Master Seminar: Machine Learning in Neuroimaging

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Yitong Li, Prof. Dr. Christian Wachinger

Lab for Artificial Intelligence in Medical Imaging

Department of Radiology

School of Med & Health, School of CIT

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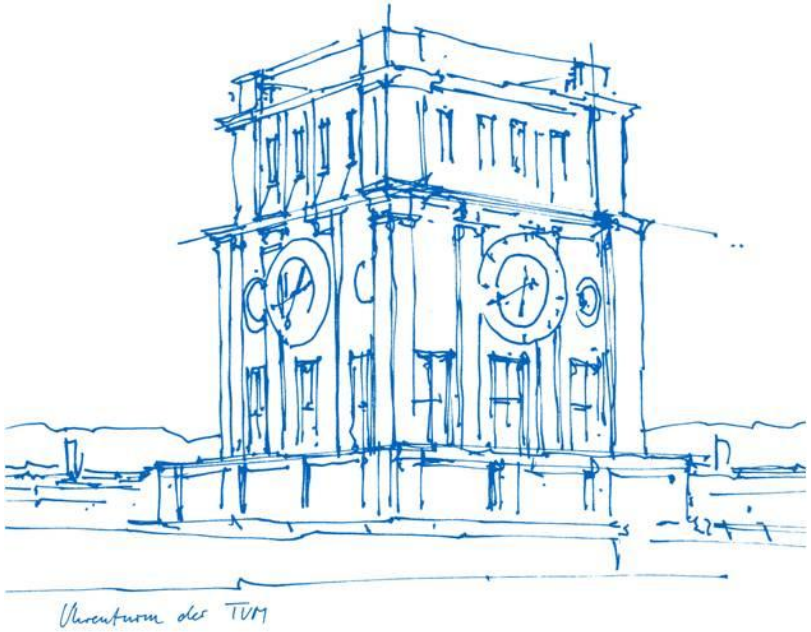
www.AI-Med.de



09.07.2024, 1pm

Lab for AI in Medical Imaging

Research topics:

- Segmentation
- Registration
- Neuroimaging
- Shape modeling
- Interpretability & Explainability
- Disease progression
- Causal inference
- Generative models
- ...

Prof. Dr. Christian Wachinger
Professor for AI in Radiology

www.ai-med.de

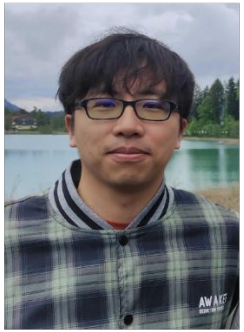
Lab For AI in Medical Imaging

@AI_medic

Morteza Ghahremani
Postdoc

Tom Nuno Wolf
PhD student

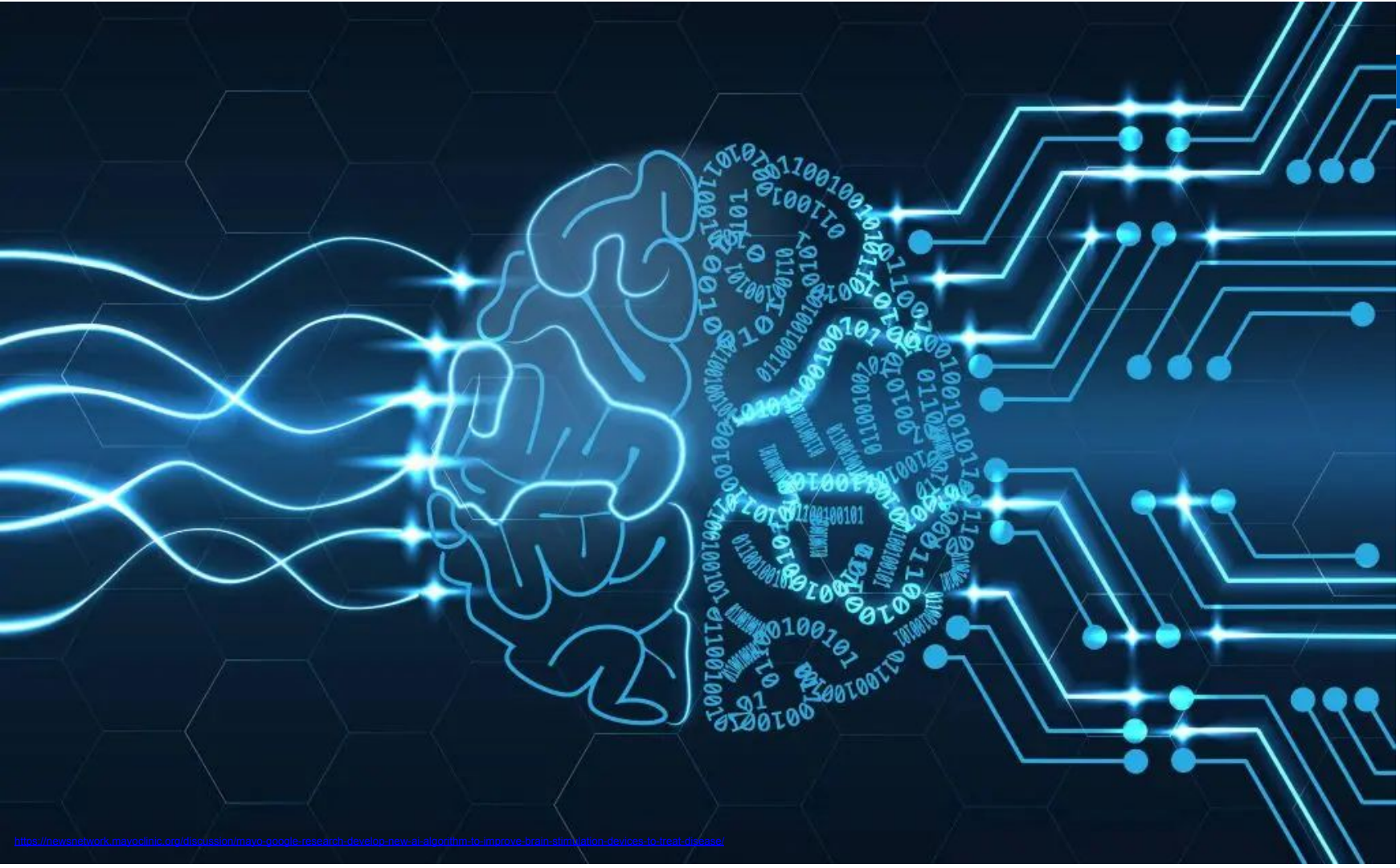
Yitong Li
PhD student



Bailiang Jian
PhD student

Anne-Marie Rickmann
PhD student

Fabian Bongratz
PhD student

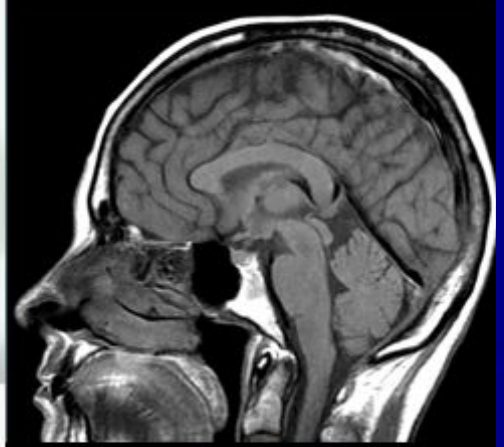


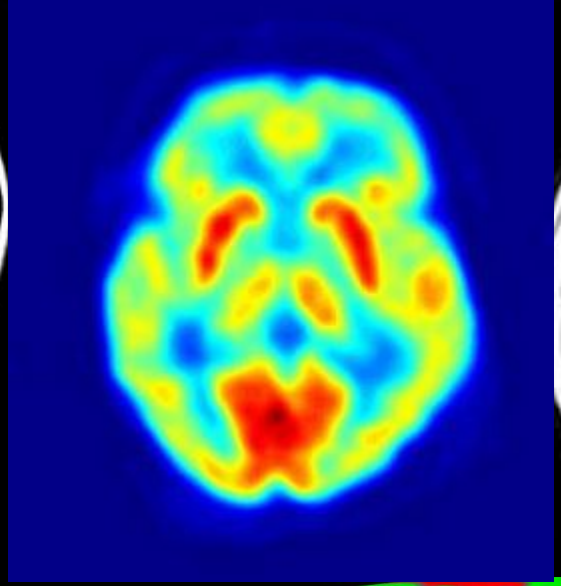
https://newsnetwork.mayoclinic.org/discussion/mayo-google-research-develop-new-ai-algorithm-to-improve-brain-stimulation-devices-to-treat-disease/

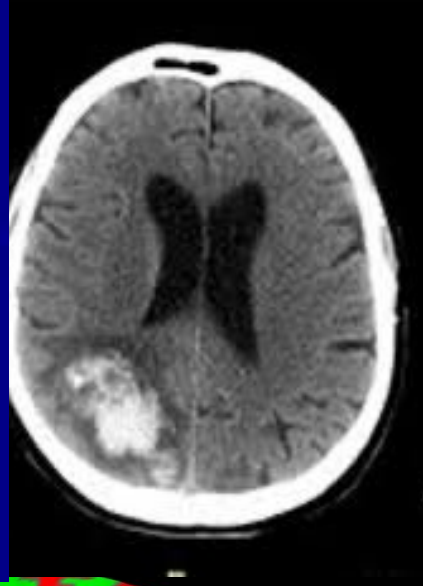
MRI

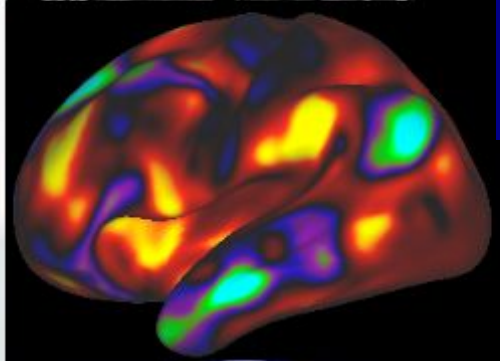
CT

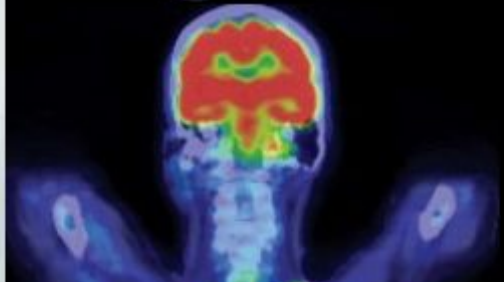
PET

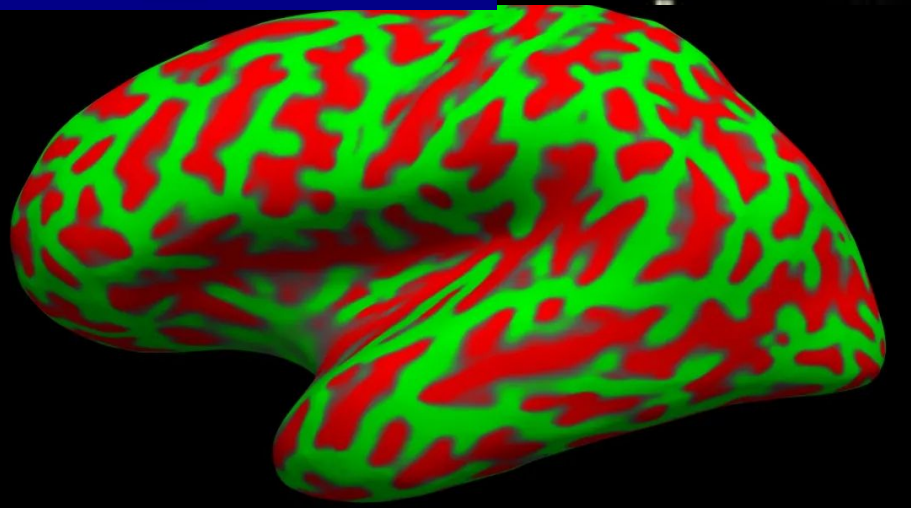


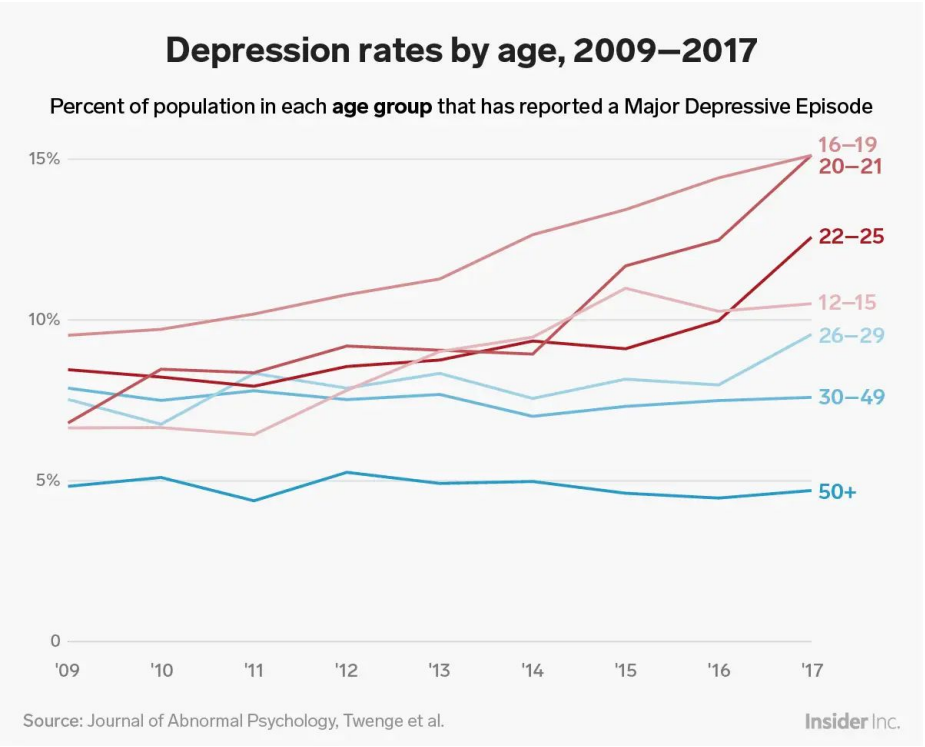












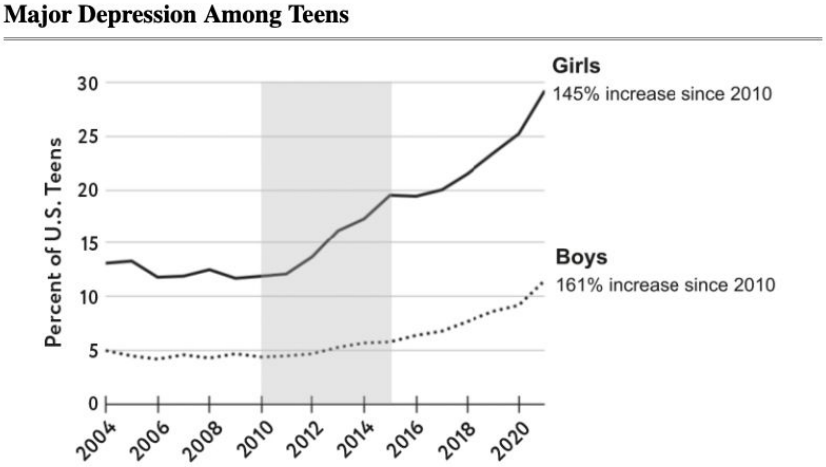


Figure 1.1. Percent of U.S. teens (ages 12–17) who had at least one major depressive episode in the past year, by self-report based on a symptom checklist. This was figure 7.1 in *The Coddling of the American Mind*, now updated with data beyond 2016. (Source: U.S. National Survey on Drug Use and Health.)[3]

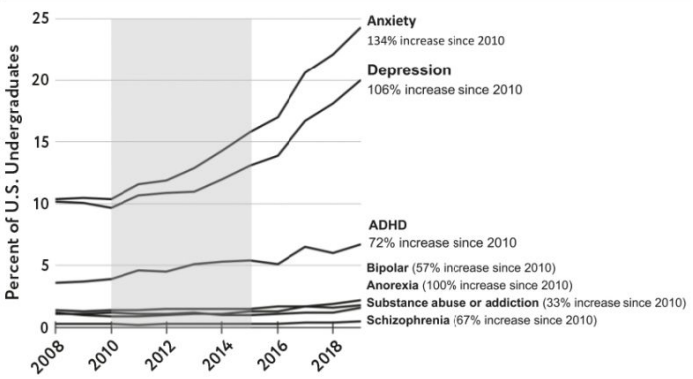
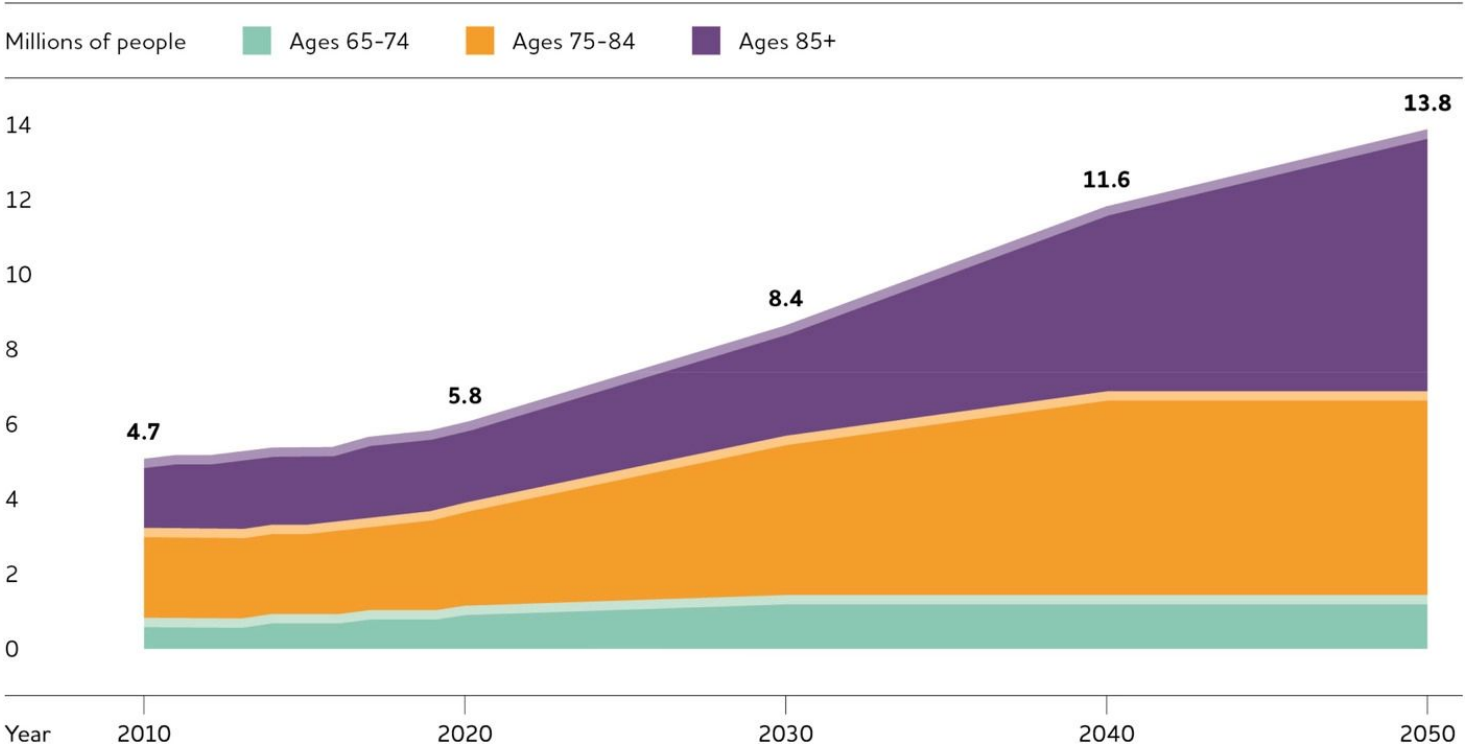
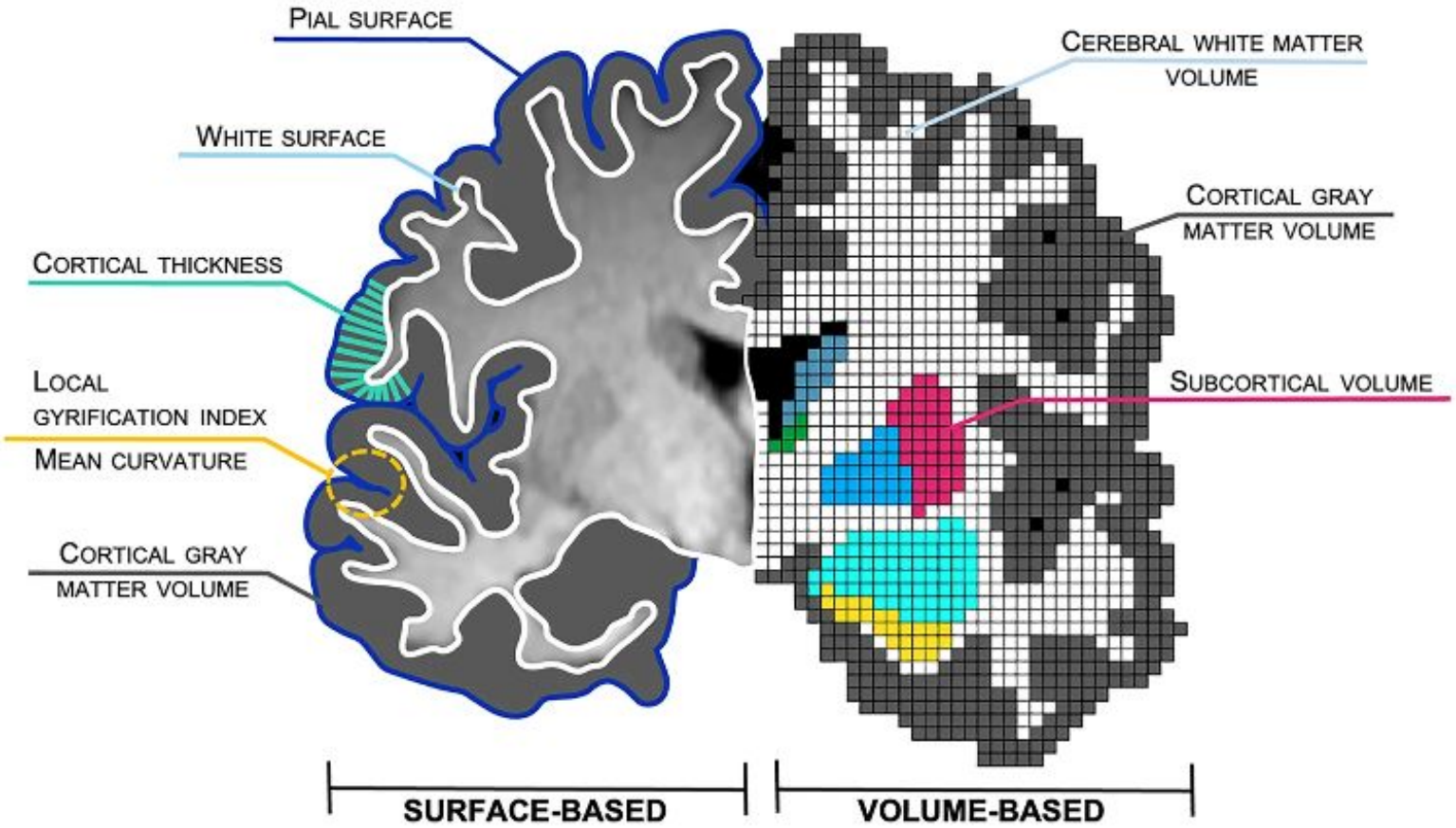


Figure 1.2. Percent of U.S. undergraduates with each of several mental illnesses. Rates of diagnosis of various mental illnesses increased in the 2010s among college students, especially for anxiety and depression. (Source: American College Health Association.)[9]

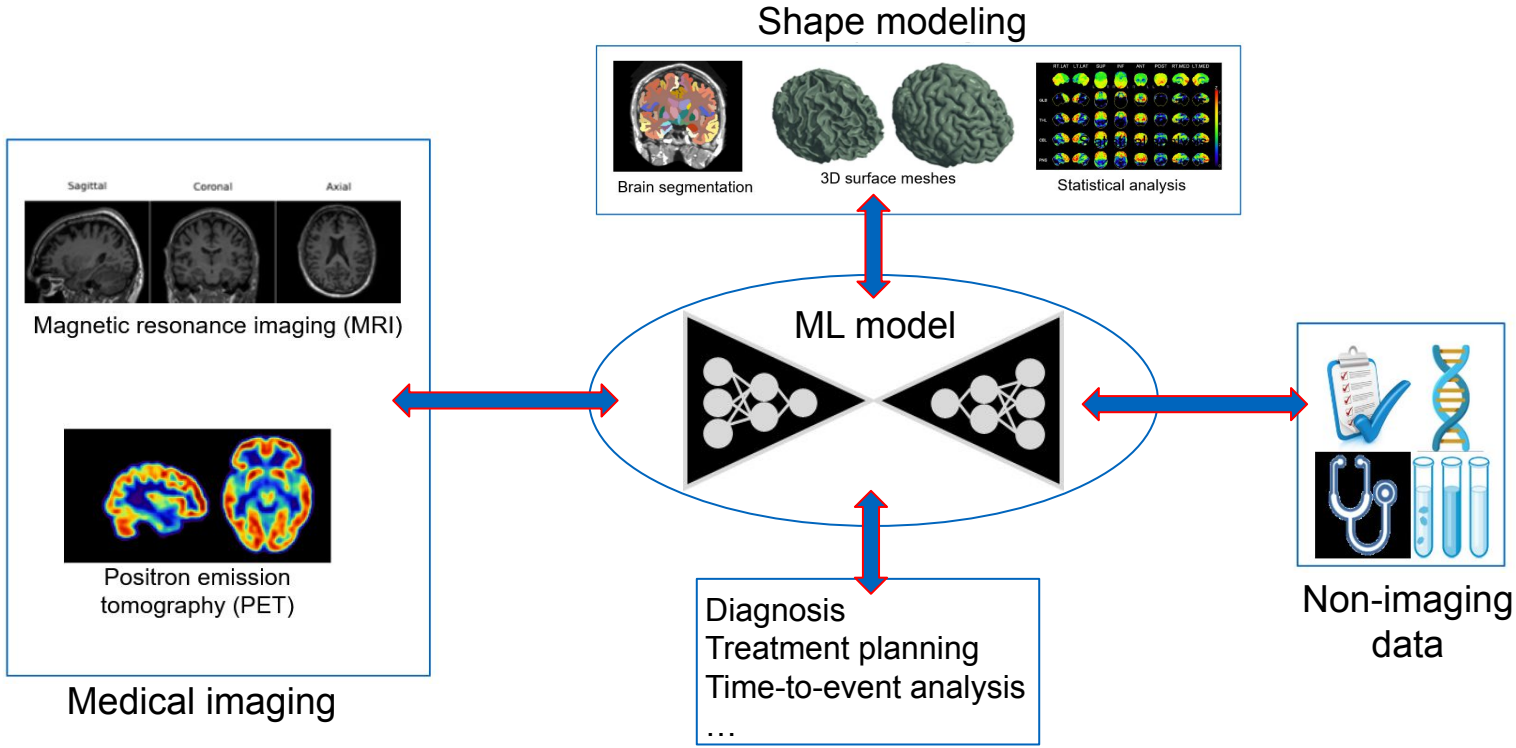
Alzheimer’s disease





https://link.springer.com/article/10.1007/s11065-021-09496-2#Fig1

Machine Learning in Neuroimaging: Overview



Exemplary Topics

- Deep learning architectures (CNN, GNN, Transformer)
- Multi-modal data analysis
- Generative models
- Disease prediction (e.g. Alzheimer's)
- Supervised and unsupervised learning strategies (and in-between, e.g., semi-supervised)
- Shape analysis, geometric deep learning
- Explainable AI
- Causal inference

See also topics from previous semesters in the wiki (the wiki is the central platform)

Learning outcomes

- How to read a paper in a structured way?
- How to phrase complex ideas in an understandable blog post?
- How to present research findings to an audience?

What to deliver?

- Paper presentation (20 min. presentation, 10 min. discussion)

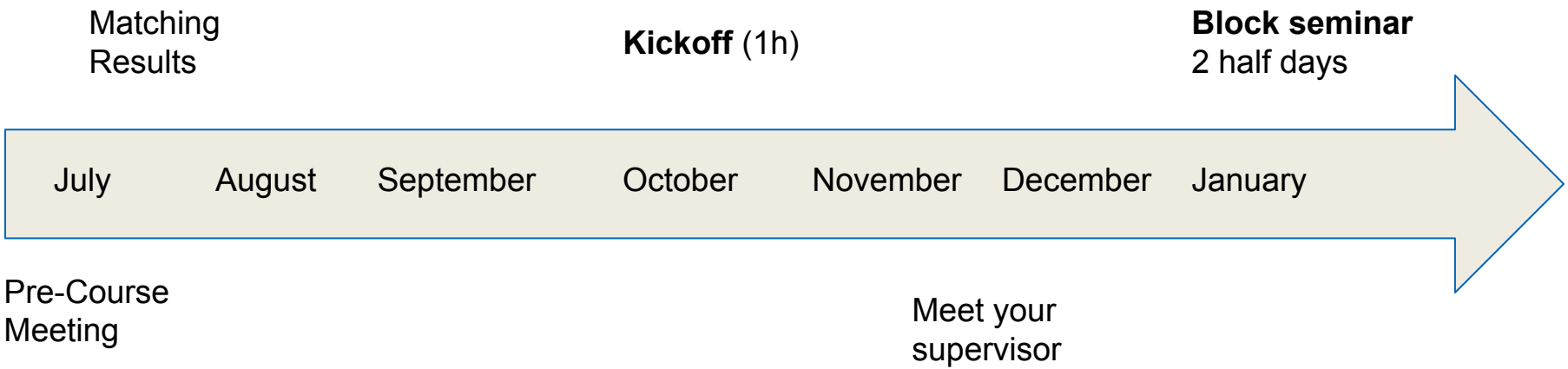
  70% of final grade
- Blog post (~4 pages DIN A4, working with ChatGPT encouraged) about the selected paper

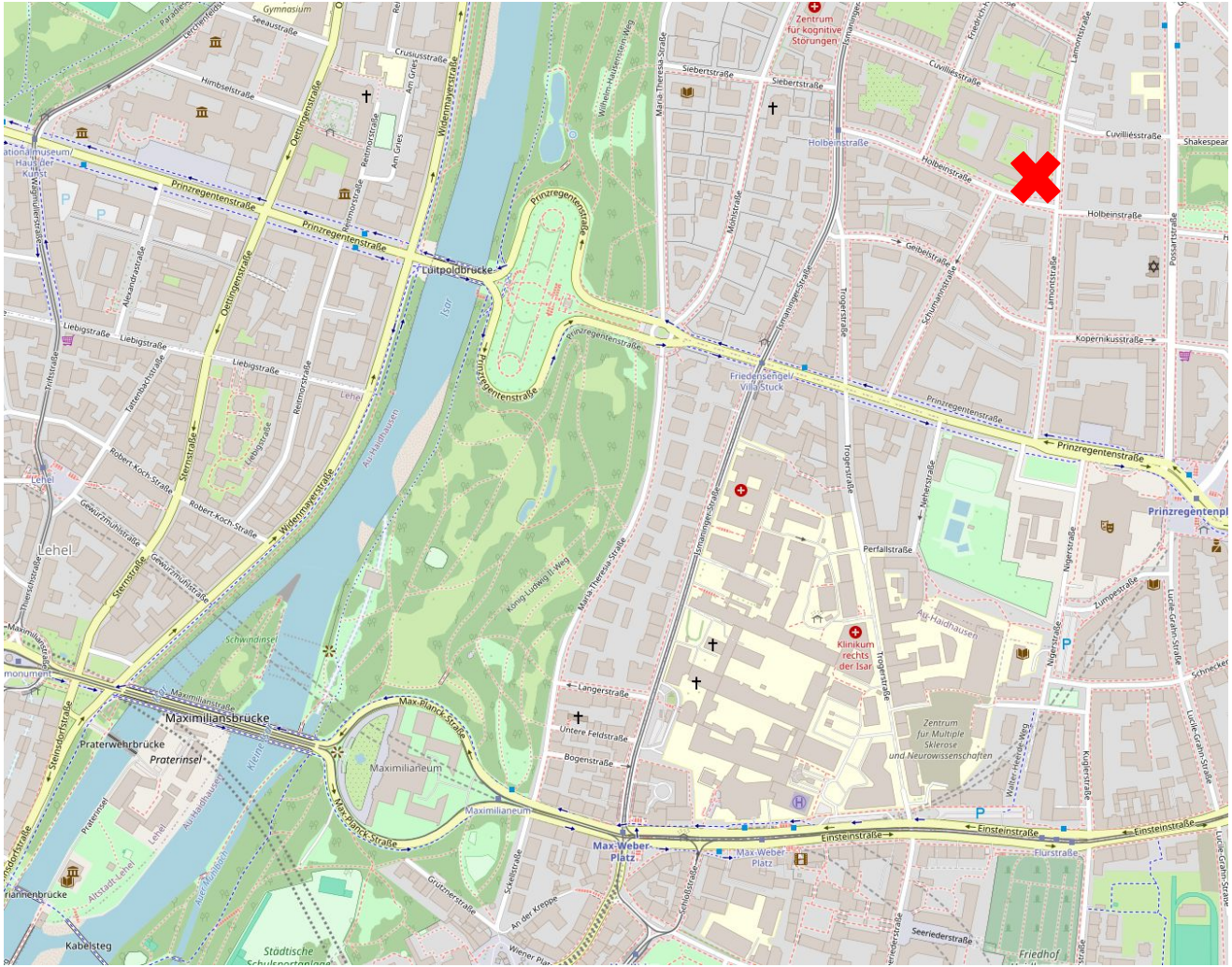
  30% of final grade

Preliminaries (recommended)

- Machine learning principles (e.g. IN2357 Machine Learning for Computer Vision, IN2064 Machine Learning)
- Fundamentals of deep learning (e.g. IN2346 Introduction to Deep Learning)
- Medical image analysis (e.g. AI in medicine I/II, CAMP I/II)
- Computer vision (e.g. IN2228 Computer Vision II: Multiple View Geometry)

Timeline


Matching
Results
Kickoff (1h)
Block seminar
2 half days
July
August
September
October
November
December
January
Pre-Course
Meeting
Meet your
supervisor



Holbeinstr. 11, 3rd floor

Copyright OpenStreetMap

Schedule

09.07.24: Pre-course meeting (today)

25.07.24: Matching results

October: Kickoff (Holbeinstr. 11, attendance mandatory)

During the semester: Meet your supervisor (not mandatory but recommended)

Early January (2 days): Block seminar (Holbeinstr. 11, attendance on both days mandatory)

Contact

seminars@ai-med.de

Find these slides at https://wiki.tum.de/display/mlneuro (TUM Wiki)

Don’t forget to register in the matching system (matching.in.tum.de)!