Medical Image Analysis 8BE030

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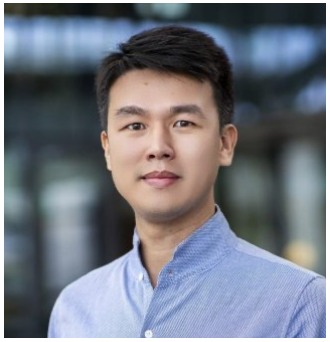
Outline for today:

- Course introduction

- Introduction to image registration
  - Causes of misalignment
  - Applications of medical image registration
  - Classification of image registration methods

- Geometrical transforms
  - Recap linear algebra
  - Rigid and affine transformations
  - Non-linear transformations

Lecturers



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Background: BSc in Electrical Engineering (Shandong University, China), MSc in Electrical Engineering (Technical University of Munich, Germany), PhD in Medical Image Analysis (Erasmus MC, Erasmus University Rotterdam)
Research: Deep learning, medical image analysis in neurovascular diseases, image-guided interventions

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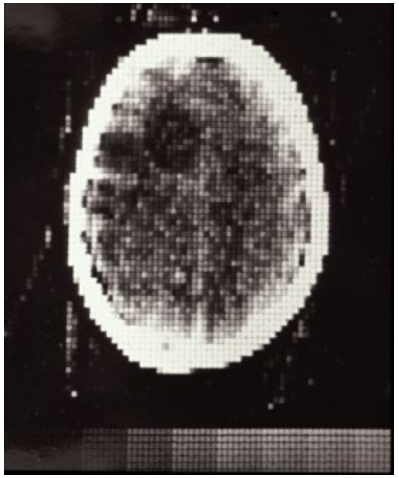
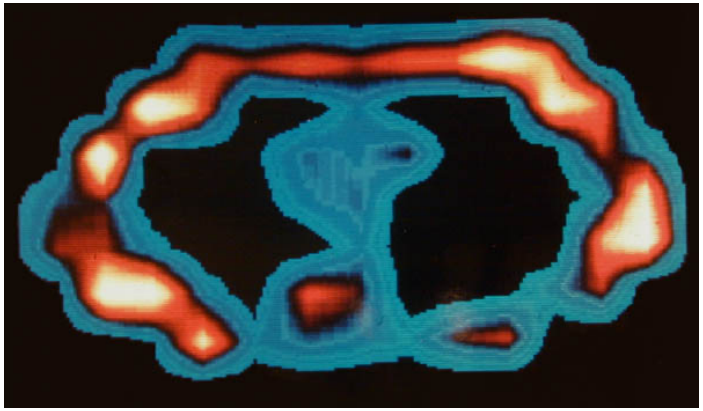
Background: BSc in Mathematical Sciences (University College Cork, Ireland), MRes in Medical Imaging, PhD in Biomedical Engineering (King's College London, UK)
Research: Deep learning, quantitative MRI, cardiovascular imaging & modelling

Student teaching assistants:

- Danny Struijk
- Joris Mentink
- Job Schöller
- Dirk Sollewijn Gelpke





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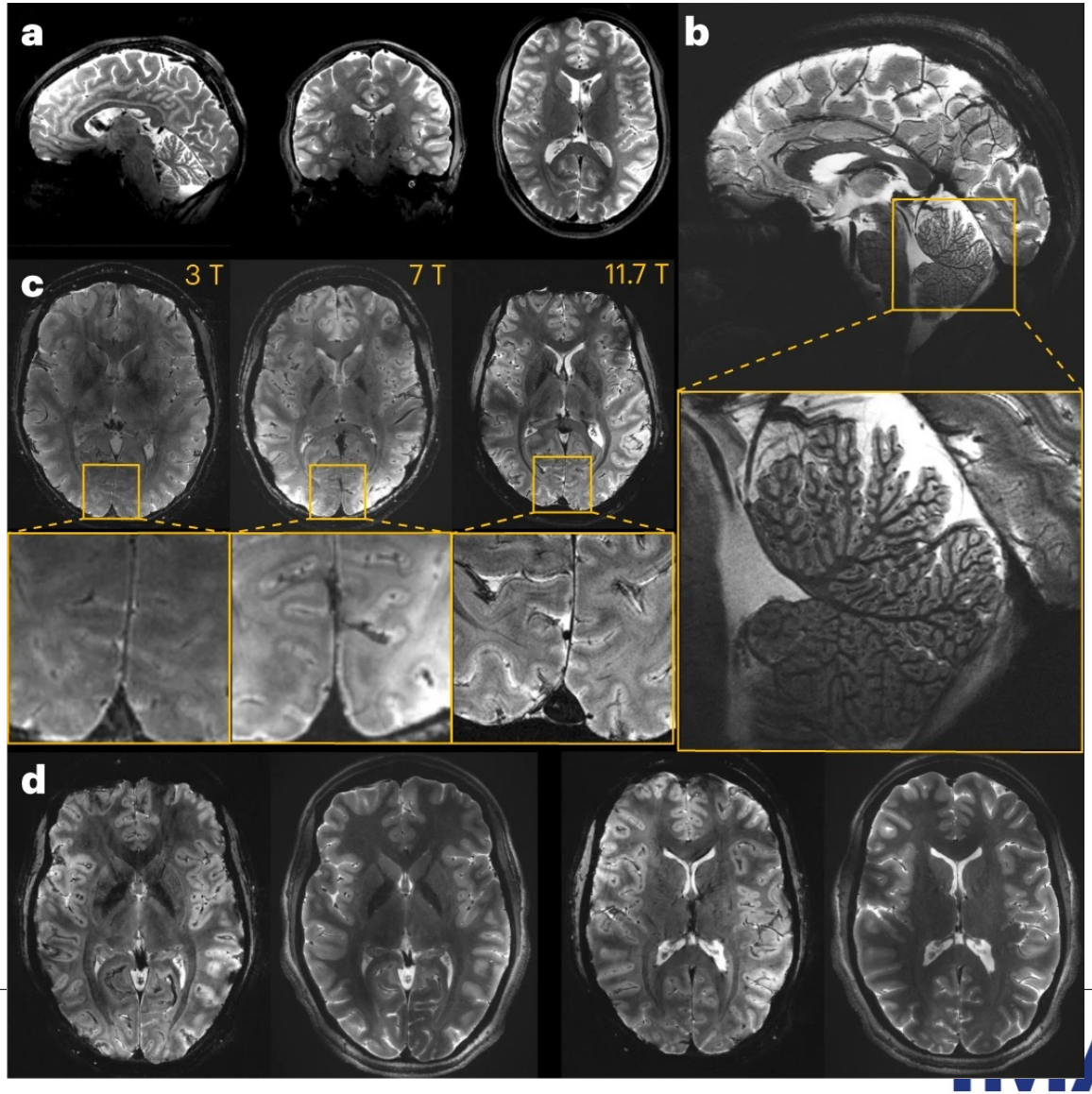
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3 T
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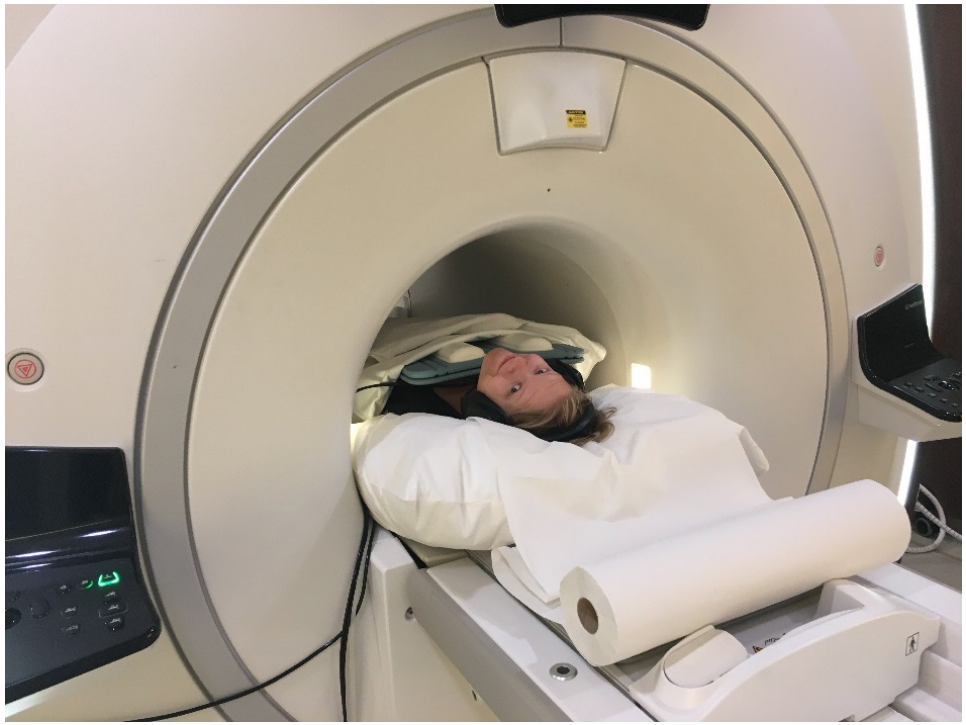
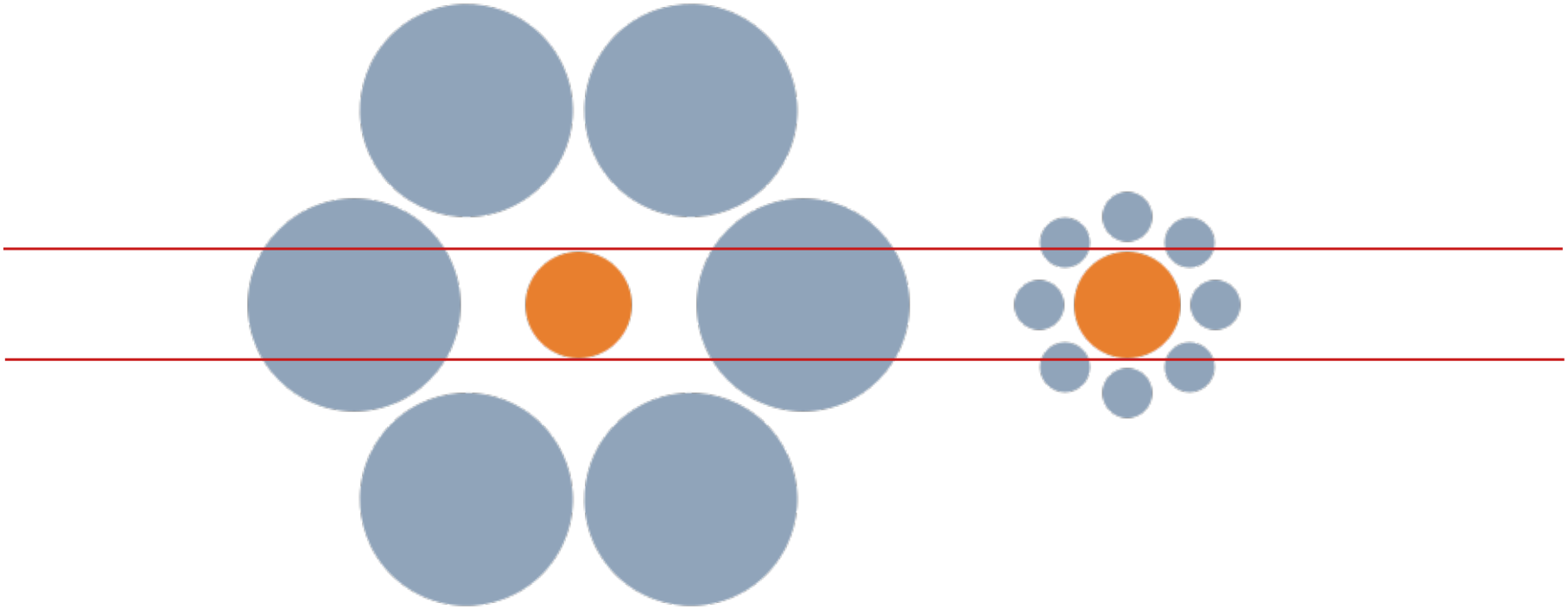
d

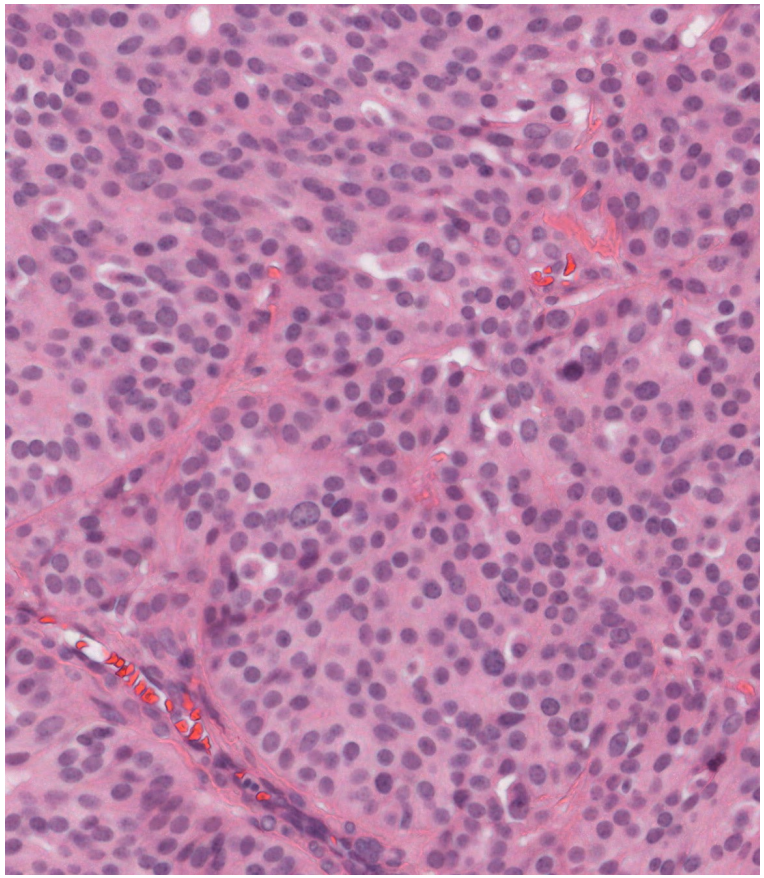
Present day in the Netherlands: 9K CT scans, 5K MR scans per 100K people per year

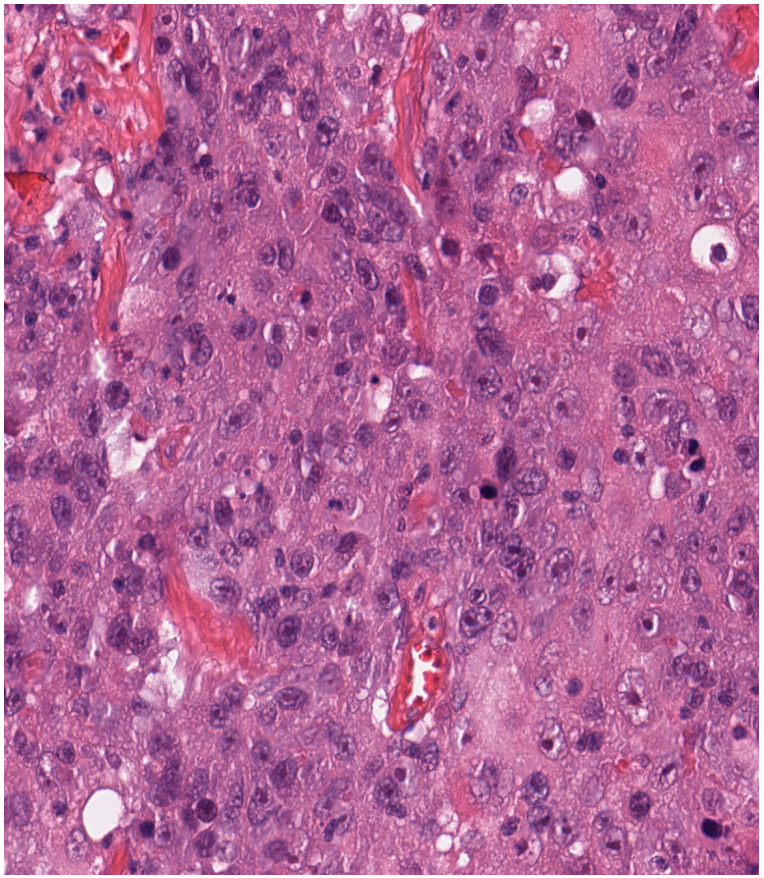


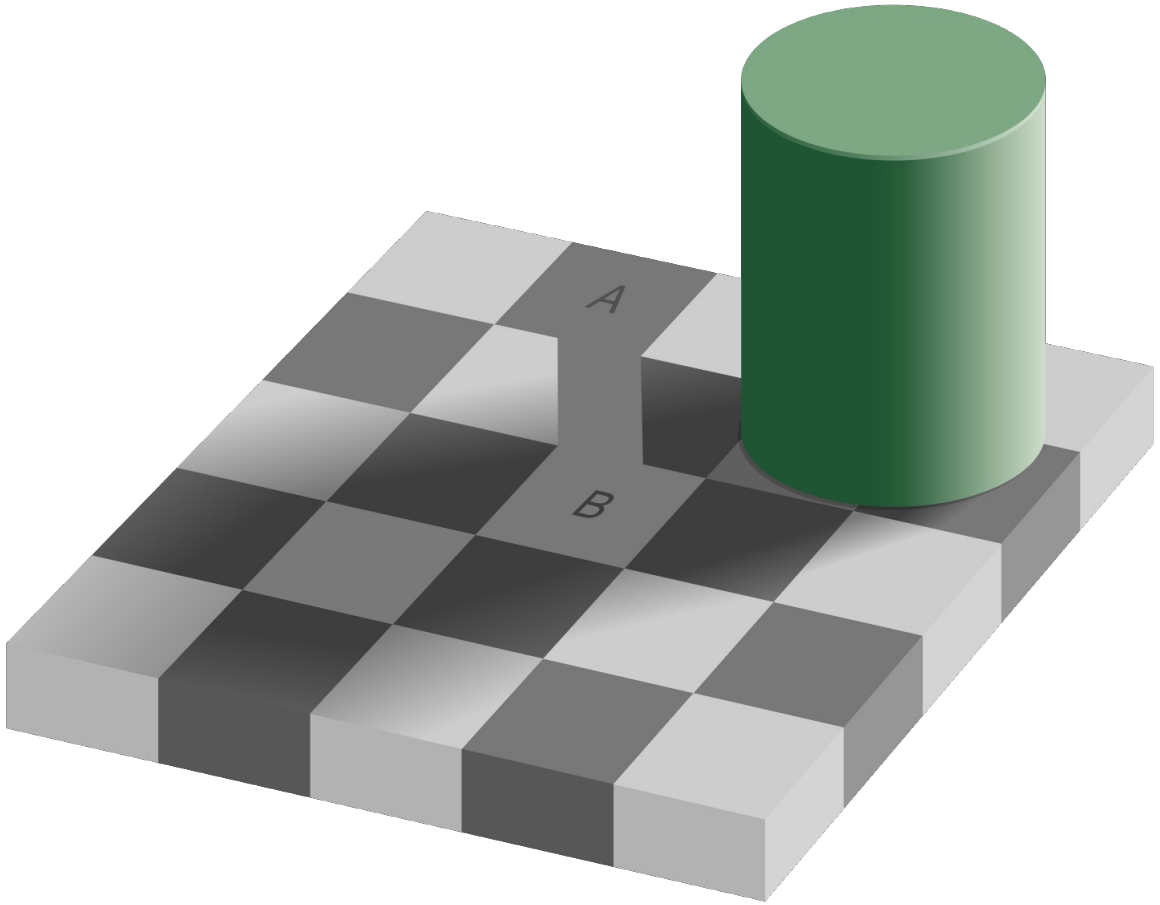
In this course, we'll explore how advanced image analysis techniques can help tackle real clinical problems.

But why automatic image analysis?








A
B

Education Corner

RG TEAM

Free Access

Understanding and Appreciating Burnout in Radiologists

Christopher R. Bailey[1], Allison M. Bailey[1], Anna Sophia McKenney, Clifford R. Weiss

Contents lists available at ScienceDirect

European Journal of Radiology Open

journal homepage: www.elsevier.com/locate/ejro

Incidence and factors associated with burnout in radiologists: A systematic review

Nader A. Fawzy[a], Muhammad
Tamara Alsheikh[a], Ali Ahmed

RADIOLOGICAL EDUCATION

Check for updates

Prevalence of burnout among German radiologists: a call to action

Moritz B. Bastian[1*], Laureen Fröhlich[1], Joel Wessendorf[1], Michael Scheschenja[1], Alexander M. König[1], Jarmila Jedelska[1] and Andreas H. Mahnken[1]

The goal of medical image analysis is to develop **automated** methods that enable **faster, more reliable and quantitative** analysis of medical images.

Learning goals

After completing the course, the student…

..has insight of the role of medical image analysis tasks in addressing clinical questions.

… has knowledge of how basic engineering and mathematical techniques can be used to design medical image analysis methods.

… can implement and apply medical image analysis methods.

… can analyze the results of medical image analysis methods.

Place of the course in the curriculum:

8BB050 Image Acquisition and Processing

8BE030 Medical Image Analysis

8P361 Project AI Imaging (3rd year BSc)

BEP in Medical Image Analysis

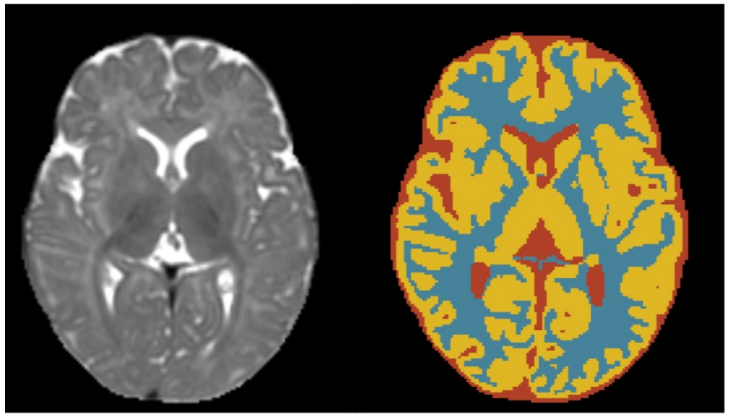
Master:

8DM20 Capita Selecta in Medical Image Analysis
8DM40 Machine Learning in Medical Imaging and Computational Biology
Master graduation project and internship

Overview of different medical image analysis tasks (2D, 3D, 3D+, …)

This course

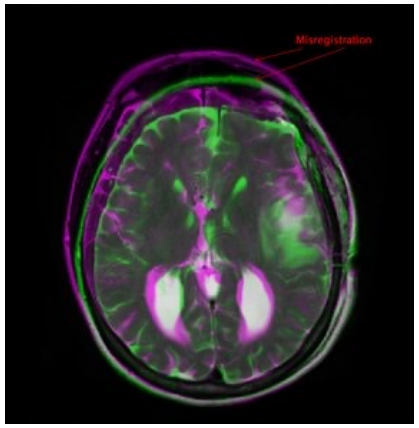
Image segmentation



Dividing an image into multiple regions with similar properties (e.g., intensity values).

NB: these regions typically correspond to different anatomical structures.

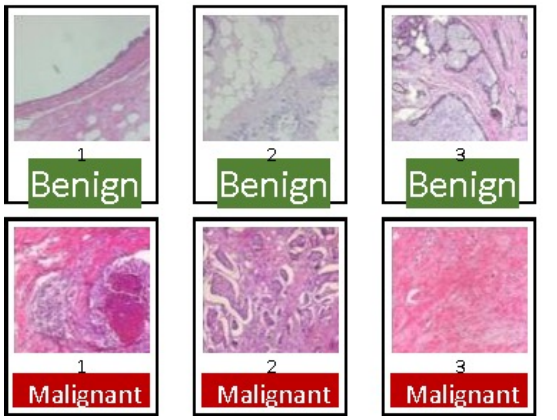
Image registration



Finding an optimal transformation that aligns two images.

8BB020

Computer-aided detection (CAD)



Categorizing/labeling images based on specific rules.

Official definition: “systems that assist doctors in the interpretation of medical images, often based on machine learning”

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Course organization

Two main topics:

1. Medical image registration (Ruisheng)
2. Medical image segmentation (Ruisheng + Cian)
3. Deep learning for registration & segmentation (Cian + Ruisheng)

Lectures, exercises & project work

Course schedule

Monday and Thursday: lectures and practicals (guided self-study)

Practicals:

You can work in **groups of up to 4 students** on:

- Exercises
- Project work

You can sign yourself up into a group on Canvas.

Report must contain a paragraph describing the contributions of each group member which can be used to to adjust individual grades to reflect a student's (lack of) contribution to the group

Exercises

Goals:

- Help you study the material
- Develop code that can be used for the project work
- Prepare for exam
- Not graded

Projects

- 2 projects (registration, segmentation)
- Each project is based on one or more **research questions** that you formulate yourself
- Short report & code
- Graded

Detailed description of the project deliverables and assessment rubric can be found in the project handouts.

Guided project work: questions and extension of the code developed in the exercises that will guide you to a **minimal project solution**.

Assessment

Projects

- Medical image registration (15%)
- Medical image segmentation (15%)

Written exam (70%), out of which some of the questions related to the project, i.e. project accounts for ~50% of the grade

Communication – digital platforms we will use during this course

- Communication
- Python quiz
- Hand in assignments (project reports & code)
- Handouts lectures

- Course overview
- Python code for exercises and projects
- Handouts lectures

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Communication

Main communication channel is Canvas: post your questions in the Discussion section.

Emailing is only for individual circumstances and not related to content. If you do email, use the tag [8BE030] in the subject line.

How to effectively ask questions?

- **Start the question by explaining the context**
  - State the goal of the task you are working

- **Formulate a specific question**
  - “I don’t know how to solve Exercise 2” is not a specific question.
  - Be clear and honest about what you want to get out.
  - “Is this enough for the project work?” is not allowed.

How to effectively ask questions?

- **Demonstrate that you have attempted to answer the questions or solve the problem**
  - Formulate a provisional answer (does not matter if it is correct or not)

- **Python:**
  - Read the documentation
  - Error messages are informative!
  - Before asking for help, make sure that your problem is reproducible

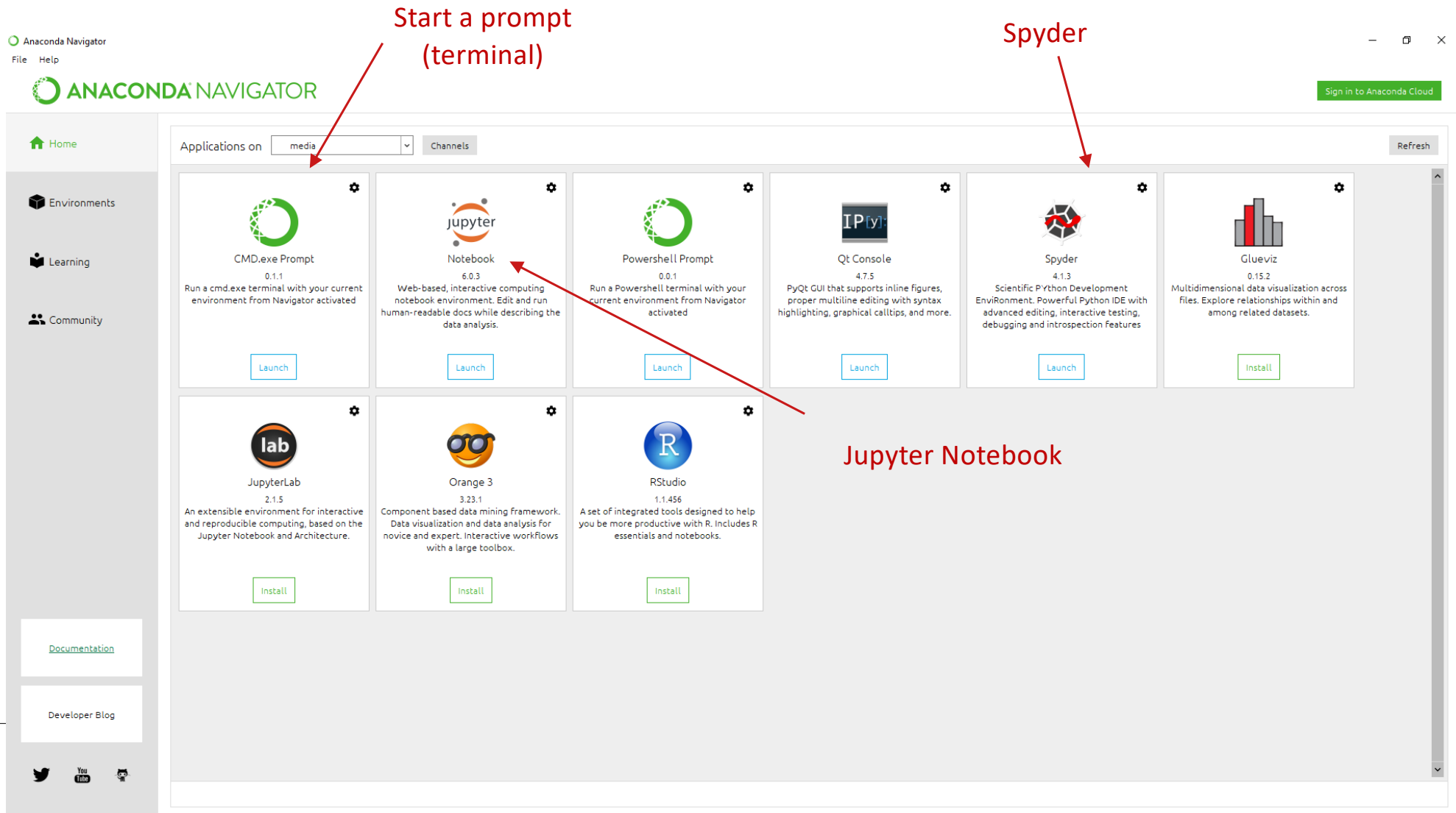
How to get started with the exercises and project work?

GitHub page: https://github.com/tueimage/8be030-mia

Follow software installation instructions:

- Anaconda / packages
- Python
- Jupyter

If you prefer a GUI: Anaconda Navigator



Example of setting up a Python environment:
https://www.youtube.com/watch?v=AxSwTvnwCUU&t=45s

Good luck

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Questions?

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