

# MATH-251(b): Numerical analysis ⇄

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This repository contains the teaching material of the course [MATH-251\(b\) Numerical analysis](#) at EPFL.

## Course outline ⇄

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### Numerical analysis

1. [Introduction](#)
2. [The Julia programming language](#)
3. [Revision and preliminaries](#)
4. [Root finding and fixed-point problems](#)
5. [Interpolation](#)
6. [Direct methods for linear systems](#)
7. [Iterative methods for linear systems](#)
8. [Eigenvalue problems](#)
9. [Numerical integration](#)
10. [Numerical differentiation](#)
11. [Initial value problems](#)
12. [Boundary value problems](#)

### **Accompanying Exercise sheets**

- [Sheet 0: Getting Started with Julia](#)
- [Sheet 0: Basic Plotting in Julia](#)

## Improving these notes ⇄

If you **spot an error** feel free to make a pull request to the [github repository](#) generating this website.

## EPFL resources ↗

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If you are an EPFL student you find the internal course resources following these links:

- **Moodle link:** <https://go.epfl.ch/numerical-analysis>
- **Lecture recordings:** <https://mediaspace.epfl.ch>

## Summary ↗

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The students will learn key numerical techniques for solving standard mathematical problems in science and engineering. The underlying mathematical theory and properties are discussed.

## Content ↗

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The topics covered include:

- Properties and issues with numerical computation
- Finding roots and fixed points
- Polynomial interpolation
- Solving linear and non-linear equations
- Gradient-based methods for solving linear and eigenproblems
- Numerical integration and differentiation
- Basic numerical techniques for solving differential equations

Algorithm demonstrations and implementations will be based on the [Julia programming language](#) and interactive [Pluto](#) notebooks.

## Prerequisites ↗

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- Analysis
- Linear algebra

The course is designed with an audience of applied scientists (physics, biology, materials science) or engineers in mind. With a basic first-year mathematics background and prior exposure to some programming the material should be accessible.

# Literature and further reading ⇄

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The outline of the course as well as many examples are taken from the excellent lecture notes "**Numerical analysis**" by **Prof. Fabio Nobile**. A copy of these notes in French as well as English is available on moodle.

For further reading and plenty of Julia code examples related to our subjects, take a look at the book **Fundamentals of Numerical Computation** by **Tobin A. Driscoll and Richard J. Braun** published by SIAM. An online version is further available at <https://tobydriscoll.net/fnc-julia/>. I will also link to this text in the lecture notes from time to time.

A slightly different emphasis in topics, but otherwise a good summary provide the lecture notes **First Semester Numerical analysis** by **Giray Ökten**. At places the text is more mathematical than our treatment. In the initial sections it has a good summary of basic Julia commands an concepts. An online PDF is available.

For an in-depth treatment with mathematical details and proofs for the results where we skip these details for brevity can be found in **Numerical Mathematics** by **A. Quarteroni, R. Sacco, F. Saleri**. A PDF can be downloaded from Springer by EPFL students.

Finally, if you are curious about Julia, I can highly recommend **MIT's computational thinking class**, which introduces Julia as well as its way of solving scientific problems in a hands-on and fun way.

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