Exercise Session 1
IESM Fall 2025-2026

Salomé, Qihao, Thibault, Evan

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EPFL

Introduction to Electronic Structure Methods

Welcome to the IESM course!

- Lecturer: Prof. Ursula Röthlisberger
- TAs:
  - Salomé Guilbert
  - Qihao Zhang
  - Thibault Kläy
  - Evan Vasey
  - Different PostDocs from LCBC lab

## Introduction to Electronic Structure Methods

- Mondays from 8:15 to 10:00 and Tuesdays from 10:15 to 12:00
- Course schedule for the semester available on Moodle and the exercise webpage

- Moodle page

EPFL | MOODLE   FR | EN

Introduction to electronic structure methods

Dashboard › Courses › Chimie, Génie Chimique (CGC) › CGC - Bachelor › CH-353

- Exercise website: **https://lcbc-epfl.github.io/iesm-public/**
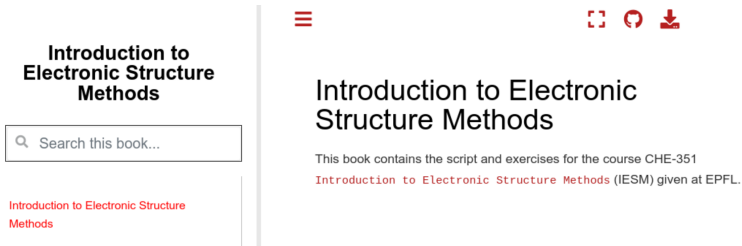
Introduction
- Learning goals
- Chapter in script
- Resources

🎯 Learning goals	📖 Chapter in script	📚 Resources

Theory section

- Relevant theory for the exercise
- Theoretical exercises

Practical exercises

- "Coding" exercises
- Interpretation of results

Exercise evaluation

- Examples:

ⓘ Exercise 9
Give the commutator of the position and linear momentum operators in the position representation (consider one dimension only).

| **ⓘ Bonus Exercise 10** |
|---|
| Show that the potential energy operator $\hat{V}(\mathbf{r})$ is multiplicative when applied to the real-space wavefunction. |

```
# Check Orthogonality

ϕ1ϕ2 = 0 # Replace with vector operation

print(f'<ϕ1|ϕ2> = {ϕ1ϕ2}')
```

- Exercises account for 1/3 of the final grade (2/3 from exams, 1 written 1 oral)

- Submit report
  - pdf document answering the questions completely with relevant results
    - Handwritten portions ok (please verify legibility)
    - We provide report templates on Overleaf and Google Docs
  - Due date is usually the next exercise session (check Moodle!)
  - Interviews during next exercise session
    - Test your understanding and discuss your doubts/questions
  - Detailed feedback via Moodle after the interview

Computer environment

- We will use a virtual environment that you can directly launch from the exercise website
- Click the rocket button on the top right of the code files and choose JupyterHub to launch noto.epfl.ch
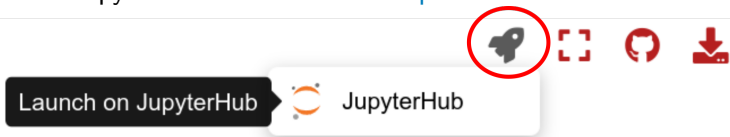
- On noto.epfl.ch your work will be saved on your EPFL storage
- Make sure to always activate (top right) the Computational Chemistry kernel
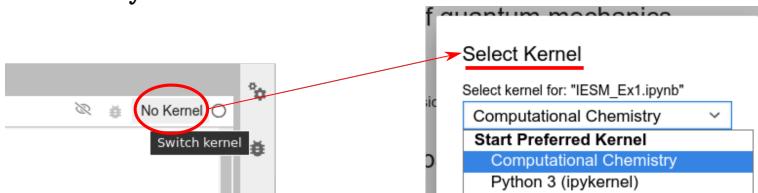
- `.iynb` files organized in cells
  - Markdown (text)
  - Code
- Run a code cell by pressing `Play` button (or `Ctrl+Enter`)

Jupyter notebooks

- `.iynb` files organized in cells
  - Markdown (text)
  - Code
- Run a code cell by pressing :arrow_forward: (or `Ctrl`+`Enter`)

Exercise 1 - Overview

Linear Algebra in Quantum Mechanics - Exercise page

- Linear Algebra in Quantum Mechanics
- Basic Concepts in Quantum Mechanics
- Working with vectors using Numpy

| 🎯 Learning goals	📖 Chapter in script	📚 Resources
Review basic concept of linear algebra Review basic notation of quantum mechanics	Chapter 2 - Basic principles of Quantum Mechanics Appendix A.1 - Vector space and scalar product	Cohen-Tannoudji, C., Diu, B., & Laloe, F. (1986). Quantum Mechanics, Volume 1. • Chapter II B - State space, Dirac notation • Chapter II C - Representations in the state space • Chapter II D - Eigenvalue equations, observables • Chapter II E - Two important examples of represantations and observables • Chapter II Complement D_{II} - A more detailed study of the $\{|r\rangle\}$ and $\{|p\rangle\}$ representations • Chapter II Complement E_{II} - Some general properties of two observables, Q and P, whose commutator is equal to $i\hbar$

Tips!

- Start from Section 1.3 - Working with vectos using Numpy to get familiar with Noto environment and Jupyter Notebooks
- How to get the slides:
  - Download from the exercise page
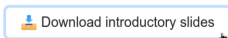
  - Once you open Noto, in the exercise folder
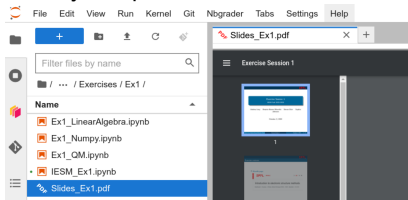
  - Will be uploaded on the Moodle page

Exercise 1 - Tips

- We provide templates for the exercise reports, you can access them from the exercise page

  `Report Template  Google Docs`

  `Report Template  Overleaf`

- The answers can be short, for a full mark we don't expect more than what is explicitly asked

- You can ask for help anytime on the exercises and also the theory!

  - During the exercise session
  - During the week, on the Moodle Forum (public, so everyone can benefit from the answers and in principle you can help each other!)
  - At least one of us will be always present at the lectures, you can ask us questions before/after or during the break

- The final grade from the exercises will be given by the best 8 out of 9 exercises. Hence in principle, you have a "free" exercise that you can decide to skip
- We will send a schedule for the interviews before each exercise session
- Please let us know in advance if you will not be able to be there for the interview
- In case of overlaps with other courses, we can schedule interviews also outside the exercise hours
- In case you don't show up at the interview and you don't contact us via email to reschedule the interview, the grade for that report will be 0