Numerical methods in Geosciences

Overview

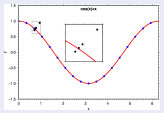
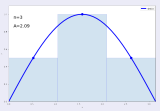
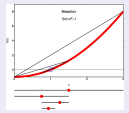
Overview: Structure of lecture

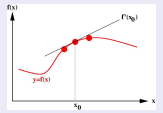
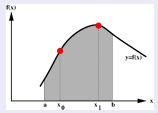
Structure of lecture

This lecture introduces the use of **numerical methods** as a tool to examine problems in geosciences.
We will use numerical methods to **approximate** solutions for problems from a variety of sources, e.g. geochemistry, geophysics, the Earth's interior, ...
Some of the concepts discussed are:

- **Roots** of functions in one or more dimensions as a basic tool used in most numerical methods.
- **Interpolation and approximation** to describe, extent, and fit data sets.
- **Differential equations** as basic descriptions of processes in geoscientific systems.

Overview: Lectures

1. Introduction

2. Basics

3. Roots

4. Interpolation

5. Differentiation

6. Integration

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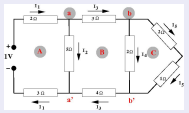
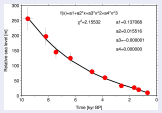
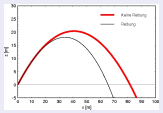
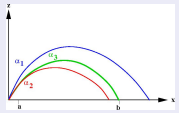

8. Optimization

9. Initial value

10.Boundary value

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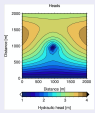
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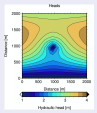

Overview: Tentative schedule

Week

1. Overview
2. Basics
3. Roots
4. Interpolation
5. Differentiation
6. Integration
7. Linear systems
8. Optimization
9. Ordinary differential equations
   - Initial value problems
   - Boundary value problems
10. Partial differential equations
    - Finite differences
    - Finite elements
11. (spare time)
12. Exam

Overview: Exercises and Seminar

Exercises

- We will have practical exercises, which follow some of the (mathematical) concepts introduced in the lectures.
- We introduce PYTHON as simple programming language.
- For some of the lectures a link is given to a running JUPYTER NOTEBOOK.
- Explore and play with it!

Seminar

- We discuss and run the concepts developed in the lectures with practical exercises in PYTHON.
- We discuss the different **functions and methods** as learning examples ...
- ... and we will introduce the **geophysical exercises**, and discuss the progress in coding them.
- The coded geophysical exercises should be **handed in** as jupyter notebook to: dropdown

Overview: Suggested reading

Suggested reading

- Faires, J. D. & Burden, R. L. (2000).
  Numerische Methoden. Näherungsverfahren und ihre praktische Anwendung.
  Spektrum Verlag.
- Press, W. H., Teukolsky, S. A., Vetterling, W. T. & Flannery, B. P. (1999).
  Numerical Recipes in Fortran.
  Cambridge University Press.
- Turcotte, D.L. & Schubert, G. (1982).
  Geodynamics.
  J. Wiley, UK.