



**Leica**

**BIO SYSTEMS**

Advancing Cancer Diagnostics  
Improving Lives

# IMAGE QUALITY IN AI ALGORITHMS

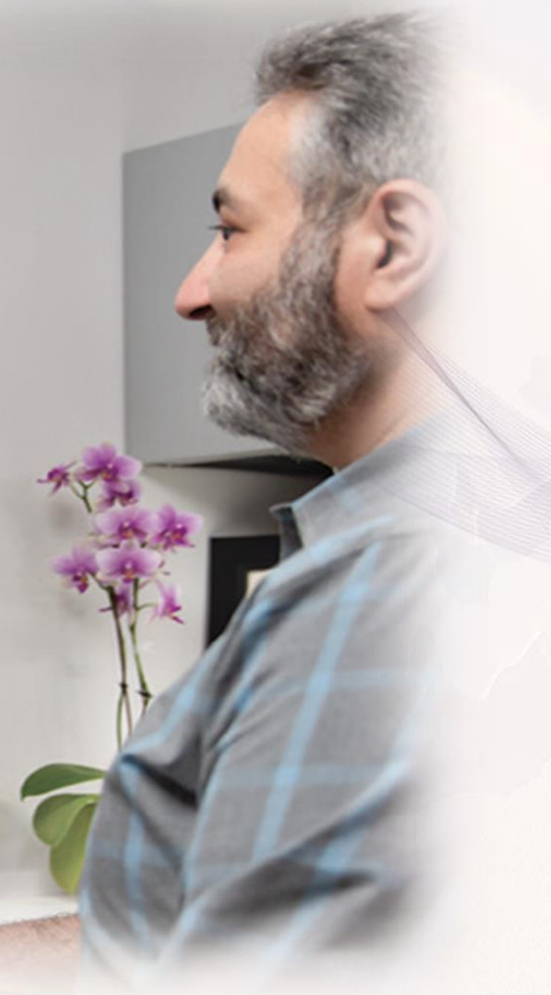
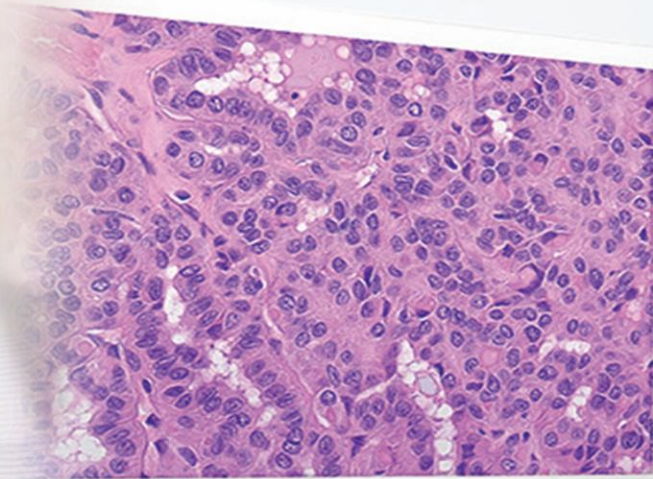
David de Mena  
22 Marzo 2024

*For In Vitro Diagnostic Use  
The clinical use claims described for the products in the information supplied  
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# DIGITAL PATHOLOGY APPROACH

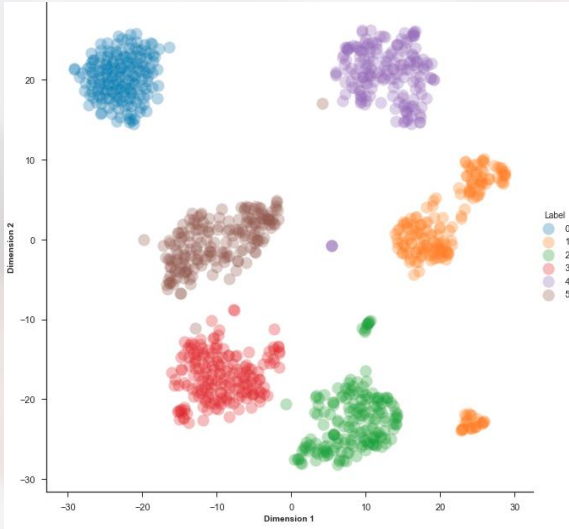
- Exhaustive computing
- Learn the underlying relationships based on the data
- Ability to quantify
- Efficient



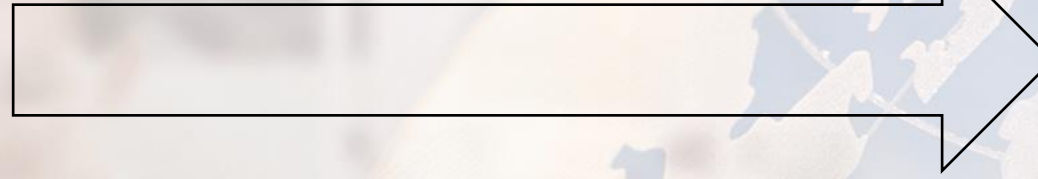
# CHALLENGES IN DIGITAL PATHOLOGY

## PREDICTION COMPLEXITY SCALE

Highly Separable

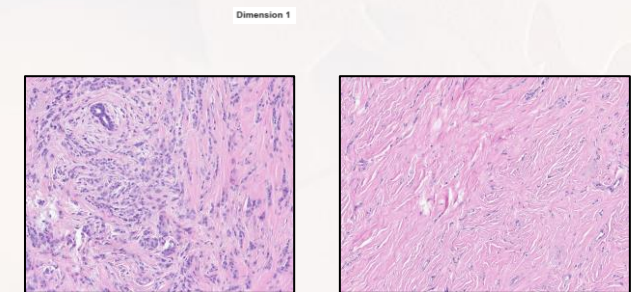
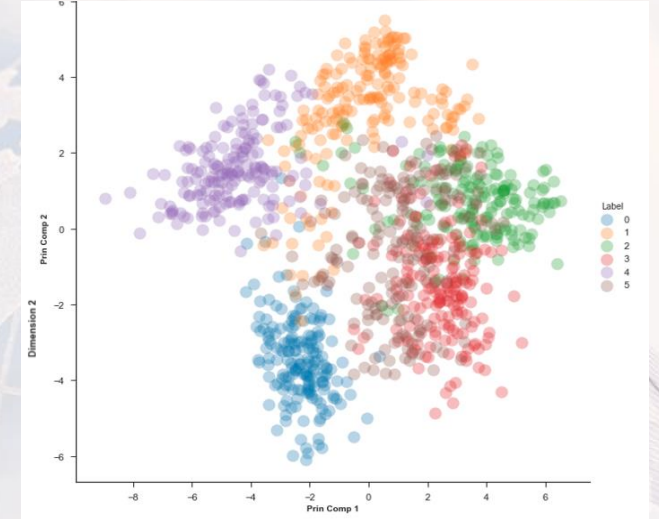


- High Intra-Class Variance
- Morphological heterogeneity



- Low Inter-Class Variance
- Morphological homogeneity

Large Overlap

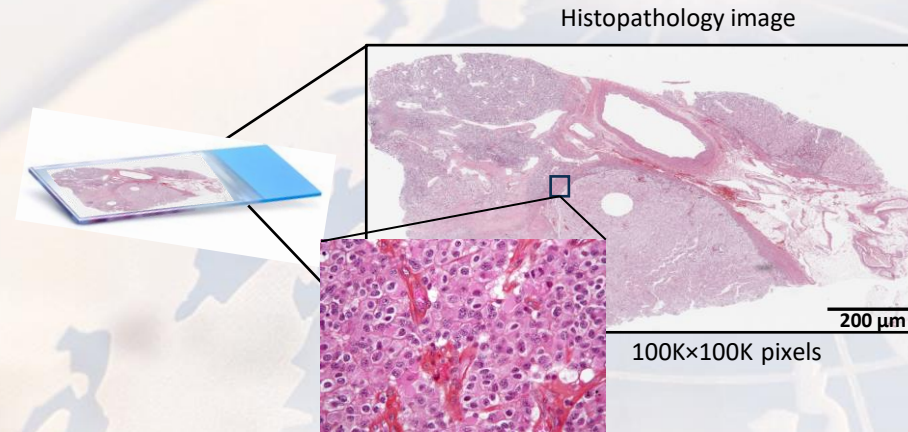
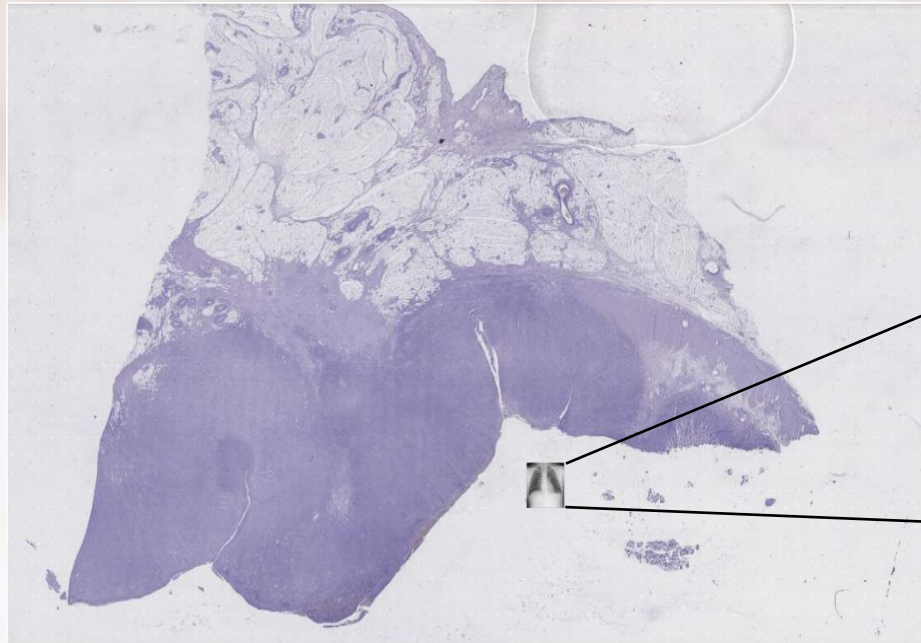


Problem complexity

# CHALLENGES IN DIGITAL PATHOLOGY



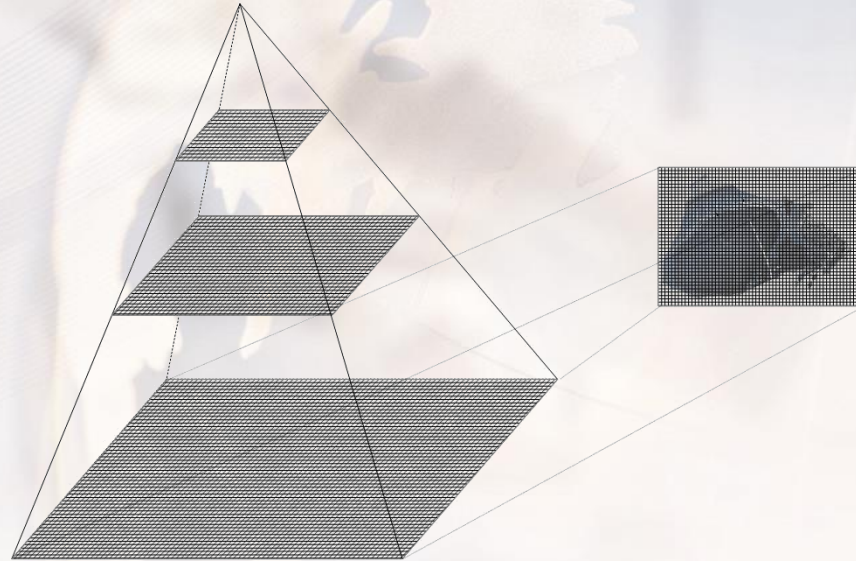
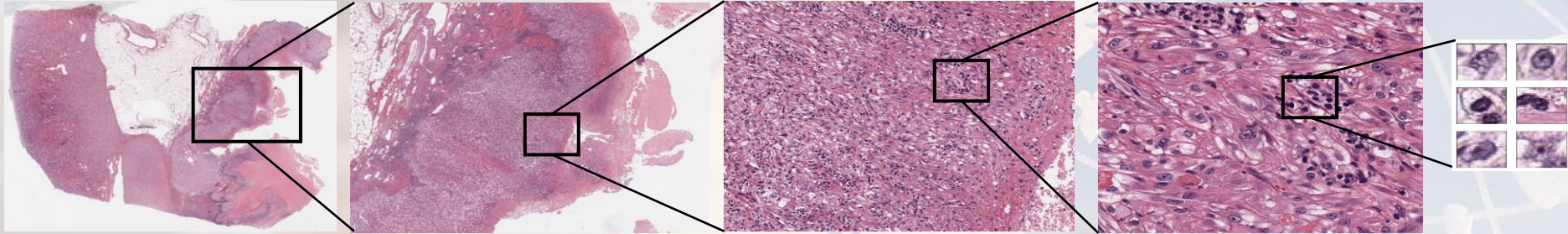
4096x4096 pixels



- **Humongous size images**
- **Giga-pixel images**

# CHALLENGES IN DIGITAL PATHOLOGY

- Digesting the whole slide for pathologists is not feasible

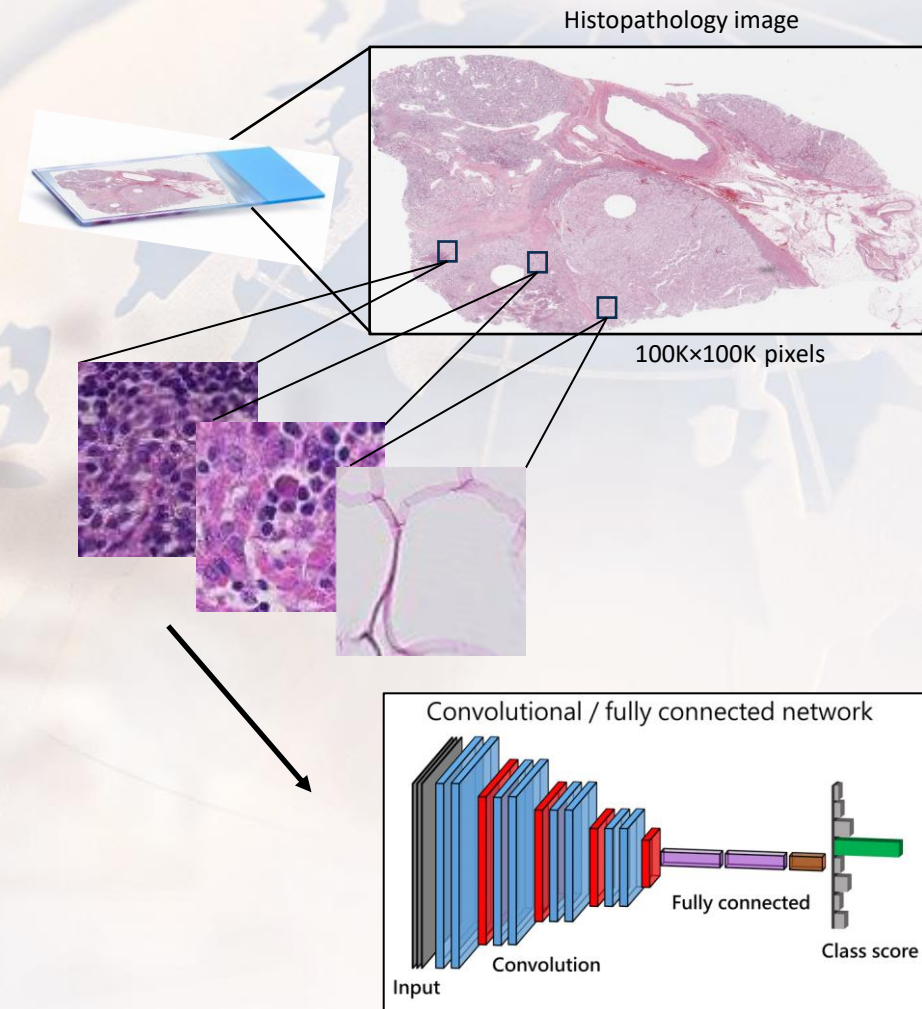


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# DEEP LEARNING IN HISTOPATHOLOGY

- Convolutional Neural Nets are state-of-the-art in computer vision
- Produce optimal network architecture
- Common approach is to extract patches from WSI and use as input



# BINARY CLASSIFICATION EXAMPLE



- The inputs include both cancer images and noncancer images.
- All images are used to generate patches.
- In feature learning processing, images/patches are used to downsample receptive fields.

Source: [Deep learning of feature representation with multiple instance learning for medical image analysis](#)  
Yan Xu, Tao Mo, Qiwei Feng, Peilin Zhong, Maode Lai, Eric I-Chao Chang

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# WHOLE SLIDE IMAGES - ANNOTATION TYPES

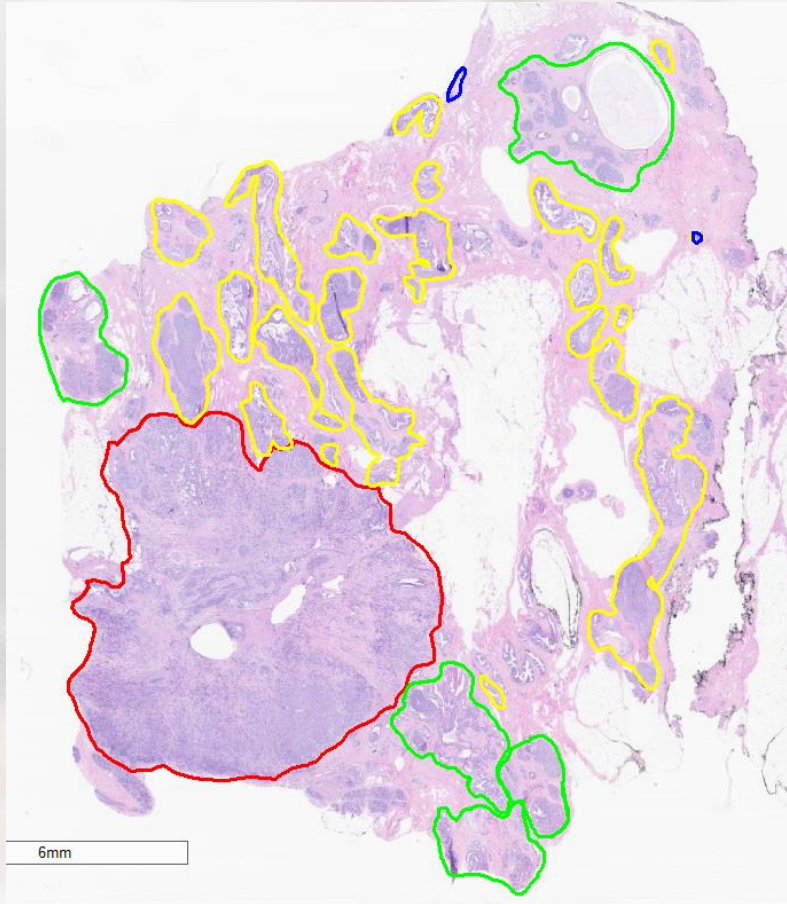
|                                    | Diagnosis                          | Archived Image                                   | Slide Level Annotation                            | Areas of High Discordance                                  | Lesion Area Annotation                         | Pixel Annotation                                 | Detailed Pixel Annotation                                        |
|------------------------------------|------------------------------------|--------------------------------------------------|---------------------------------------------------|------------------------------------------------------------|------------------------------------------------|--------------------------------------------------|------------------------------------------------------------------|
| Image example                      |                                    |                                                  |                                                   |                                                            |                                                |                                                  |                                                                  |
| Objective                          | Inform treatment and prognosis     | Provide clinical slide image for use in research | Full description of features important to project | Drive pathologist alignment on high discordance parameters | Highlight location/presence of specific lesion | Classify every area of the slide at lesion level | Classify every area of the slide at lesional and cell type level |
| Annotation Complexity              | Line; only select slides annotated | Slide diagnosis (nothing circled)                | Slide diagnosis (nothing circled)                 | Variable, but usually slide diagnosis                      | Free hand, broad                               | Free hand, within 200 microns of lesion          | Free hand or assisted at cellular level                          |
| Time to Annotate (Per Pathologist) | < 1 minute                         | <<1 minute                                       | ~ 1 minute                                        | ~1 - 5 minutes                                             | ~1 - 5 minutes                                 | 15 - 30 min                                      | Usually over 1 hour; may be multiple hours                       |
| Number of Pathologists             | 1 (most cases)                     | 1                                                | 1 - 5                                             | 5 - 15                                                     | 1 - 5                                          | 3 - 5                                            | Variable, usually 3 - 5                                          |

In the field of computational pathology, datasets consisting of whole slides images are essential to the development of AI-based image analysis systems



# DEVELOPMENT AI

The difference in image quality between scanners can pose multiple challenges



Inter-scanner variability can affect downstream image quality and deep learning solutions

- Image compression
- Color profile
- Contrast
- Brightness
- Sharpness

Source: Assessment\_of\_image\_quality\_of\_whole\_slide\_images\_digitized\_by\_the\_Aperio\_GT450\_DX\_scanner.

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# YOUR FOCUS IS OUR OBJECTIVE

Leica Biosystems (LBS) and Leica Microsystems (LMS) optics engineers worked together to solve the problem:

“What objective design can maximize field of view, handle very fast accelerations and decelerations, and deliver excellent image quality during extremely fast scanning speeds using real-time focusing?”

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# AUTO-QUALITY CONTROL

- International Color Consortium (ICC) correction

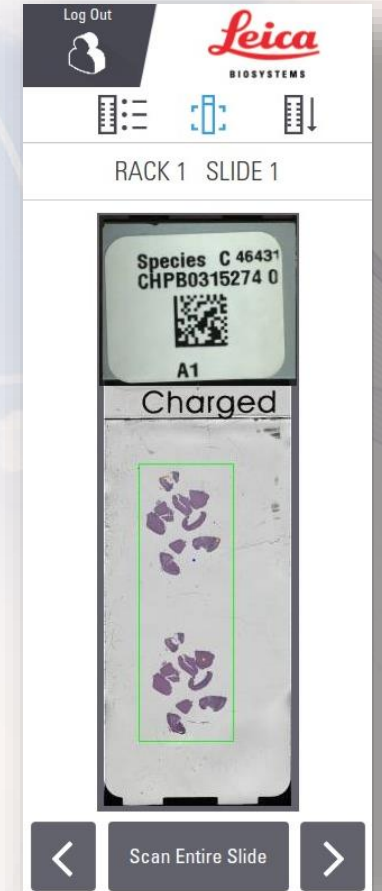
The industry standard protocol for color reproduction, is used in Aperio GT 450 for color consistency and color accuracy of the images. The ICC profile was created based on the spectrum of the illumination, the spectral response of the camera, and the spectral properties of stained tissue. It represents the true color of a slide if it's viewed under a daylight illuminated microscope.

- Auto-Quality Control (QC)

If a stripe-focus error remains, an auto-QC procedure uses a series of parameters extracted from the image data against thresholds, which was pre-configured using a SAM (Scanner Administration Manager), to show an image quality warning note on the console screen for further investigation.

# READY FOR AI DIAGNOSES

- The results indicated that diagnoses made using the Aperio GT 450 DX were accurate and comparable to diagnoses made using light microscope and had an acceptable level of precision.
- This creates an efficient, and ergonomic diagnosis workflow resulting in improved turn-around time which benefits healthcare professionals, and ultimately the patient





# Thank you!

We envision a world where comprehensive insights enrich cancer diagnosis and offer reassurance to all patients.

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