Basic Mathematical Tools for Imaging and Visualization

winter term 2017/18

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Computer Aided Medical Procedures
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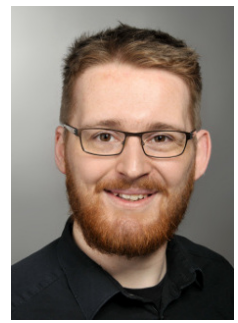
Program today

1. Administrative stuff
2. Contents of the lecture
3. Introduction

Who?

- Lecture:
  - PD Dr. Tobias Lasser
    - Akademischer Rat at Chair of Prof. Nassir Navab, I16 Computer Aided Medical Procedures

- Exercises:
  - Anca Stefanoiu
    - Scientific Staff I16
  - Rüdiger Göbl
    - Scientific Staff I16
  - Walter Simson
    - Scientific Staff I16


What?

Aim of the lecture:

- present and refresh basic mathematical tools
  - linear algebra, analysis, optimization, probability theory
- show applications in imaging and visualization
  - medical imaging, image processing, computer vision

Target audience:

- Master students of Biomedical Computing
- Master students of Informatics, CSE, Robotics
- Bachelor students of Informatics (higher terms)
- anyone who is interested!

When and where?

Dates and rooms

- Monday, 16:00 - 17:30, room Interim Hörsaal 2
- Tuesday, 12:30 - 14:30, room MW 1801

Generally:

- Monday: lecture
- Tuesday: exercise

Online

Website

http://campar.in.tum.de/Chair/TeachingWs17BasicMathTools

- news and announcements
- lecture slides and exercise sheets
- solutions and materials
- authentication required
  - User: BMT17
  - Password: basicmath

Contact and feedback

Questions

- email: bmt@mailnavab.in.tum.de
- office hour: arrange via email

Feedback

- email
- personal contact :-)

Feedback is always welcome!

Examination

- Written exam:
  - at end of the term, date to be announced
  - 90 minutes duration
  - allowed material: none (closed book)

- Grade bonus :
  - improve your final grade by 0.3 by passing exercise attestations
  - exceptions in edge cases:
    - 1.0 cannot be improved
    - if you get 4.3, the grade bonus will not make you pass

You will be part of an experiment!

Engaged Learning

- move away from the traditional "passive listening"
- encourage your active participation

So how is it supposed to work?

Lecture

- instead of me reading the script to you
- you read the script online before the lecture hour
  - using the `nb.mit.edu` tool
  - annotate comments and questions
- during lecture: we discuss your comments and questions
  - and some additional material presented by myself

- this requires your active preparation and participation to work
  - yes, it is most likely more time-consuming than traditional passively listening
  - yes, you will learn more
- this is an experiment
  - fallback: standard lecture

So how does it really work?

- sign up for the course on `nb.mit.edu`:
  - subscription link: `http://nb.mit.edu/subscribe?key=XkOoPQfWzHd7mLlym4wpvRba5Hl093mpgBj94feYKHfPy7VISv`
- each week:
  - read the current part of the script on `nb.mit.edu`
  - annotate your comments and questions
  - deadline: early morning of lecture day (usually: Monday, 7:00)
    - to give me enough time to prepare the class
- perk:
  - the best of your questions will be used as exam questions

How does it work? (Part 2)

Exercises

- one exercise sheet every week
- available for download one week before the exercise
  - use time before exercise to work on the problems
  - use the exercise for discussion and questions
- pen & paper problems as well as programming problems

- "traditional" exercise format
- exercise attestations for grade bonus
  - each sheet contains one attestation programming problem
  - work in teams of 2 or 3 students
  - present solutions in one of the four attestation sessions
  - gain at least 9 out of 12 OKs as a team, and 3 as an individual

How does it work? (Part 2)

Attestations

- four attestation dates spread throughout the term
  - dates will be announced on website soon
- you will have to register for each attestation date by email
  - send email to `bmt@mailnavab.in.tum.de`, with subject [BMT_Attestation]
  - state team members with name and MatrikelNummer
- time slots will be assigned to each team
- each team presents their solution to attestation problem
  - around 5 minutes per problem
  - get an OK or not OK depending on your solution and understanding of the problem

Course format: summary

Lecture

- each week:
  - until Monday: read and annotate script on `nb.mit.edu`
  - on Monday: class discussing your comments and questions

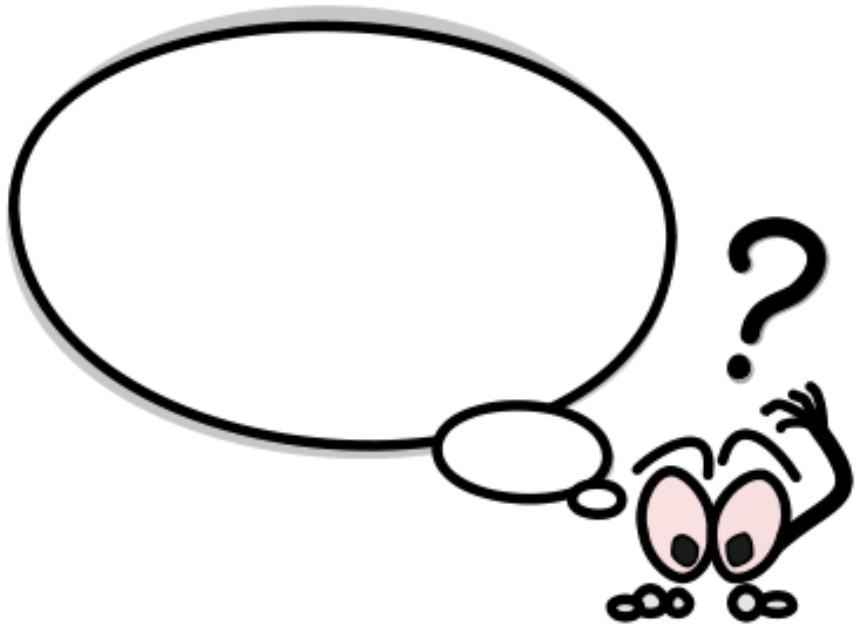
Exercise

- each week:
  - until Tuesday: read and work through exercise sheet
  - on Tuesday: exercise session

Examination

- written exam at end of term
- earn 0.3 grade bonus through exercise attestations
  - by earning at least 9 out of 12 OKs as a team
  - and at least 3 OKs yourself

Questions?



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Aims of the lecture

What will be done?

- present and refresh basic mathematical tools
  - linear algebra, analysis, optimization, probability theory
- show applications in imaging and visualization
  - medical imaging, image processing, computer vision

What for?

- to get an overview over available mathematical tools
- to be able to proceed on your own when and where necessary

For who?

- if your mathematical background is spotty
- if you are interested in the shown applications

Lecture schedule

1. Linear Algebra
   - basics, matrix decompositions, solving of linear systems
2. Analysis
   - basics, differential calculus
3. Optimization
   - convexity, linear and non-linear optimization
4. Probability theory
   - random variables, expectation maximization

Application examples

- tomographic reconstruction
- image filtering
- face recognition
- vessel detection
- image tracking
- electromagnetic tracking
- manifold learning
- and others...

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