

Case Studies 2025

Life Science Mathematics

Optimization

Scientific Computing

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Welcome



About the course



What will you learn?

- ▶ apply mathematical skills to practical problems
- ▶ analyze and model problems
- ▶ evaluate solution techniques
- ▶ implement suitable algorithms
- ▶ assess solutions

What will you learn?

- ▶ work with practioners
- ▶ experience real-world challenges
- ▶ communicate to different audiences
- ▶ outreach / science communication
- ▶ experience impact of your work

What will you learn?

- ▶ experience teamwork / team dynamics
- ▶ self / team management
- ▶ organization / documentation / communication
- ▶ presentation / writing skills

Successful Participation

- ▶ mandatory participation in central meetings
- ▶ in-person participation only
- ▶ active project work and contributions to project outcome
- ▶ active contributions to presentations and final report

Workload

▶ 10 ECTS ✦✦

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- ▶ estimated workload: 20 hours per week

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- ▶ groups of 3-4 students

Grading

- ▶ project work
- ▶ project report
- ▶ poster
- ▶ presentation

All Projects

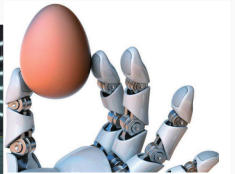
Optimization

- ▶ Inventory Routing (DO)
- ▶ District Heating Networks (DO)
- ▶ Trajectory Optimization in Learned Environments (NLO)
- ▶ Robust Bundle Adjustment for 3D Scene Reconstruction (NLO)

All Projects

Scientific Computing

- ▶ S1: High-Speed Driving with Predefined Level of Safety
- ▶ S2: Heat Transfer in Concentrated Solar Powerplant
- ▶ S3: Abort Landing in case of Uncertain Windshear
- ▶ S4: Virtual Wind Tunnel
- ▶ S5: Dynamic Deformation of an Elastic Robot Fingertip



Preliminaries



What do we expect?

- ▶ dedication
- ▶ open mindedness & creativity
- ▶ motivated by real-world challenges
- ▶ teamwork & communication
- ▶ **in-person participation over the whole semester**

Required courses

Optimization

- ▶ Introduction to Optimization (basic linear / nonlinear optimization)
- ▶ project specific skills

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... for Nonlinear Optimization

- ▶ Numerical Linear Algebra
- ▶ Nonlinear Optimization: Advanced
- ▶ Modern Methods of Nonlinear Optimization (optional)

Required courses

Optimization

- ▶ Introduction to Optimization (basic linear / nonlinear optimization)
- ▶ project specific skills

... for Discrete Optimization

- ▶ Integer / Discrete Optimization
- ▶ Combinatorial Optimization (optional)

Required courses

Scientific Computing

- ▶ Analysis, Linear Algebra & Discrete Structures
- ▶ Numerical analysis
- ▶ Numerics of differential equations (ordinary / partial)
- ▶ Nonlinear optimization & Optimal control (*dep. on the project*)
- ▶ Programming skills in (some of) *MATLAB, Python, C/C++, ...*

Required courses

Life Science Mathematics

- ▶ Analysis, Linear Algebra
- ▶ some course(s) in the area of Mathematical Biology, Nonlinear Dynamics etc.
- ▶ AND/OR some course(s) in Statistics
- ▶ helpful: some programming skills

Why should you do it?



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Mathematics

Manage

Communicate

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- ▶ apply mathematical theory to real-world challenges

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- ▶ project management, team organization

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- ▶ apply mathematical theory to real-world challenges
- ▶ project management, team organization
- ▶ communication and presentation skills

What to do next?



Application

- ▶ limited intake
- ▶ application until **17 March 2025**
- ▶ online form → website
- ▶ courses, skills, project ranking, preferred team members, etc.
- ▶ final allocation: **24 March to 07 April 2025**
- ▶ important dates → website

Further Questions / Application



<https://go.tum.de/396156>

