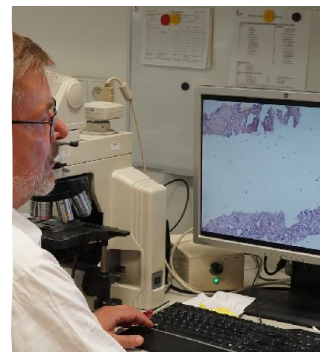
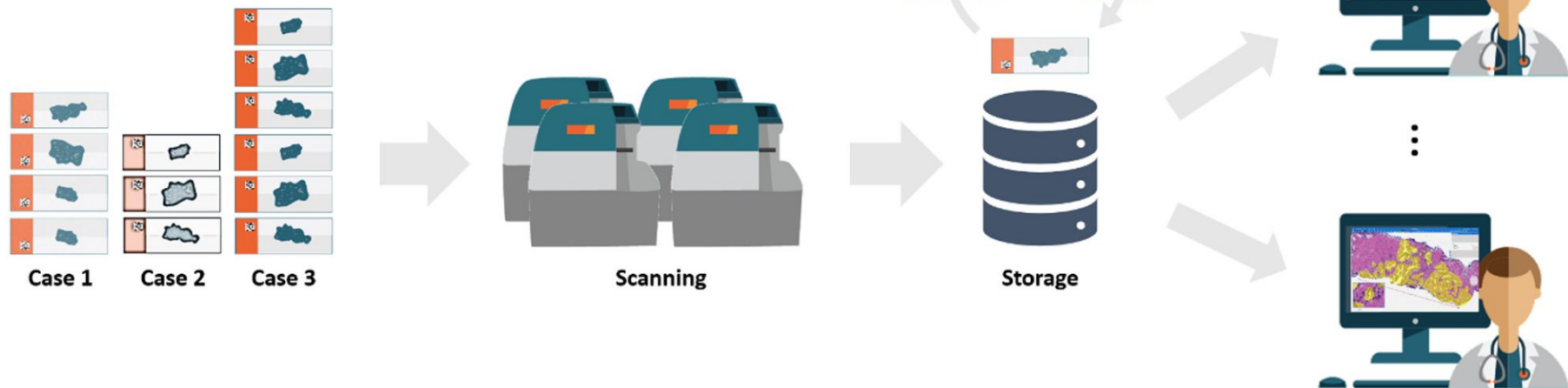


AI Solution for Inflammatory Bowel Disease

Tomáš Brázdil, Ondřej Fabián, Adam Kukučka, Vít Musil



Digital pathology



Our team and collaborations



RationAI: Research group at MUNI

- More than 30 members
 - Eight senior members at MUNI
 - Two Ph.D. students,
 - Master and bachelor students

Project oriented

Projects in digital pathology, explainable AI, AI infra development

IKEM: Institute for Clinical and Experimental Medicine

- Prof. Fabián and Dr. Květoň
- Prof. Sticová and Dr. Vajsová - sample preparation, scanning, data preparation
- Collaboration with Liberec a Thomayer hospitals

Other RationAI collaborations:

- Masaryk Memorial Cancer Institute - main collaboration in digital pathology, deployment of prototype AI systems
- Med Uni Graz, FN Brno, etc.

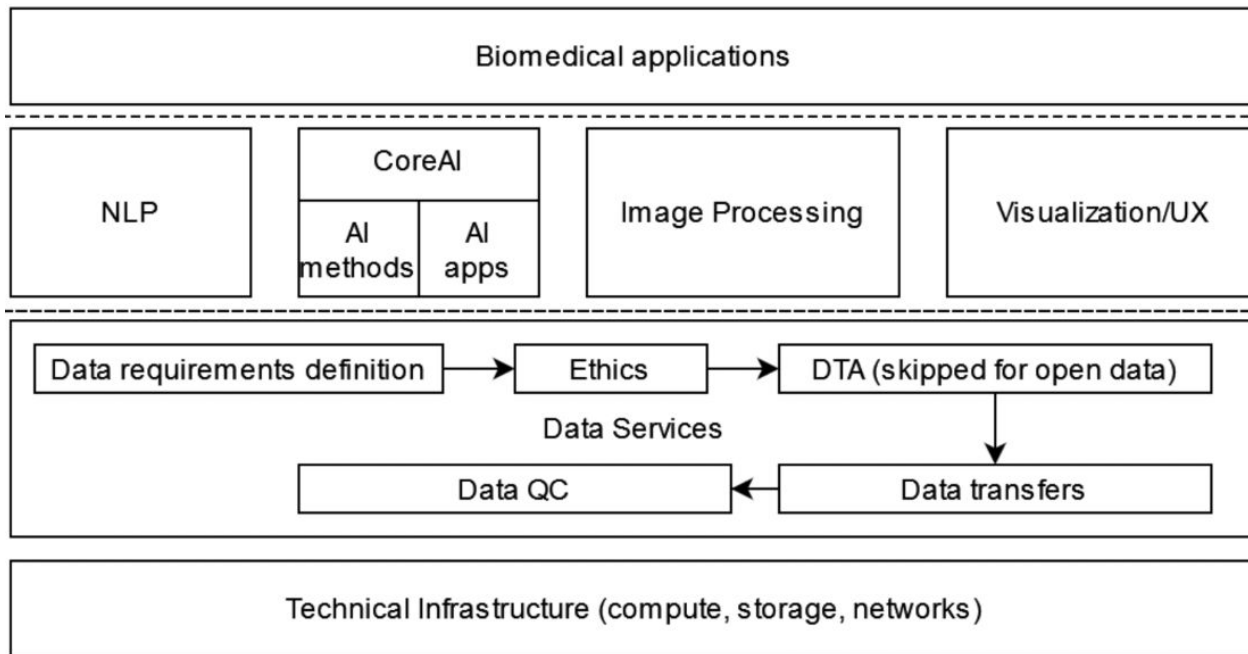


Full Stack AI



MUNI
FI

MUNI
ICS



Experimental clinical deployment at MMCI

RationAI Cases Search Annotations Upload

mmci

- mamma
 - test-novy
 - P2023_01466
 - P2023_02535
 - P2023_03221
 - ...
 - P2023_02746
 - P2023_01141
 - Show more
 - Public
 - TEST24-03
 - Gleason
 - fnb
 - ppni
 - 9-24
 - 8-24
 - 5-24
 - 7-24
 - ...
 - 6-24
 - Slinivka_1
 - Show more
 - prst
 - AIProstate2023_139
 - AIProstate2023_47

8-24

pancreas perineural invasion

Visualizations

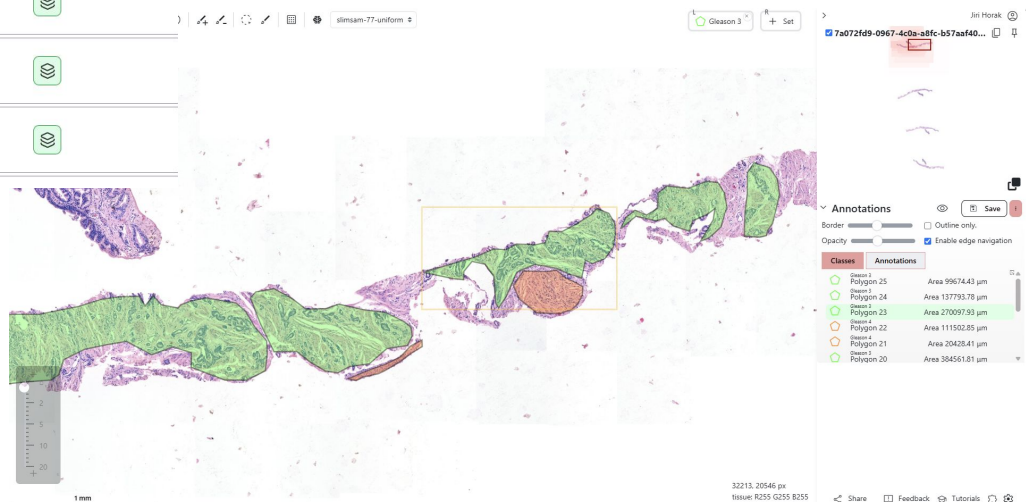
	d55a1be6-7adc-5260-89ee-16588a933c6a 21. 1. 1970 2:33:22	
	ab48a2f3-38db-5430-b66e-3f3c66bc9aef 21. 1. 1970 2:33:22	
	d5e20c84-621f-50a2-9c72-60dc9fb6acee 21. 1. 1970 2:33:22	
	c9af56bd-ca8a-5761-91fd-07e3eabf4d83 21. 1. 1970 2:33:22	
	b09d10b0-271b-50c7-801a-88dd97238e4 21. 1. 1970 2:33:22	

Case browser

- Execution of AI models
- Metadata examination

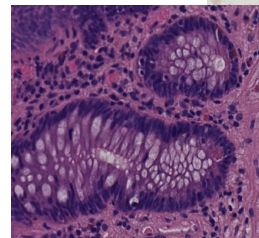
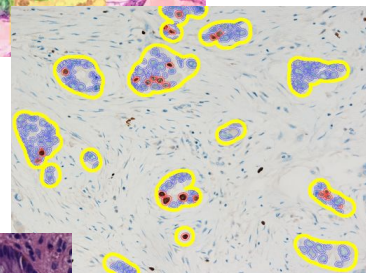
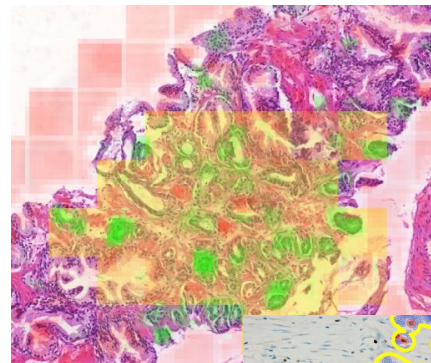
xOpat viewer

- Display scanned samples
- Annotations, model outputs



AI in DP Problems Portfolio

- **Cancer prediction**
 - Prostate, colon, breast, pancreas, etc.
 - Data from MMCI, FN Brno, MUG
Deployment at MMCI
- **Genomics**
 - Prediction of markers from morphological structures
Ki-67 index, Mammaprint
 - Collaboration with MMCI and FN Brno
- **Inflammatory bowel disease**
 - Ulcerative colitis (Nancy index etc.)
 - Collaboration with IKEM
(and other hospitals such as Thomayer, Liberec)

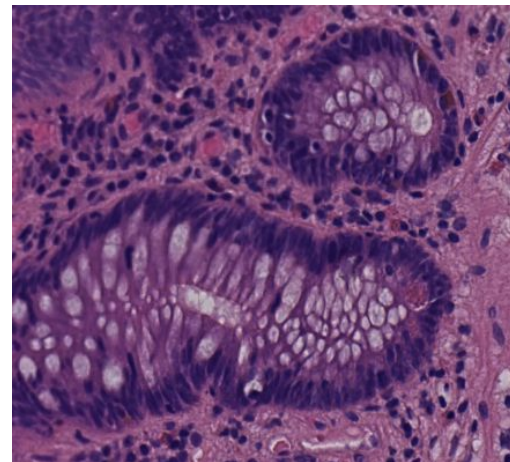


IBD

Nancy index 0 - 4 grading inflammation severity based on whole-slide images of colon tissue samples

The work comprises:

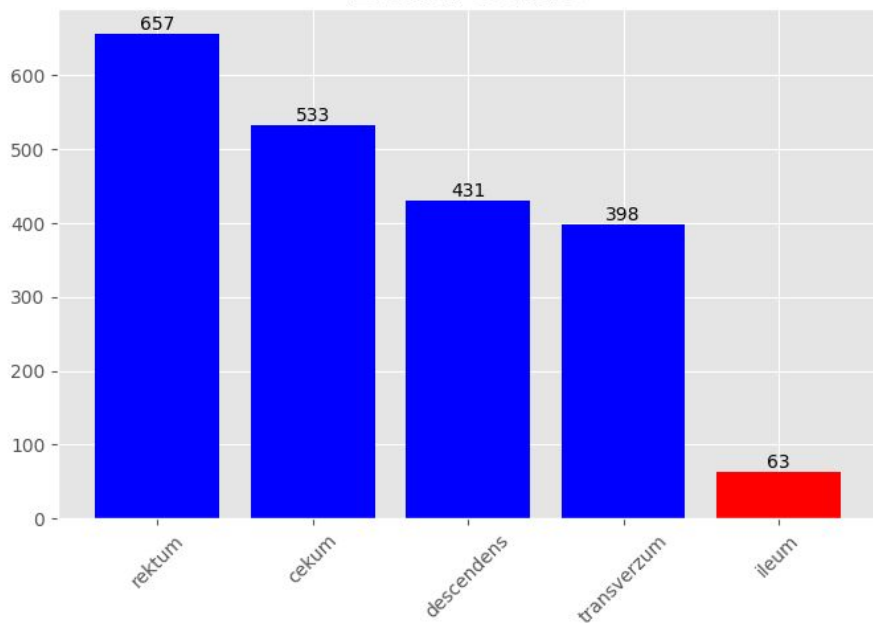
- **Sample preparation and data acquisition (IKEM)**
Retrieve samples, select, scan, connect with clinical data (such as locality, Nancy index)
- **Data preparation (IKEM, MUNI)**
 - Scan level annotations: Clean-up labels (assignment correctness), data exploration
 - Image quality control
- **Model training (MUNI)**
 - Training on Cerit-SC infra, foundation models employed
- **Model testing (IKEM, MUNI)**
 - Metrics computation, visual inspection, pathologist's feedback



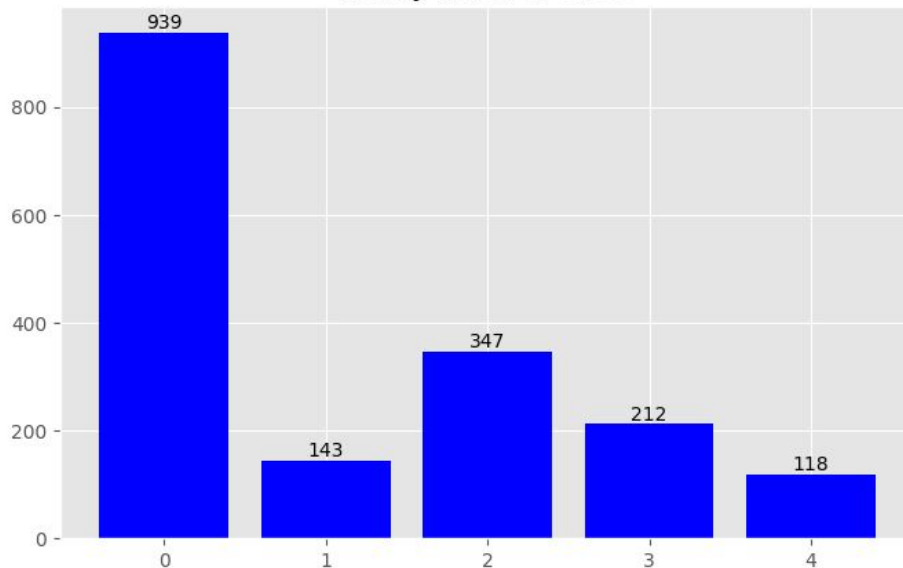
IKEM Dataset

2019 WSI, labeled with Nancy index

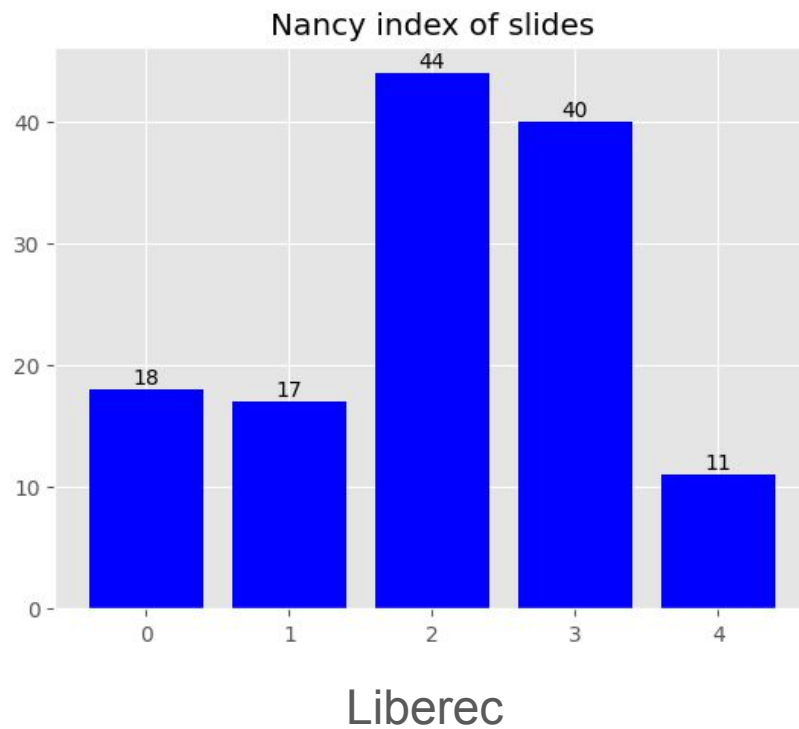
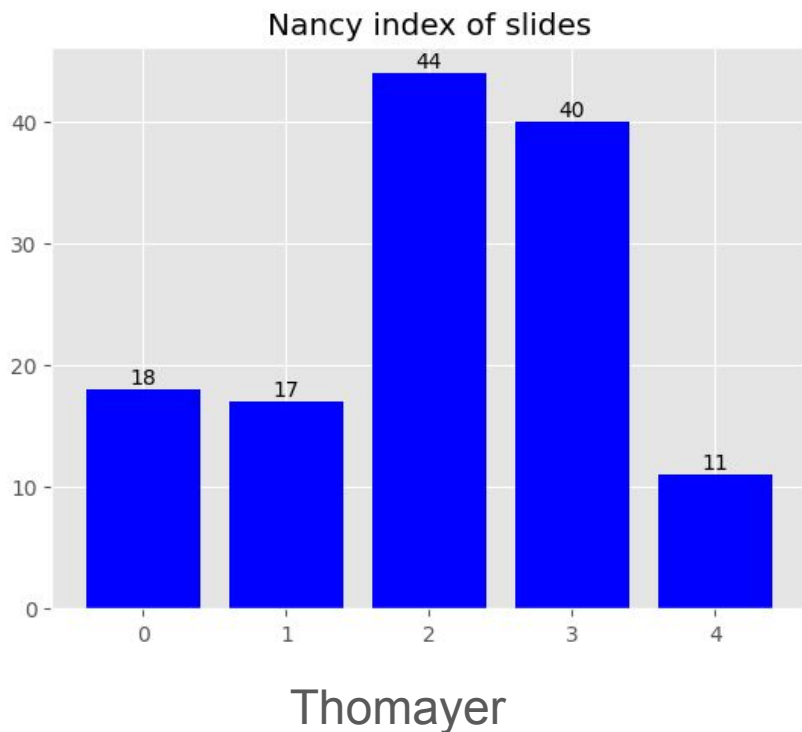
Location of slides



Nancy index of cases



Thomayer Hospital & Liberec



These datasets have not yet been used

Training Nancy 0-1 vs 2-4 predictor

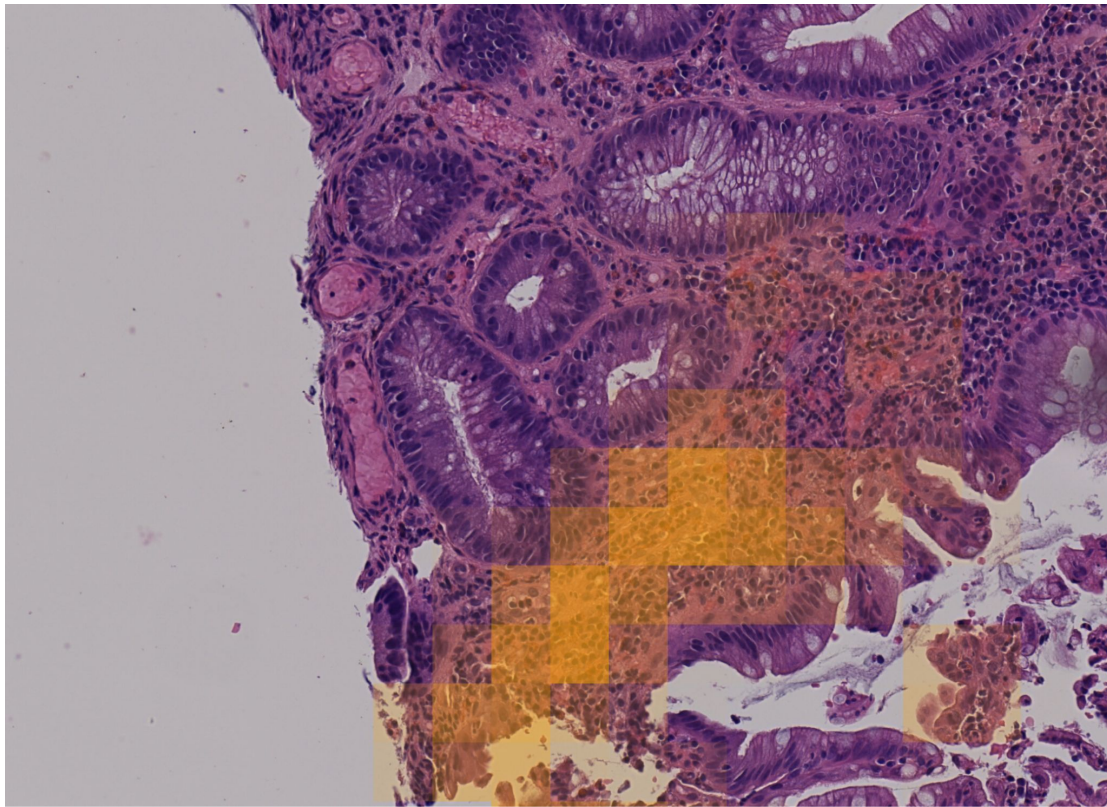
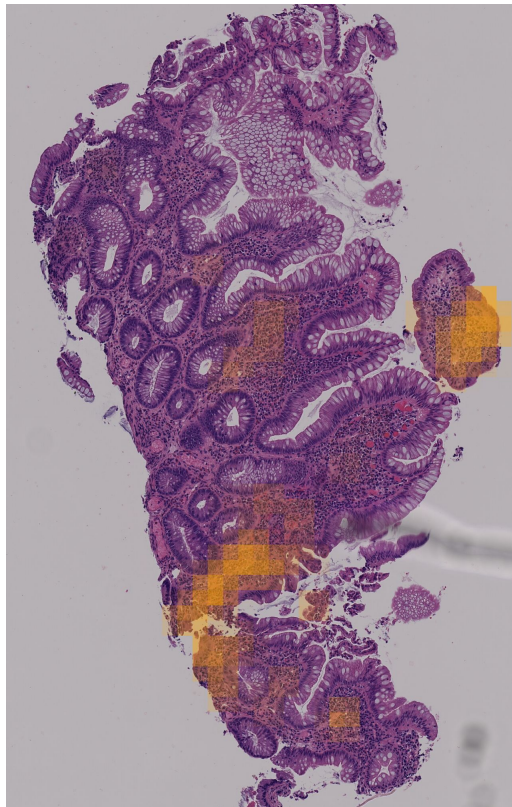
Binary prediction: Class 1 = Nancy < 2

Class 2 = Nancy >= 2

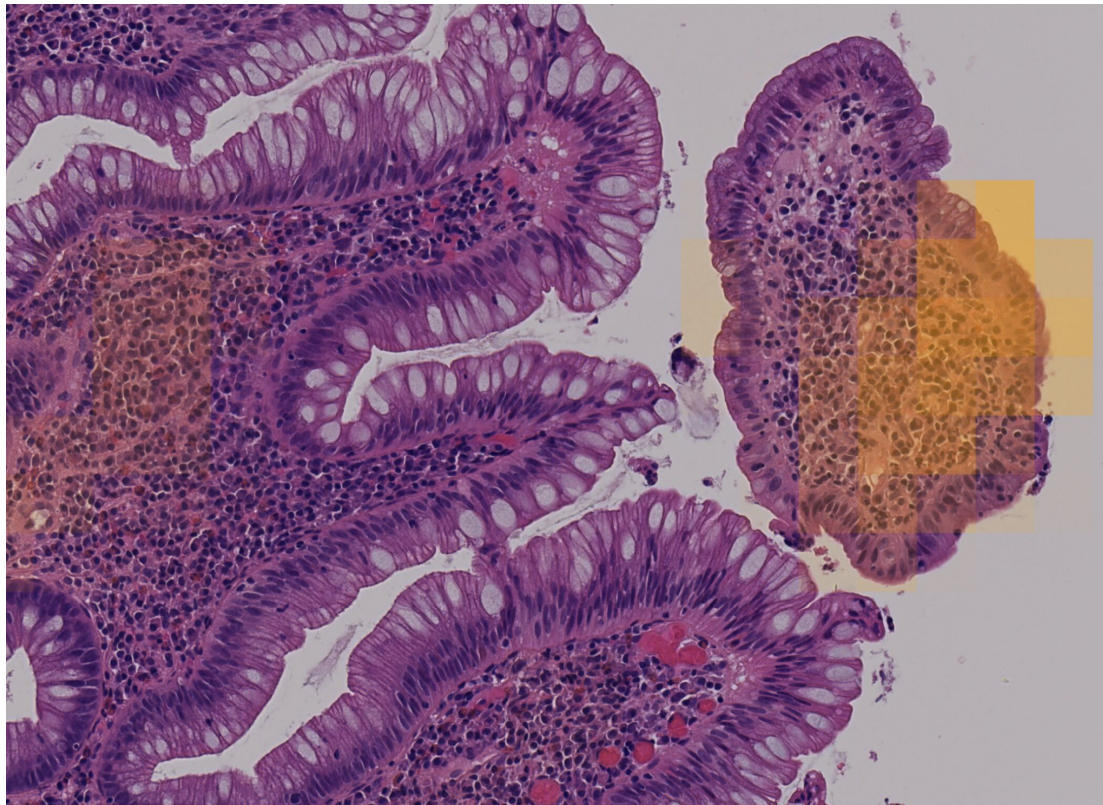
- Foundation model (ProvGigapath)
- Folded training & eval
Leave one out, 5 folds
- Trained to predict on small patches + summarization using attention

Fold	AUC	accuracy	sensitivity	specificity
1/5	0.9473	0.9007	0.9023	0.8994
2/5	0.9476	0.8508	0.9266	0.8035
3/5	0.9360	0.8410	0.9160	0.7904
4/5	0.9566	0.8684	0.9297	0.8387
5/5	0.9547	0.8587	0.9431	0.7937

Example predictions



Example predictions



Future Work

- Distinguish Nancy =0 from >0 and ≤ 2 from >2
 - Difficult: The index values determined by the size of the inflammation area
 - High inter-person variability
- Multi-centric testing (and training)
 - More data from Thomayer and Liberec
 - Expected issues with color shifts, etc.
- Deployment in IKEM
 - Inclusion of AI into the clinical workflow
 - Continuous execution



Dysplasia Detection

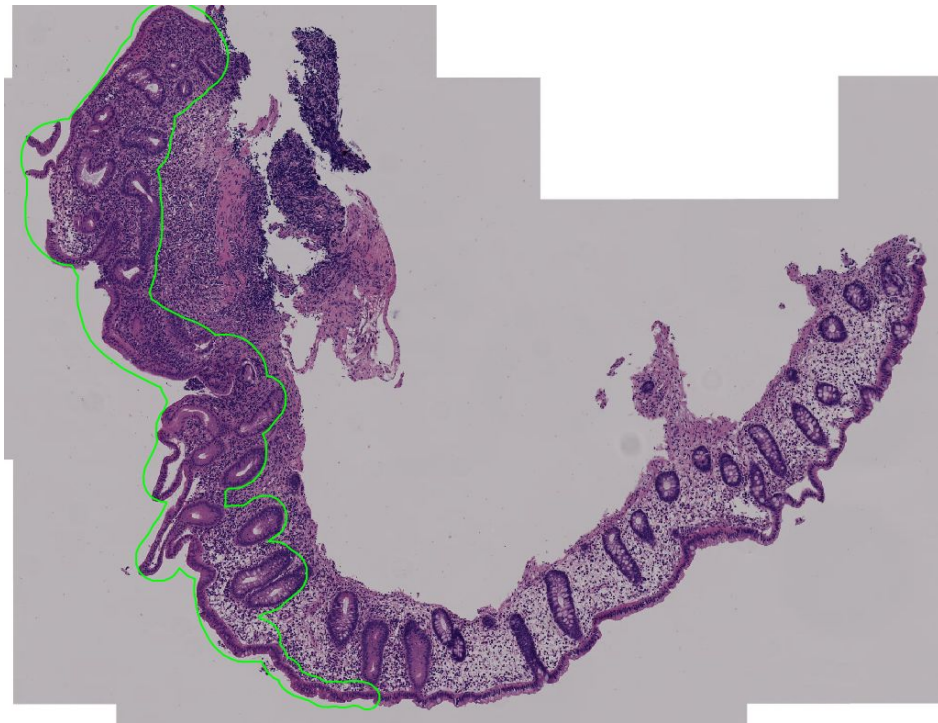
Detection of high grade dysplasia in colon

Current state: Data preparation

- Local hand-crafted annotations: IKEM
- QC

Plan

- Use similar models as for prostate cancer prediction



Conclusions

- Our group is ready for full stack development of AI in digital pathology
- We have already developed AI model distinguishing Nancy <2 and ≥ 2 for colon WSI
- Our plan is to
 - finish models detecting all Nancy index levels
 - do multicentric testing
 - deploy in hospitals (IKEM)
 - continue with dysplasia detection AI methods