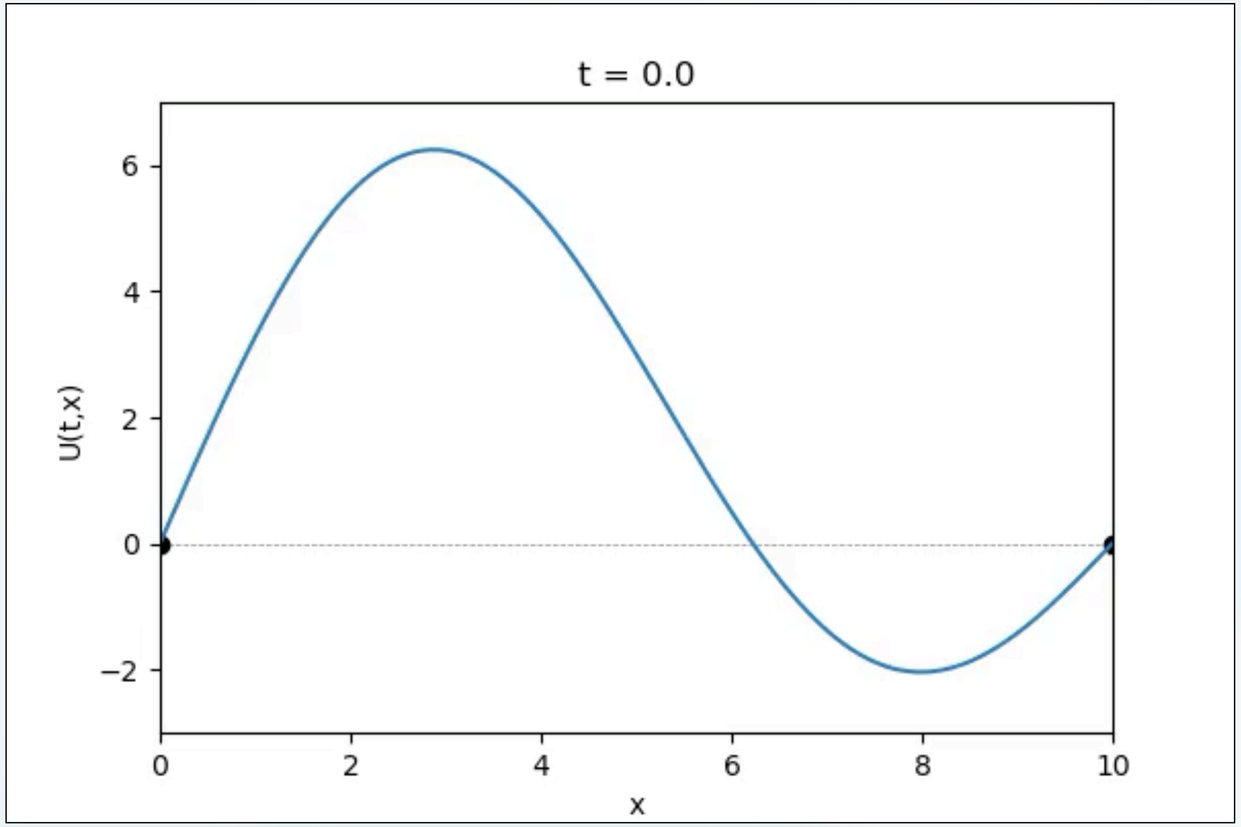


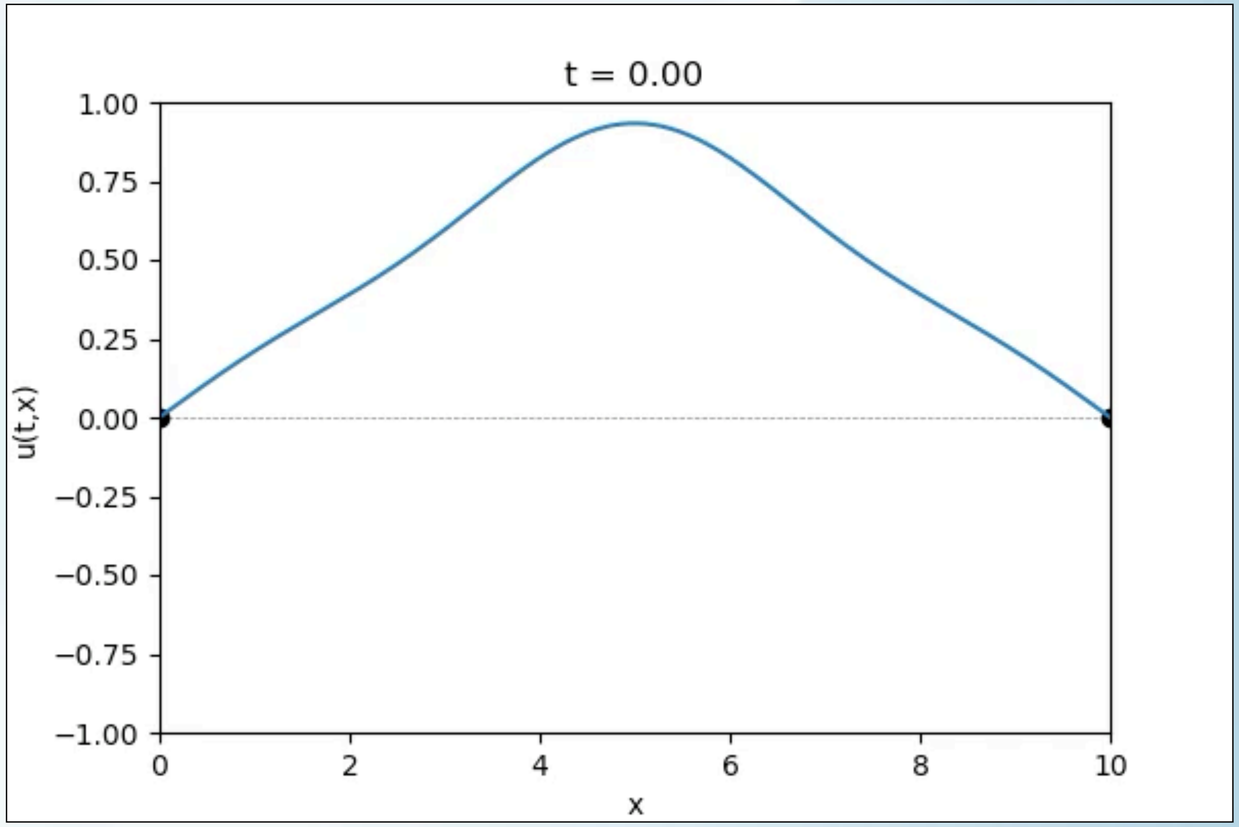


Physical applications: Extending vector concept to functions (electromagnetism, classical mechanics, quantum mechanics)

Topics Covered in Physics 320

- Functional analysis (Fourier Series and differential equations)





Physical applications: L-R circuit and harmonic oscillator with forcing terms, vibrating string, heat equation.

General course information:

Class: Monday, Wednesday, Friday 11:00–11:50am (GOS-2300)

Office hours: Wednesday and Friday 3:00-4:00pm (CAR-3140)

Link to Slack channel (use is mandatory): https://join.slack.com/t/physics320mat-zwy4716/shared_invite/zt-21nt4xwxh-O0WDzE8KZwYjuBxwXyN8XA

Attendance policy: Attendance is required. Records of attendance will be maintained and contributes to the final course score (in case of special circumstances, contact me in advance)

Active participation is the most important thing!

General course information:

Course Material:

- **Lecture Notes:** Detailed notes will be posted on myCourses after each lecture. These notes are not a substitute to class attendance and provide an organized overview of the main topics.
  - *Content enclosed within a purple environment exceeds the course requirements but provides supplemental material useful for future studies.*
  - *The lecture notes are a work in progress and may necessitate revisions. Feedback and typographical error reports are welcome.*
  - *Distributing or sharing these notes outside of the class is prohibited and considered plagiarism.*

- **Main textbook (required):** "Mathematical Methods in the Physical Sciences," Mary Boas.

- **Other suggested textbook:** "Multivariable Mathematics: Linear Algebra, Multivariable Calculus, and Manifolds," Theodore Shifrin.

General course information:

Assessment and grading:

- Pre-assessment: 0% (beginning of next lecture)
- First exam (September): 15%
- Second exam (October): 15%
- Final exam (December): 15%
- Assignments (about 8 throughout the semester): 50%
- Attendance and active participation: 5%

Letter grades:

- 90-100: A- to A
- 80-89: B- to B+
- 70-79: C- to C+
- 60-69: D

Key advices:

1. *Ask questions !!!*

2. *This course is for you, so give feedback: Going too slow? Too fast? Did you miss some step? Is the homework too hard/easy?*

3. *Participation and homework are the most important thing. Do your best!*