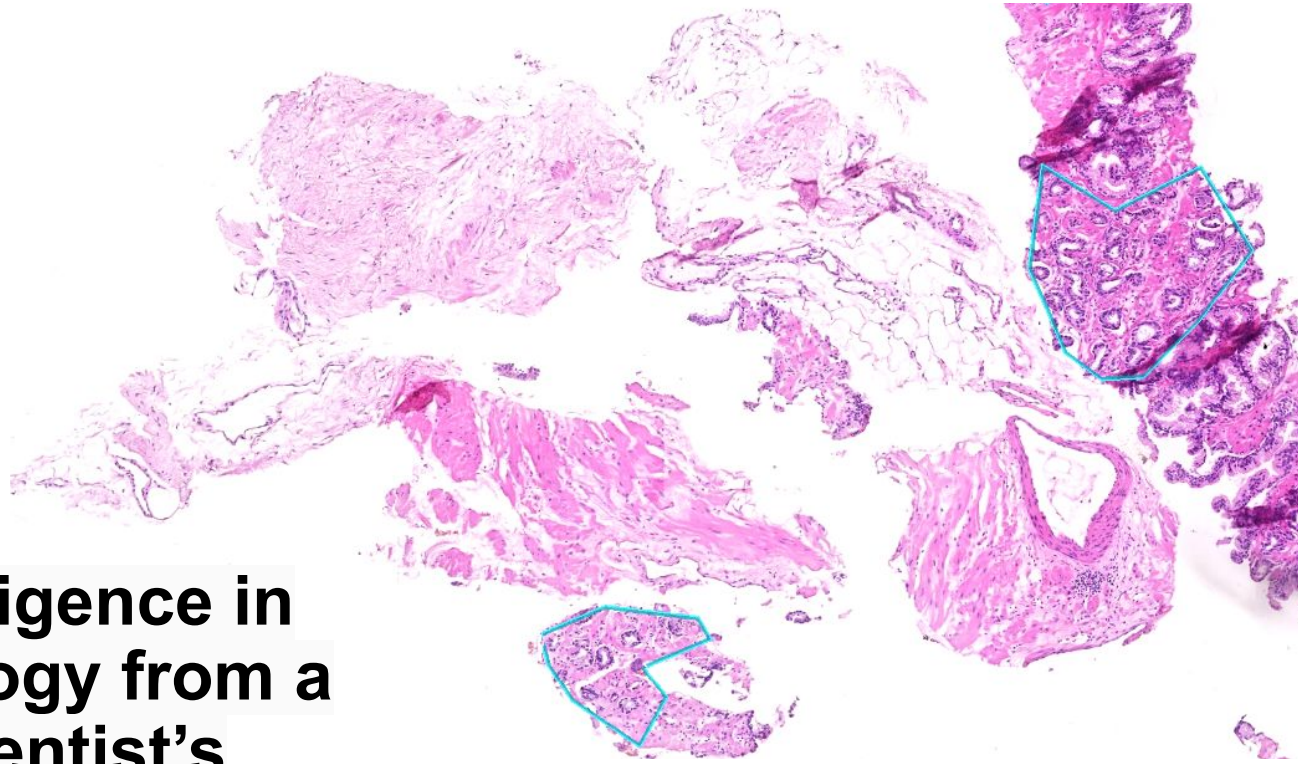
RationAI

aigopath



Artificial Intelligence in Digital Pathology from a Computer Scientist's Perspective

Tomáš Brázdil

MUNI

Who We Are

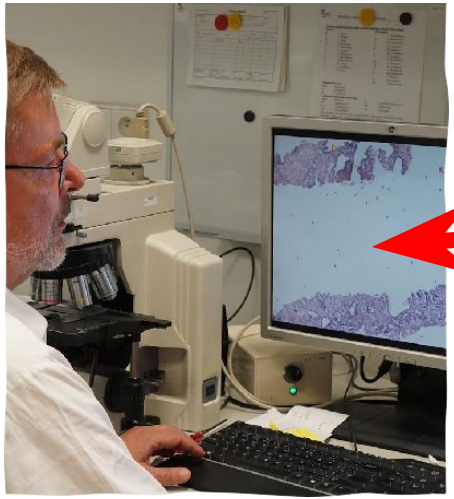
RationAI

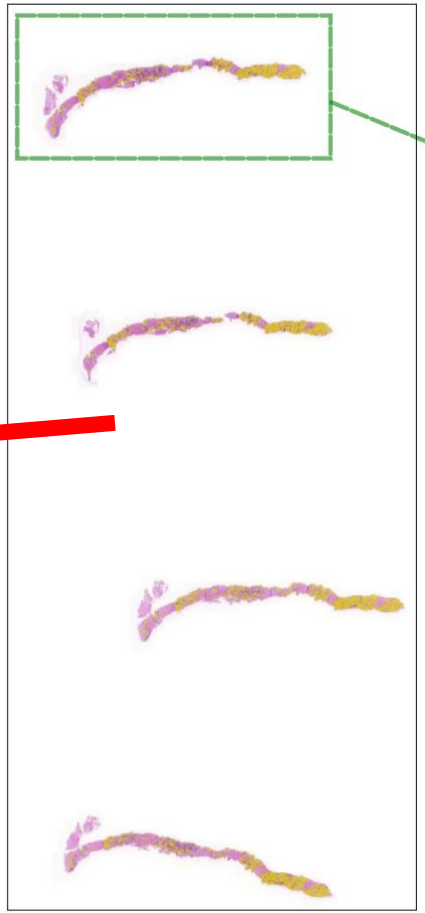
- a research group at Masaryk University (in Brno)
- 8 senior members, approx. 20 students
- Research in AI in digital pathology, especially explainable methods and clinically relevant problems
- Collaboration with MMCI, IKEM, Med Uni Graz, FN Brno, etc.

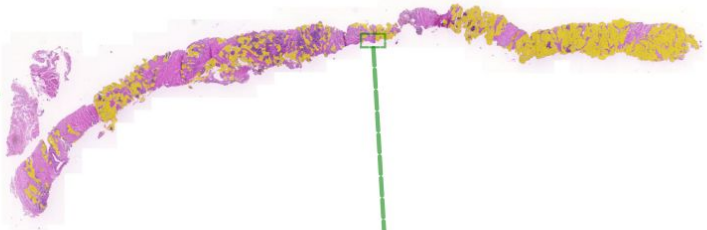
AigoPath

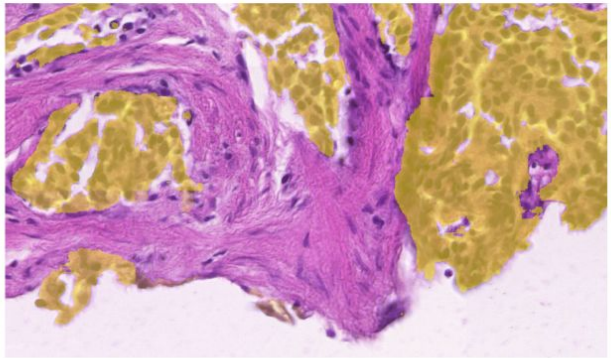
- a startup closely related to RationAI
- *Product*: xOpat viewer enhanced with AI tools

AI in DP







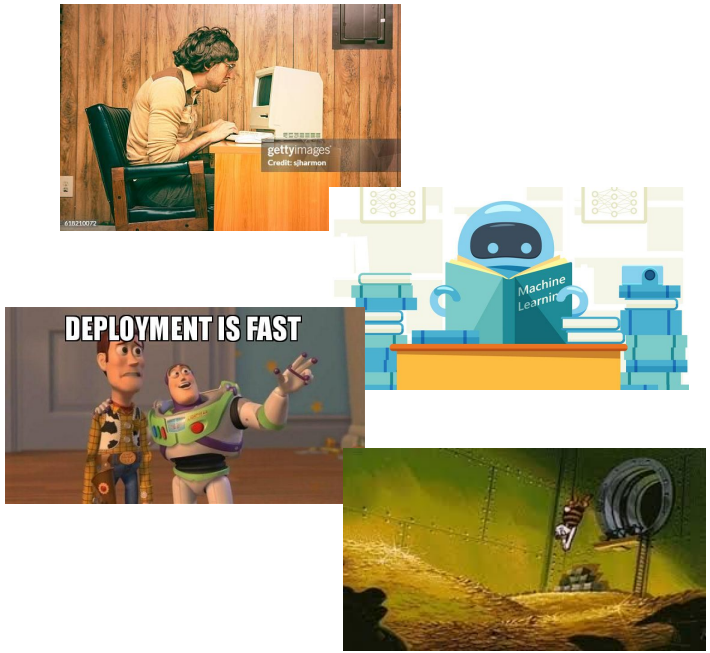


AI learns from data: Here microscopic images (WSI) of tissue labeled with cancer

AI in Digital Pathology

Needs to be

- Developed
- Trained
- Deployed
- Monetized



How to do the above in a university research group and a small startup?

Typical AI training workflow - the research group

- The **pathologist formulates** the **medical problem**

  E.g. detect prostate cancer in whole-slide images (WSI) of prostate needle biopsies
- The **pathologist selects** the appropriate **cases/slides** for AI training

  Cooperation of IT experts and pathologists …

  IT experts do not understand pathology the pathologists are short of time
- The slides are **scanned**
  - No standard of WSI format (DICOM, MIRAX, SVS, NDPI, VSI, new proprietary formats)

    small group/company does not have official access to the formats
- The resulting data transfered to safe storage
  - smaller projects = thousands of WSI (**terabytes**)
  - large projects = hundreds of thousands/millions of WSI (**petabytes**)
- AI *trained, evaluated, visualized* -> feedback from the **pathologist**

RationAI

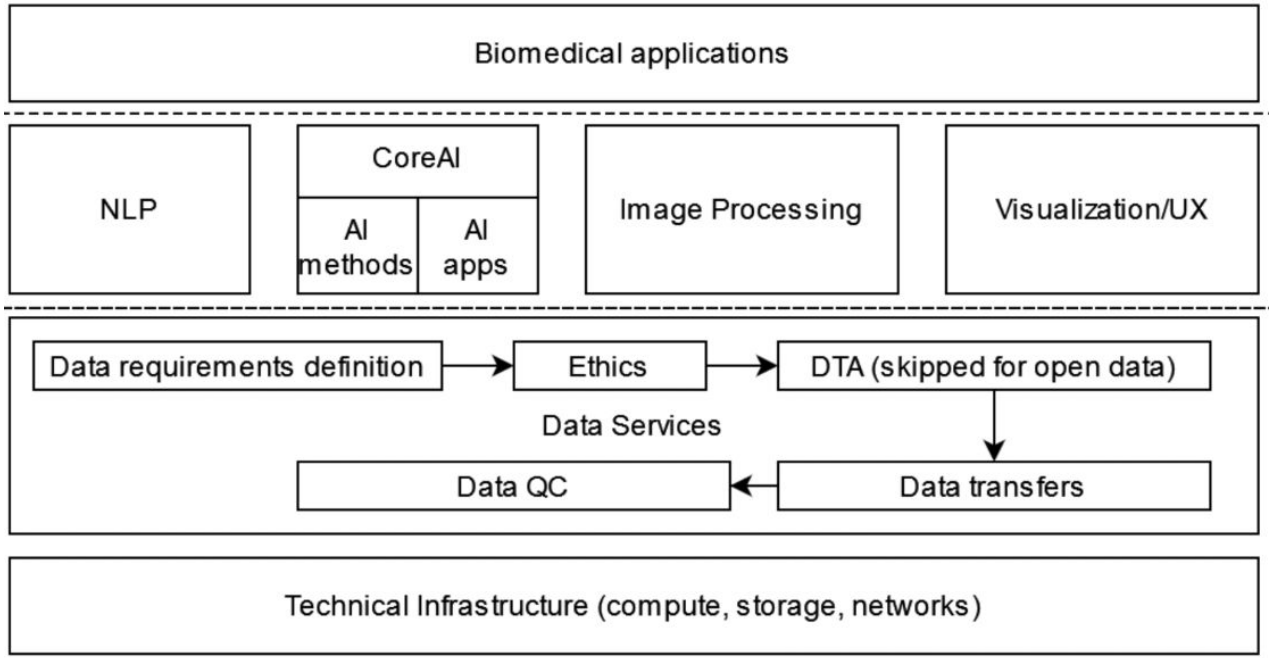
Masarykův onkologický ústav

IKEM

Med Uni Graz

MUNI FI

MUNI ICS



cerit scientific cloud

e-INFRA CZ

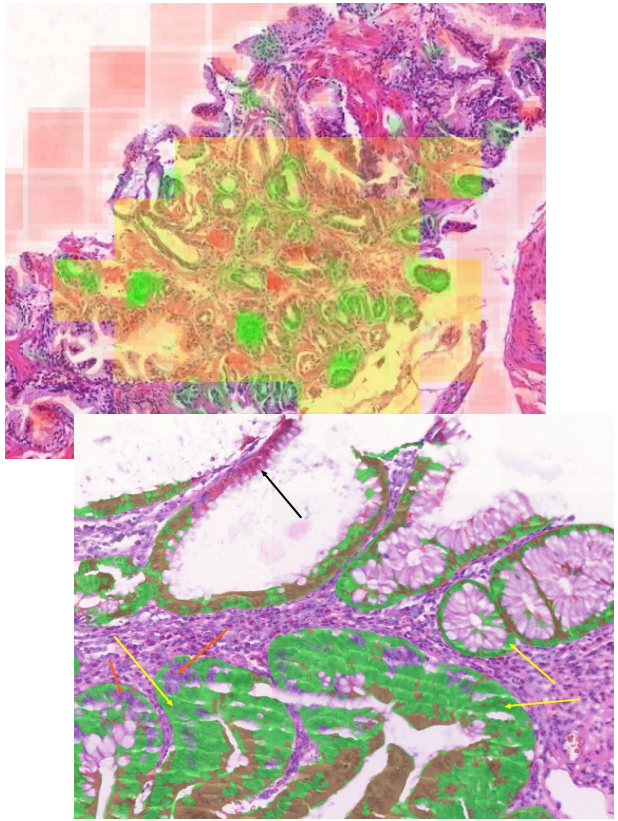
BioMedAI TWINNING project

Some results of RationAI

Cancer segmentation

- *Prostate, breast, colon* tumor segmentation
- Explainable
- Using foundation models

  Prov-GigaPath, etc.
- Tested on multi-centric data



Epithelium segmentation

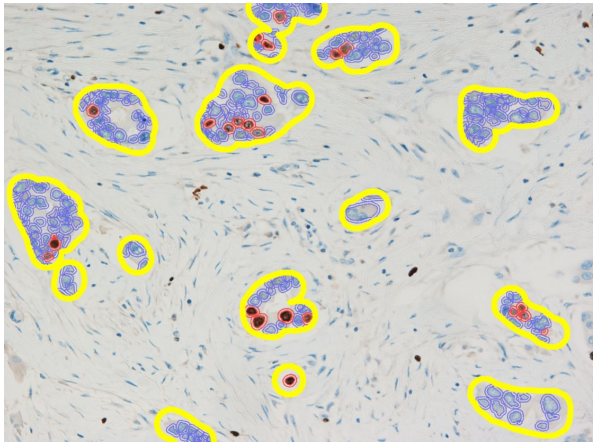
- Trained on double stained WSI

  H&E, cytokeratin
- Various types of tissue, reliable, (relatively) precise

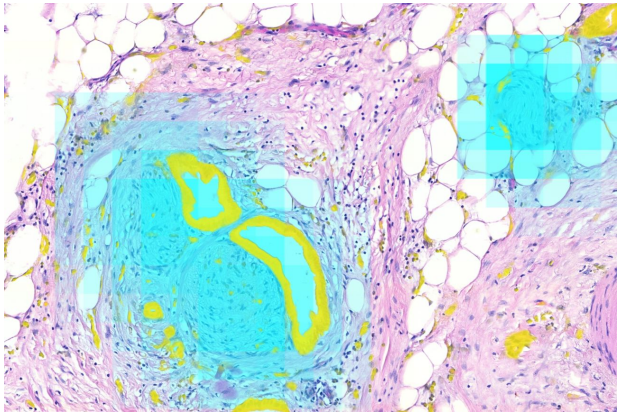
Some results of RationAI

Ki-67 proliferation index estimator in ROI

- Trained on clinical data
  no manual annotation
- More precise than usual
  “working estimates”



Perineural invasions detection in pancreatic resections



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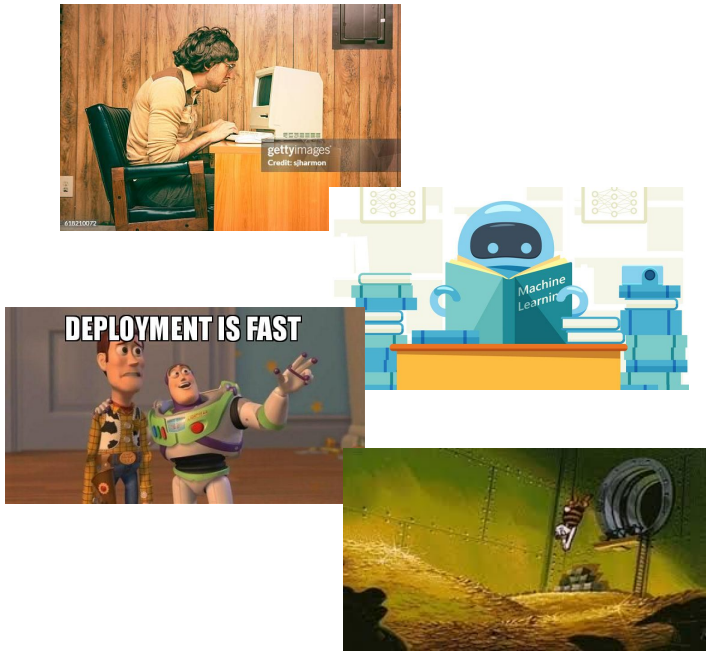


How to do the above in a university research group and a small startup?

Solved by AI?

Pathologist's view: It does not bother me and sometimes it's helpful

IT expert's view: In 2018

cancer patients with clinicopathological and outcome data available. The results show that deep learning-based outcome prediction with only small tissue areas as input outperforms (hazard ratio 2.3; CI 95% 1.79–3.03; AUC 0.69) visual histological assessment performed by human experts on both TMA spot (HR 1.67; CI 95% 1.28–2.19; AUC 0.58) and whole-slide level

Bychkov et al (2018). Deep learning based tissue analysis predicts outcome in colorectal cancer. *Scientific Reports*, 8

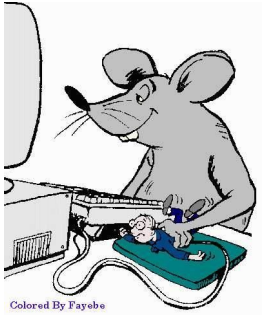
Solved by AI?

IT expert's view: In 2024 (and still in 2025)

> Researchers have published many promising algorithmic solutions.[11,12] However, the path to wide clinical adoption is difficult. A core problem is a lack of standardization and interoperability for the seamless integration of image analysis methods into diverse image management and laboratory information systems. Commercialization and clinical implementation of pathology AI must overcome additional hurdles,[13,14] namely the transformation of an idea into an AI prototype (which requires data acquisition), a validation process towards market readiness, and certification as a medical product. Finally, reimbursement and billing issues must be solved to generate revenue.

Zerbe et al (2024). Joining forces for pathology diagnostics with AI assistance: The EMPAIA initiative. *Journal of Pathology Informatics*, 15

Prototype deployment:
What is expected from a clinical solution?



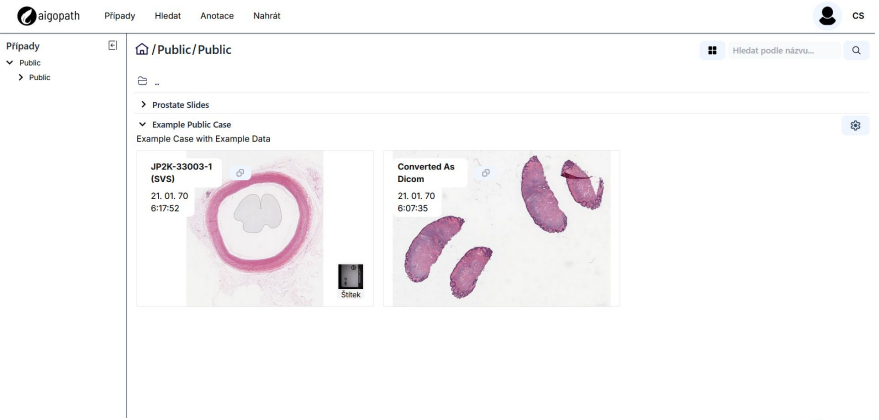
End users (pathologists, lab technicians) usually need

- "Invisible" connection between scanner and the user interface

  Quickly

  - get images from the scanner to storage
  - process them (using AI)
  - visualize results
- Ergonomy, clarity, reliability of the user interface (UX classics)
  - Single system for everything - LIS integration
  - Images rendered quickly
- Necessary tools at hand
  - Annotation, morphometry, area measurement tools
  - Reporting system (possibly pre filled by the AI system)

Our deployment at MMCI

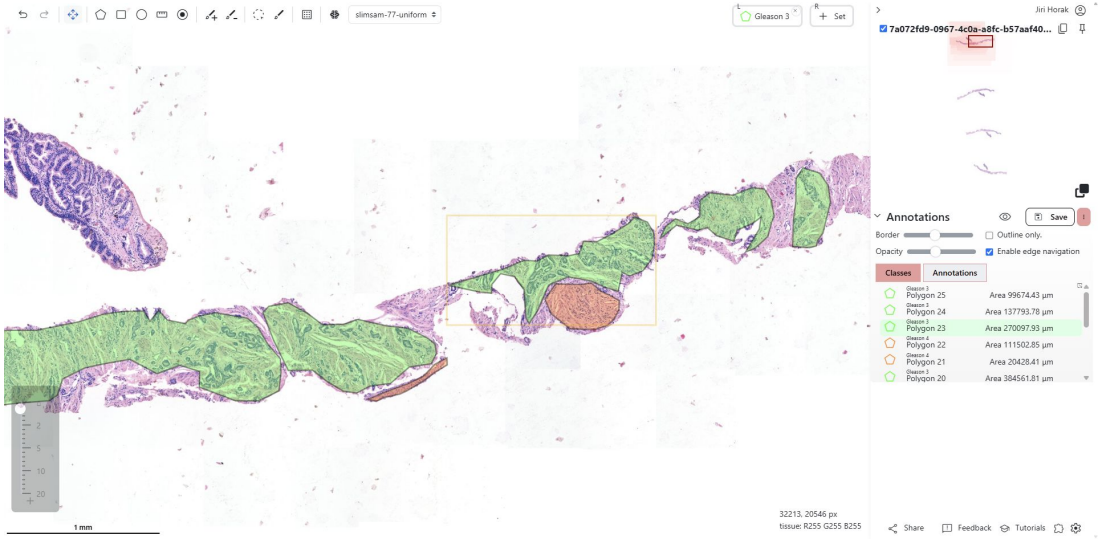


Case browser

- Execution of AI models
- Metadata examination
- Can be substituted by LIS

xOpat viewer

- Fast and reliable
- Advance visualization of AI outputs, annotations
- Mesurements, morphomentry



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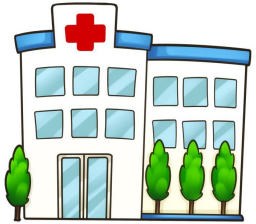


Institutional needs (laboratory, hospital)

- Security of processed data and access control

  Dependent on the solution: Cloud vs on-premise (next slide)

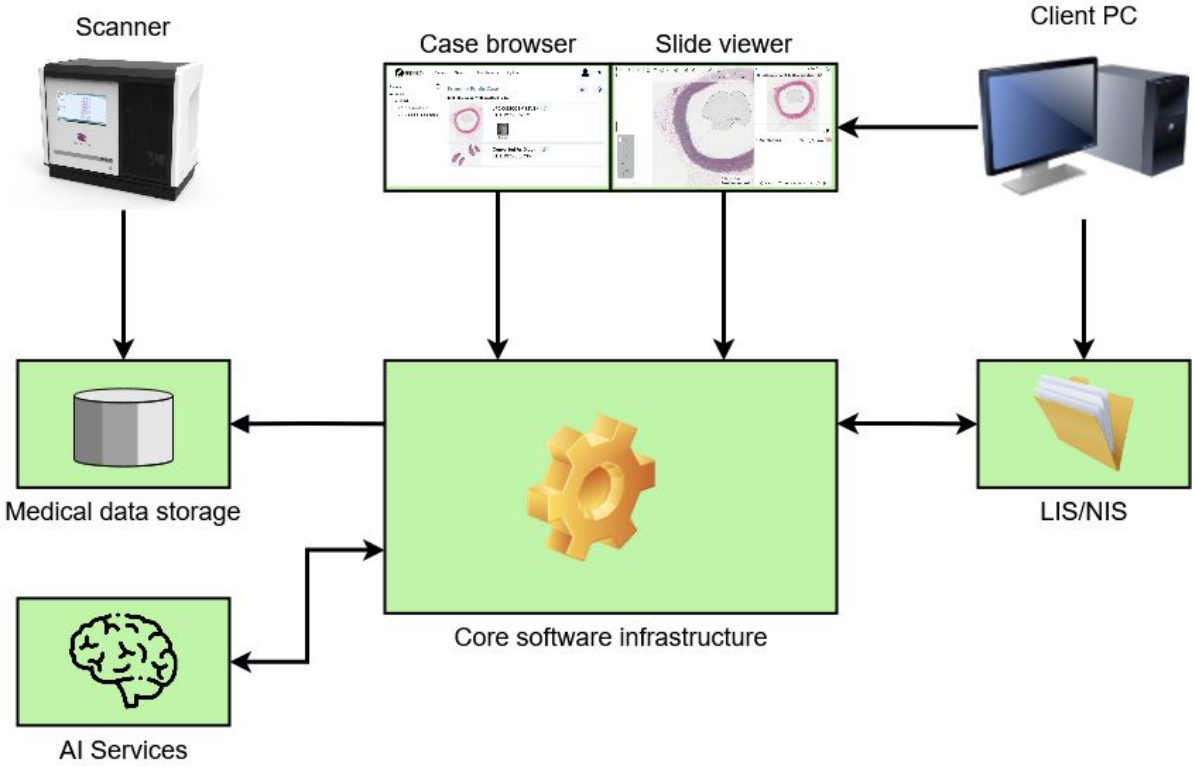
- Certification (ISO, MDR, IVDR)

  For small startup: Expensive, complicated, opaque

- Integration with existing processes

  Typically the most complicated part: User education, integration with other software solutions, cooperation of IT departments, etc.

Prototype deployment: Infrastructure setup



Question: Have all this on-premise or in cloud?

Prototype deployment: Self-managed vs cloud-based infrastructure

Self-managed

- Complete control over the data
- Easier security measures
- Fast access to the data (short network travel time)
- Possible to optimize costs
- Requires dedicated personnel

Cloud-based

- Hardware managed for you
- Dedicated technicians not needed
- Complex services such as backups, disaster recovery, etc.
- Secure clouds are expensive

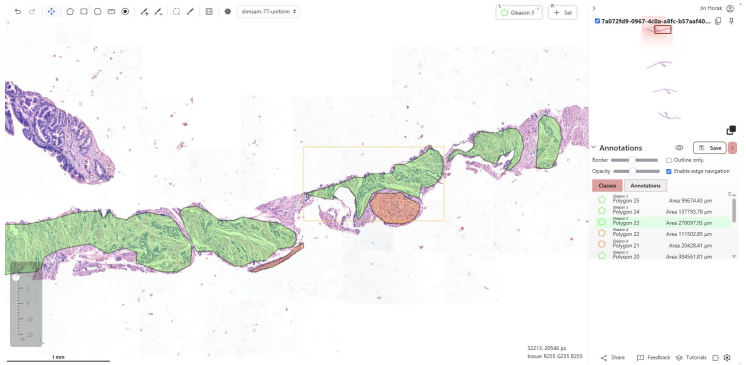
Smooth integration

aigopath

Multiple separate applications: Cumbersome, annoying, and potentially dangerous

Few providers manage to deliver smooth integration with LIS/NIS

xOpat viewer is ***lightweight and web-based***
-> ready for integration with larger systems



First integrated solution with DS Soft Olomouc was developed in **two weeks**!

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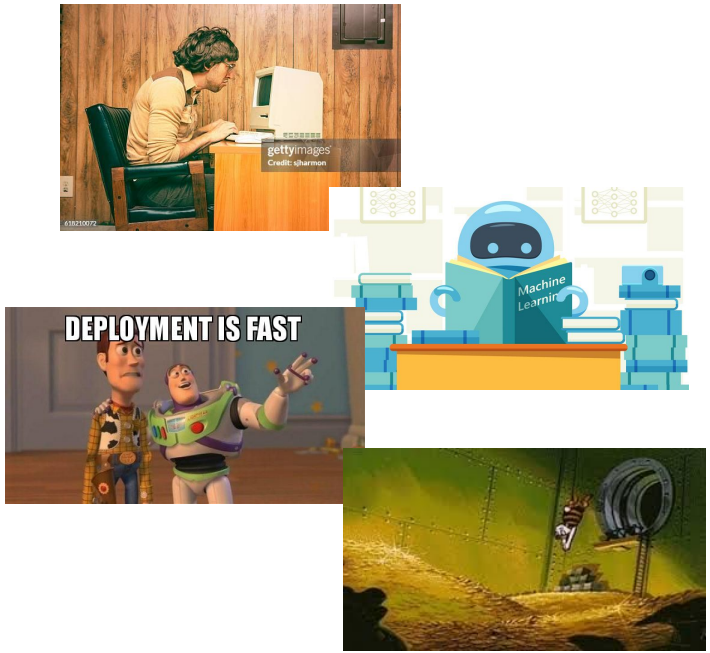

How to do the above in a university research group and a small startup?

The market - AI company view

- The usual **clients**
  - Hospitals
  - Private labs
- The usual **providers**
  - Scanner manufacturers (Roche, Leica)
  - Companies from related disciplines (Sectra, Dedalus, Fujifilm)
  - Startups and dedicated companies (Ibex, Proscia, Smart In Media, Pathozoom)
  - Majority of LIS/NIS providers did NOT jump in yet!

- The **market** is relatively **small** - compared, e.g., with radiology
- *Specialized* - only larger institutions have pathology departments
- Tender based acquisition in state-owned hospitals

Institutional issues when buying DP (AI) solution

Which scanner to get?
- Expensive, long-term purchase
- Can be borrowed for a trial
- Who will operate it

How much data will we work with?
- Slides per day, gigabytes
- Scanner and storage space

Where to keep the digital images?
- Self-managed in-house servers
- Cloud storage (or even compute)

How users will access the digital slides?
- Access from home or purely on-site?
- On-site network capacity must be sufficient
- Hospital security allowing remote access

Institutional issues when buying DP (AI) solution

From whom to get the software?

- Large differences in service and products
- Scanner manufacturers vs sw only companies
- Large companies often less amenable to customizations
- Localization, customer support

Is LIS/NIS integration desirable?

- Willingness of vendors to accommodate other vendors
- Smaller providers usually more flexible and cheaper
- Larger providers offer more complex services

Conclusions

- We have considered **challenges** and **opportunities** encountered by a small research group and a small company in AI in digital pathology
- The research in the area is much faster than testing, deployment, certification, and market release
- AI will assist digital pathology only when sensibly integrated within processes of pathology departments and labs

Now comes LLM based
Agentic AI !