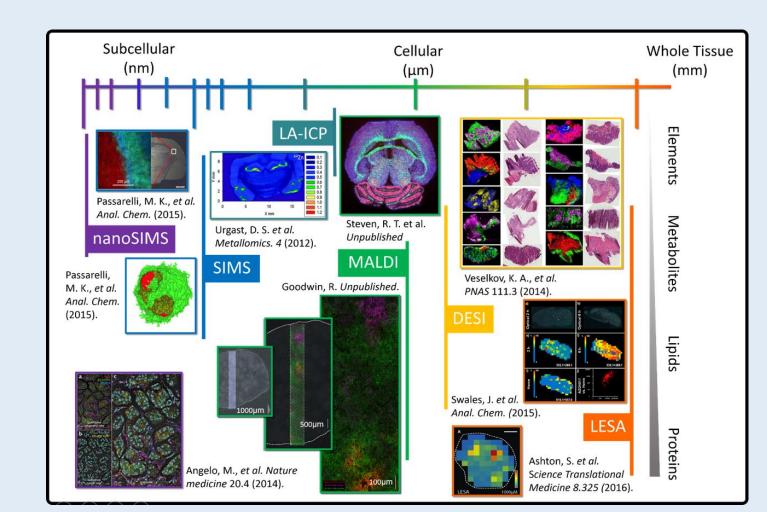# Workshop report: Bioinformatics meets digital pathology

Organizing Committee for the workshop: Yves Sucaet, Vrije Universiteit Brussel, Belgium, Jeroen Van der Laak, UMC Radboud, Netherlands, Marius Nap, HistoGeneX, Belgium and Rigshospitalet Copenhagen, Denmark, Zev Leifer, New York College of Podiatric Medicine, USA, Yukako Yagi, Harvard Medical School & Massachusetts General Hospital, USA ,Raphaël Marée, Université de Liège, Belgium, David Ameisen, IRIF, CNRS and Université Paris Diderot, France, Paul Van Diest, UMC Utrecht, Netherlands
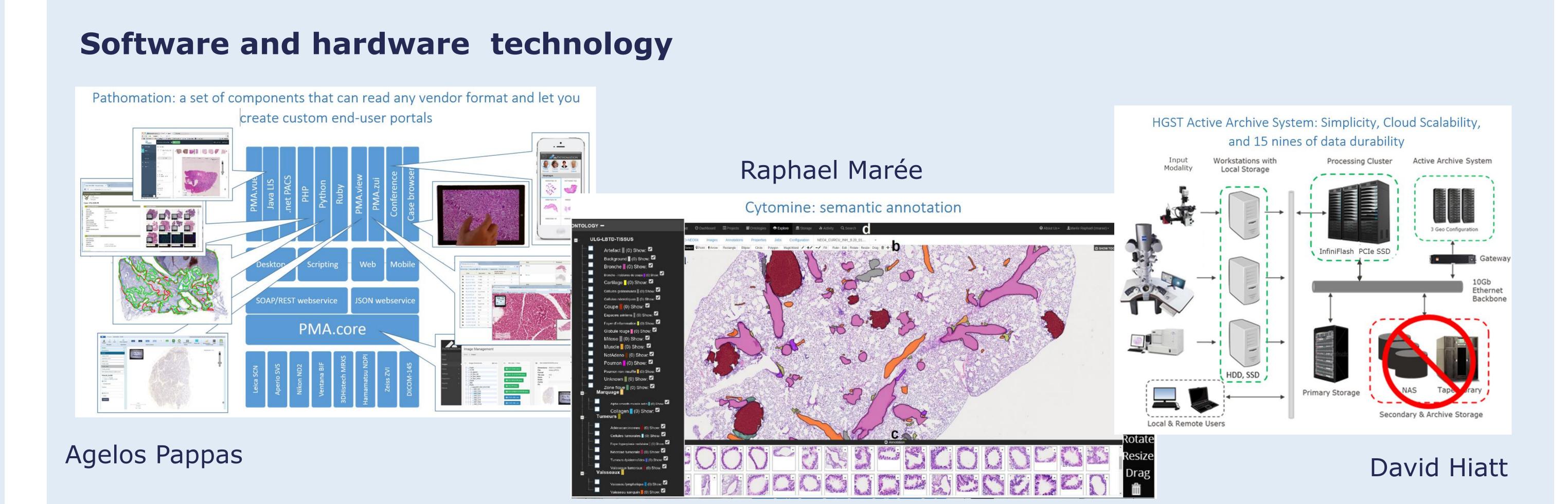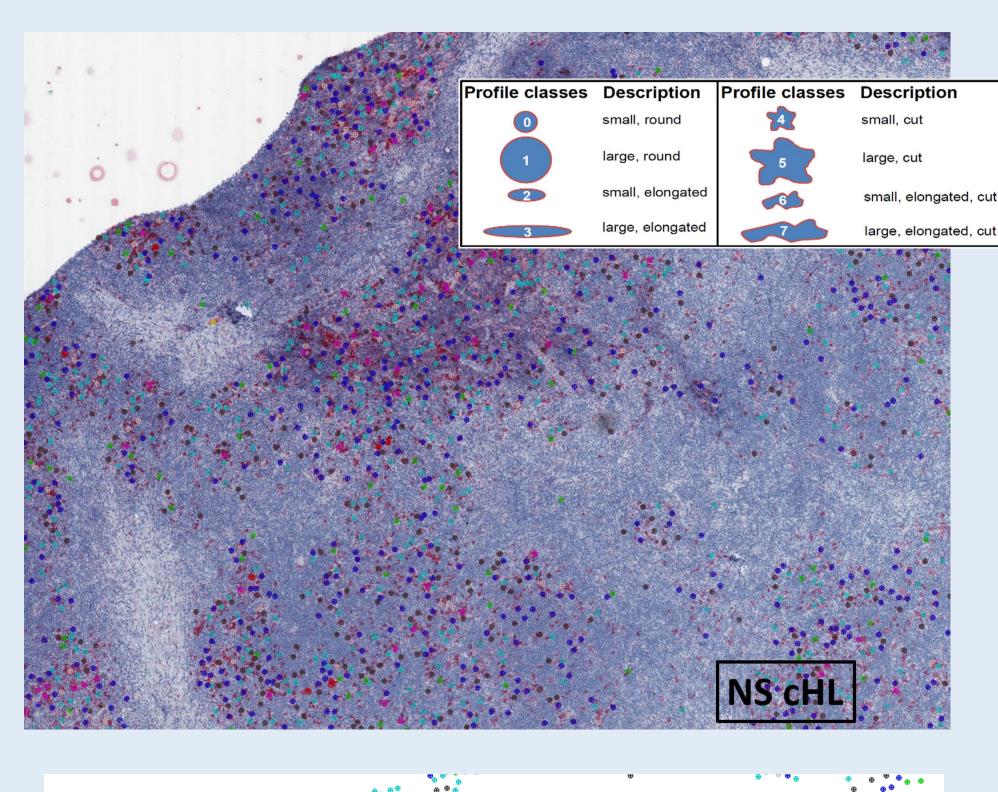
VRIJE UNIVERSITEIT BRUSSEL

Abstract

In September 2016, the first international computational pathology workshop (CPW) took place in The Hague, The Netherlands. This happened in conjunction with ECCB, the annual international European Conference on Computational Biology. While Rrsulting multi-gigapixel images can be viewed on a computer screen via dedicated software, automated analysis of such large-scale datasets is challenging and their combination with omics data is not trivial. This workshop wanted to facilitate bridging opportunities between the bioinformatics and tissue image analysis communities.
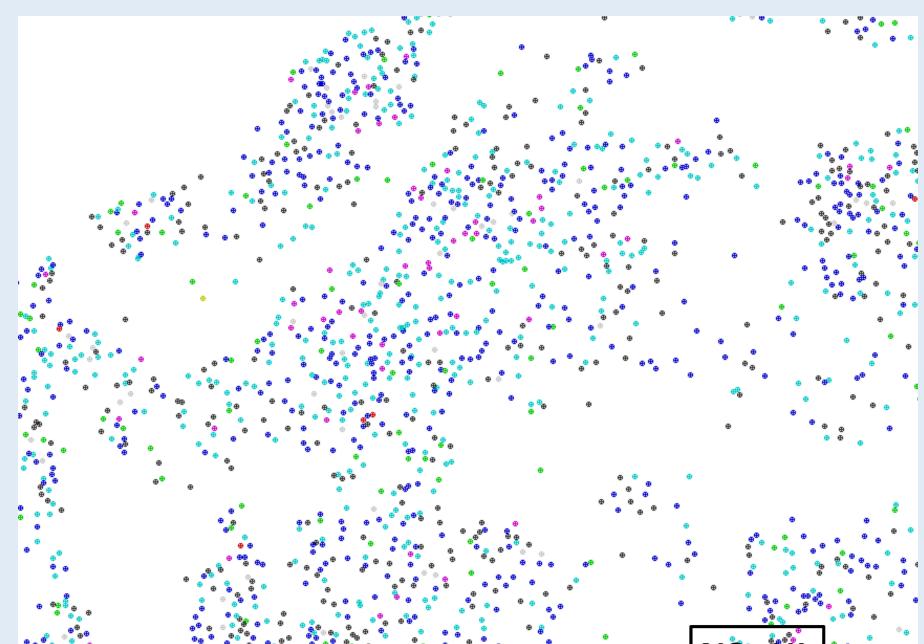
Two emerging opportunities were addressed: 1) There are real problems in (digital) microscopy that deserve their attention and are at least as (if not more) interesting than the "hot" NGS and *seq stuff they're working on today and 2) Digital microscopy in its own right offers a new layer of data that can be added to and mixed with their current levels of *omics-datasets, and help them gain new insights into projects that they're already working on.
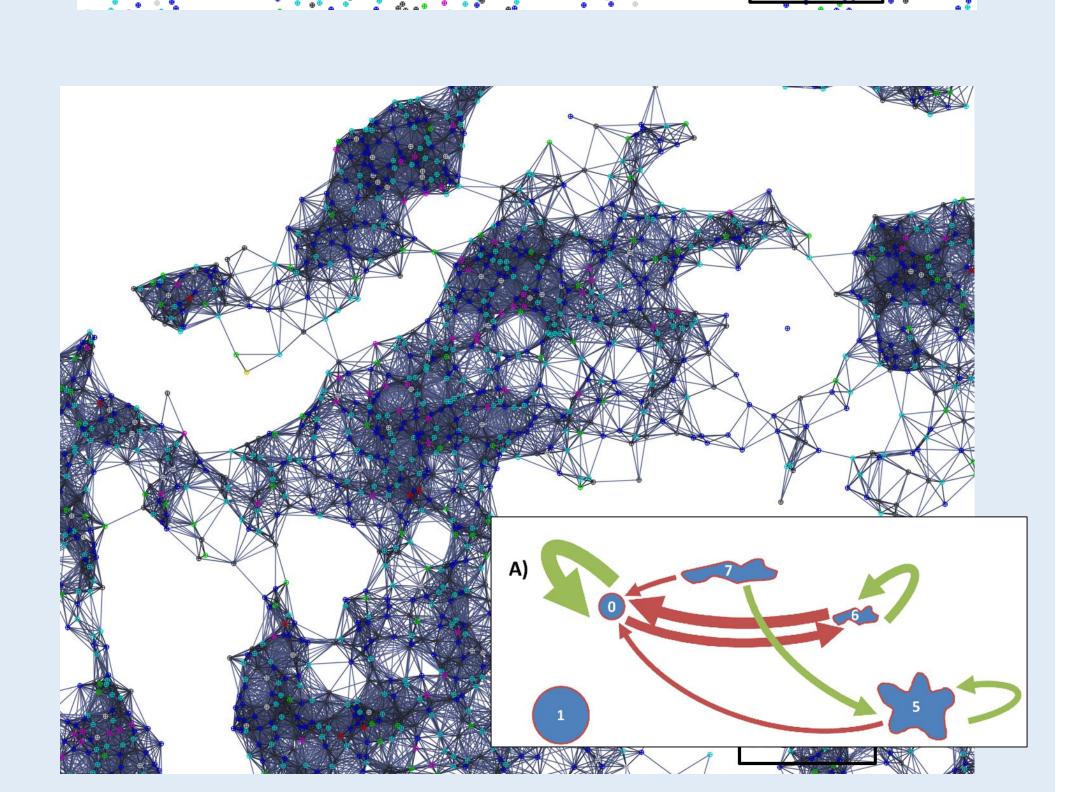
Software and hardware technology

Pathomation: a set of components that can read any vendor format and let you create custom end-user portals

PMA.core

Raphael Marée
Cytomine: semantic annotation

HGST Active Archive System: Simplicity, Cloud Scalability, and 15 nines of data durability

Agelos Pappas

David Hiatt

Imaging and analytics

Profile classes Description / Profile classes Description
- small, round
- large, round
- small, elongated
- large, elongated
- small, cut
- large, cut
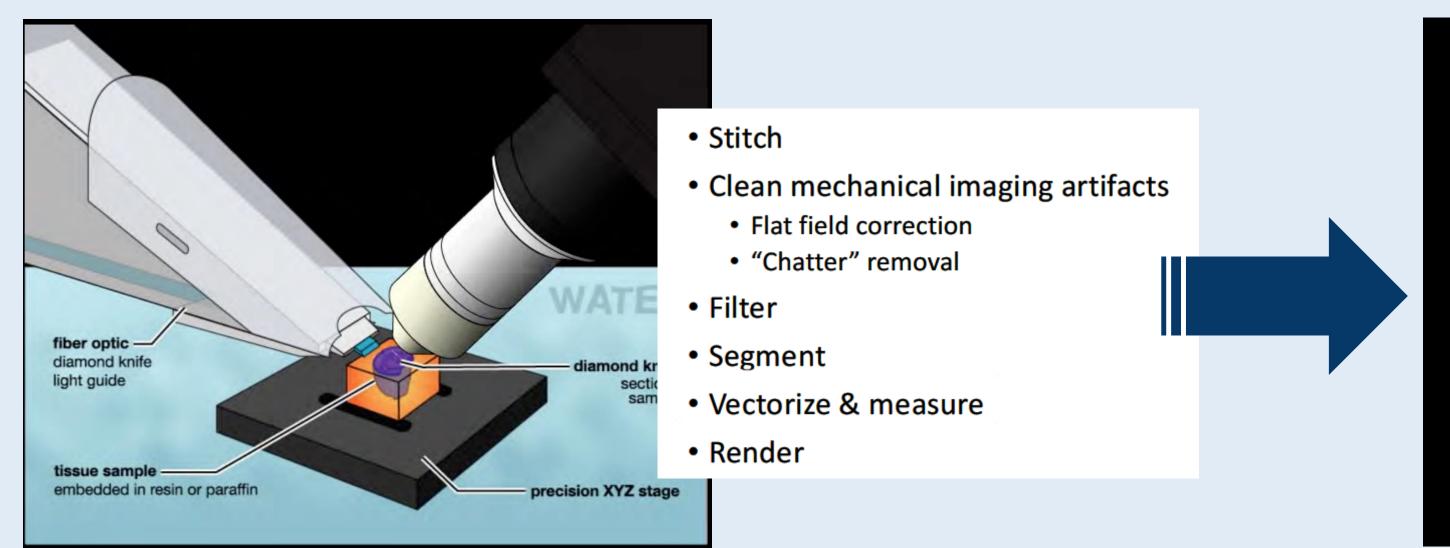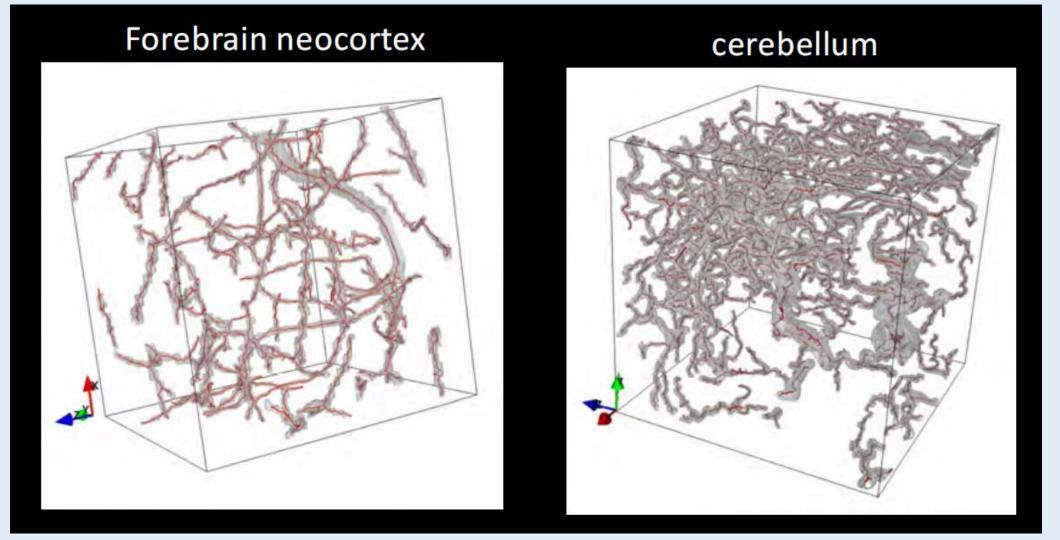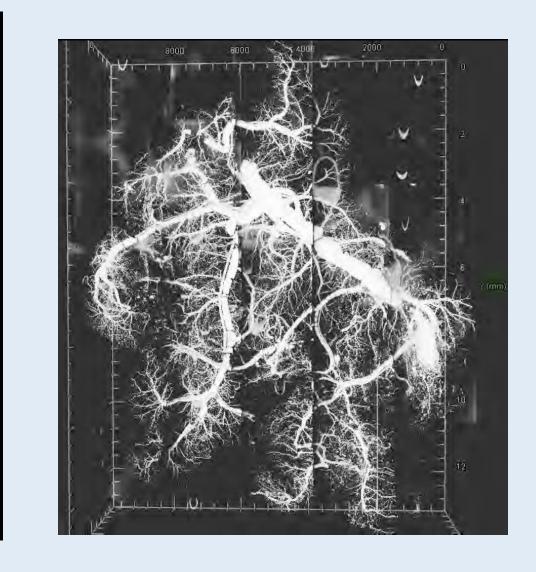- small, elongated, cut
- large, elongated, cut

NS cHL

NS cHL

Jörg Ackermann

Alternative slicing (Knife Edge Scanning Microscope – KESM)

Michael Pesavento

- Stitch
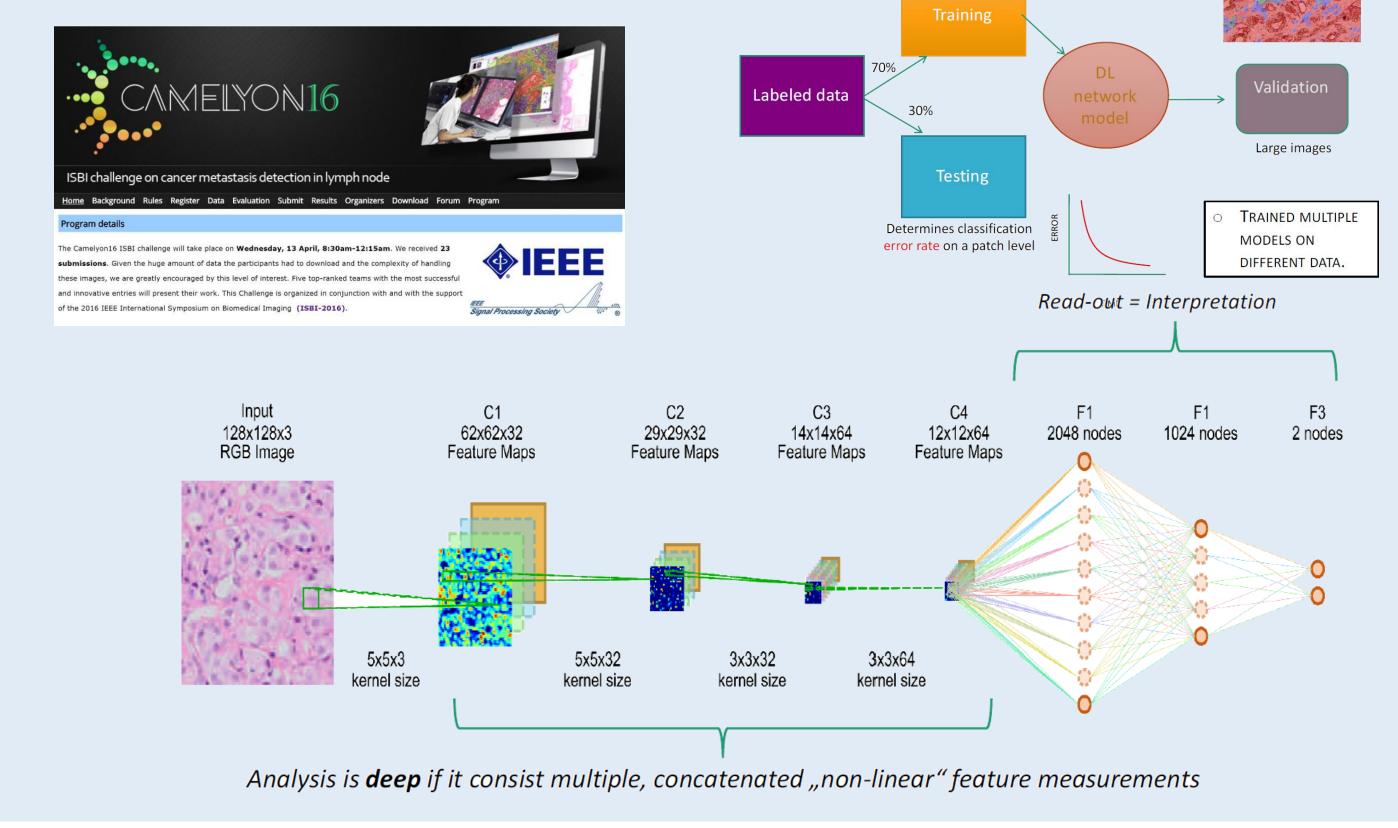- Clean mechanical imaging artifacts
  - Flat field correction
  - "Chatter" removal
- Filter
- Segment
- Vectorize & measure
- Render

fiber optic diamond knife light guide

diamond knife section sam

tissue sample embedded in resin or paraffin

precision XYZ stage

Forebrain neocortex   cerebellum

Deep learning

CAMELYON16

Labeled data

Training

D network model

Validation

Testing

Determines classification error rate on a patch level

Trained multiple models on different data.

Read-out = Interpretation

Large images

Input 128x128x3 RGB image

C1 62x62x32 Feature Maps
C2 29x29x32 Feature Maps
C3 14x14x64 Feature Maps
C4 12x12x64 Feature Maps
F1 2048 nodes
F1 1024 nodes
F3 2 nodes

5x5x3 kernel size
5x5x32 kernel size
3x3x32 kernel size
3x3x64 kernel size

Analysis is **deep** if it consist multiple, concatenated „non-linear" feature measurements

Niels Grabe / Jeroen Van der Laak

Mass Spec Imaging (MSI)

Normal   Tumour

Spencer Thomas

Wish you were there!

Discussion & conclusion

Digital pathology can benefit from the input from other fields of science. Just like the hardware is heavily dependent of physics and optics, we believe the software aspect of diigital pathology stands to benefit from the field of bioinformatics. Computational pathology takes place at the interface of digital pathology and bioinformatics. The interaction between both fields, offers for new algorithms and applications that can benefit reseachers, doctors, students, and patients alike. Most recently, the application of deep learning to digital pathology imaging data seems to have resulted in another leap forward in terms of algorithmic speed and accuracy.

Tumor

Continue the conversation through http://cpw.pathomation.com

INNOVIRIS EMPOWERING RESEARCH

PATHOMATION

indica labs informed pathology

HGST a Western Digital brand