The Role of Image Search In Digital Pathology Workflows

HURON Digital Pathology

About Huron Digital Pathology

- Located in Waterloo Region in Canada
- Design and manufacture award-winning whole slide scanning hardware
  - CE-IVD
  - Health Canada
- Bring to market the world's first image search engine for pathology
- Partner with Dell Technologies

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A Crisis in Pathology

Higher rates of cancer and other diagnostic-intensive diseases

Severe shortage of pathologists and laboratory services

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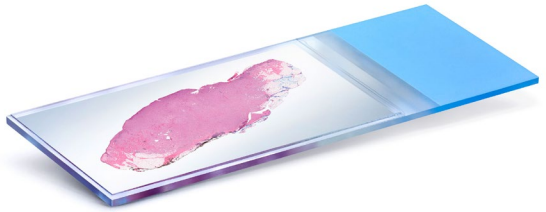
A Digital Transformation in Pathology

Analog workflow using microscopes

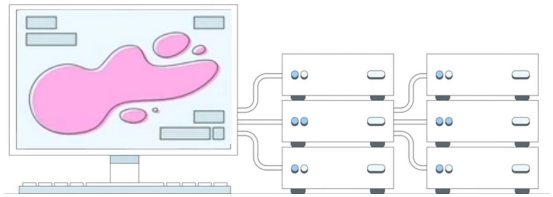
Digital workflow using digital slides

Over the next 5 years, hospitals and labs will:

Scan hundreds of millions of glass slides



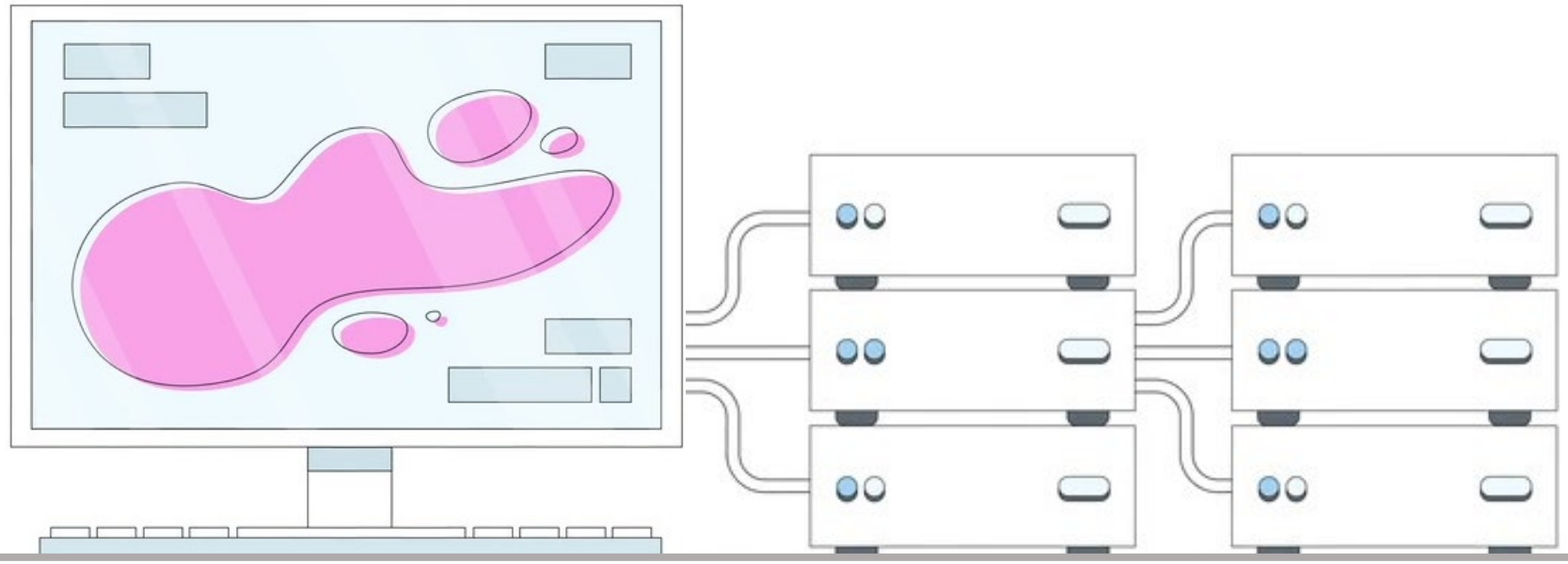
Generate exabytes of unstructured image data



Produce tens of millions of pathology reports

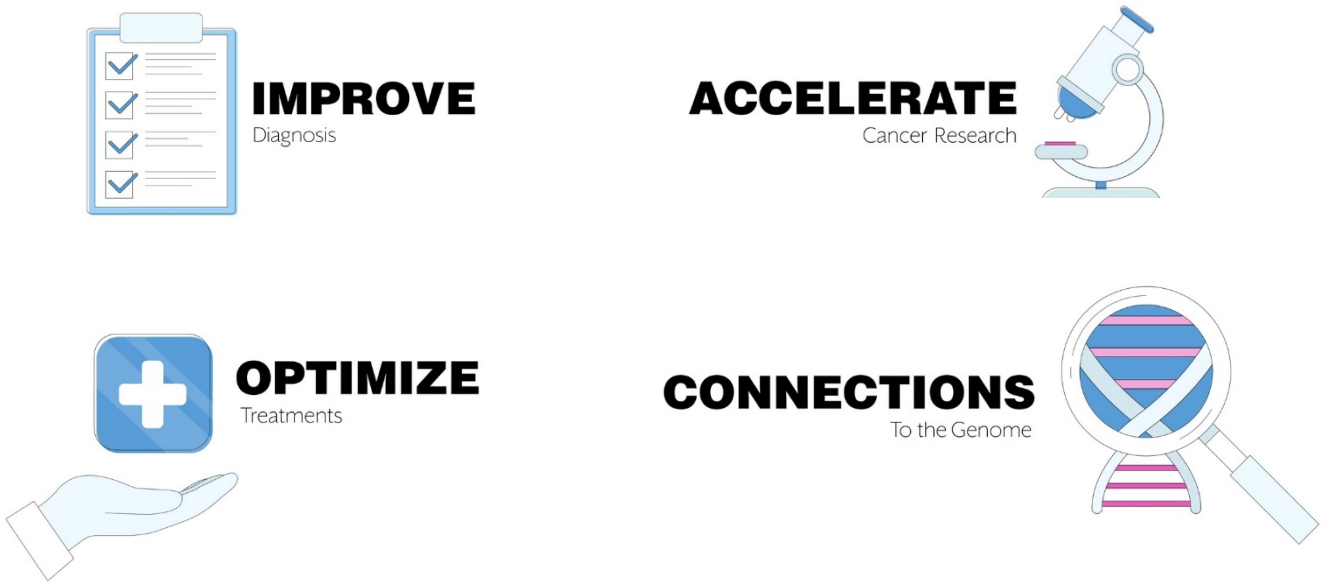
…to improve quality and speed of diagnosis, accelerate discovery, and address a severe world-wide shortage of pathologists

How do we search exabytes of unstructured, unlabeled image data?



How do we tap into the vast knowledge contained in the pathology reports?

How do we leverage the data to improve diagnosis and accelerate research?



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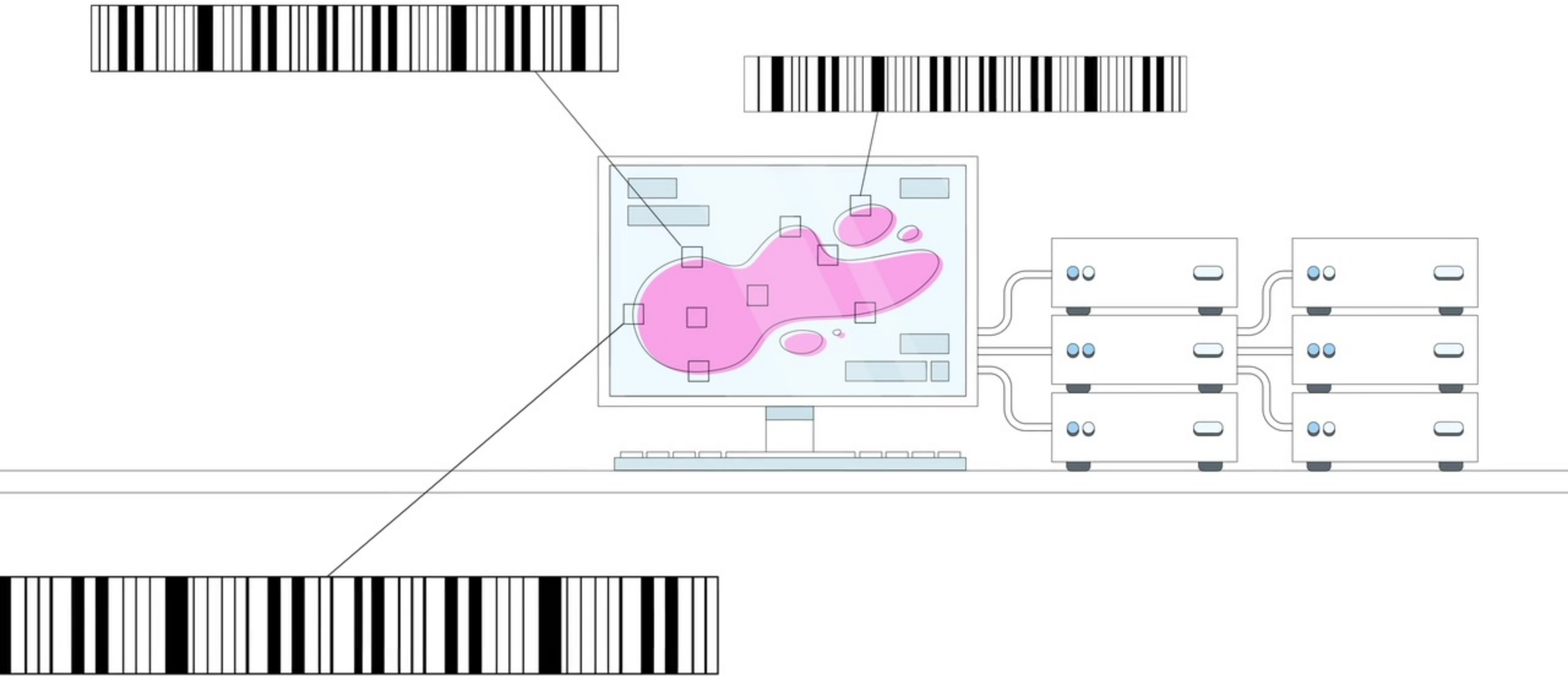
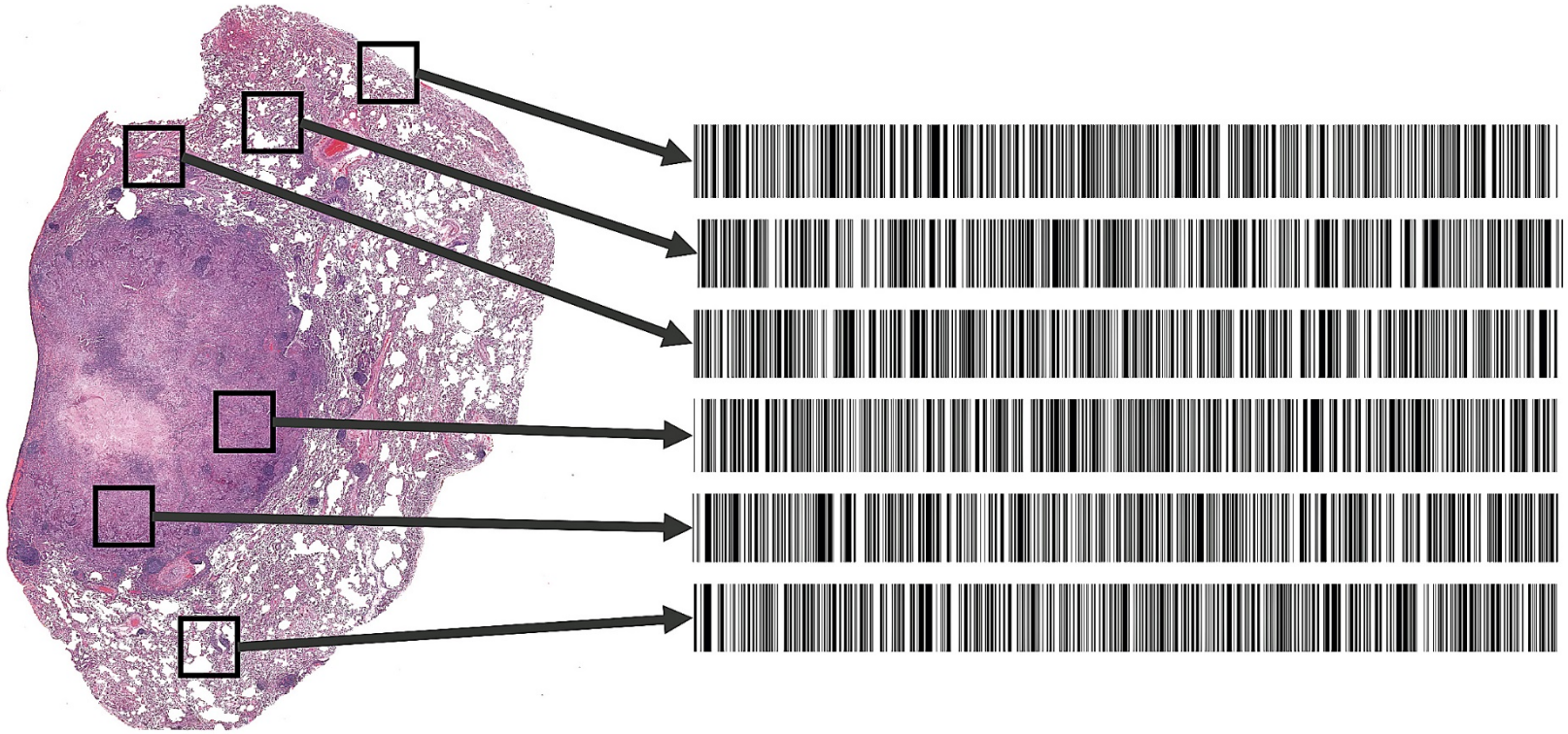
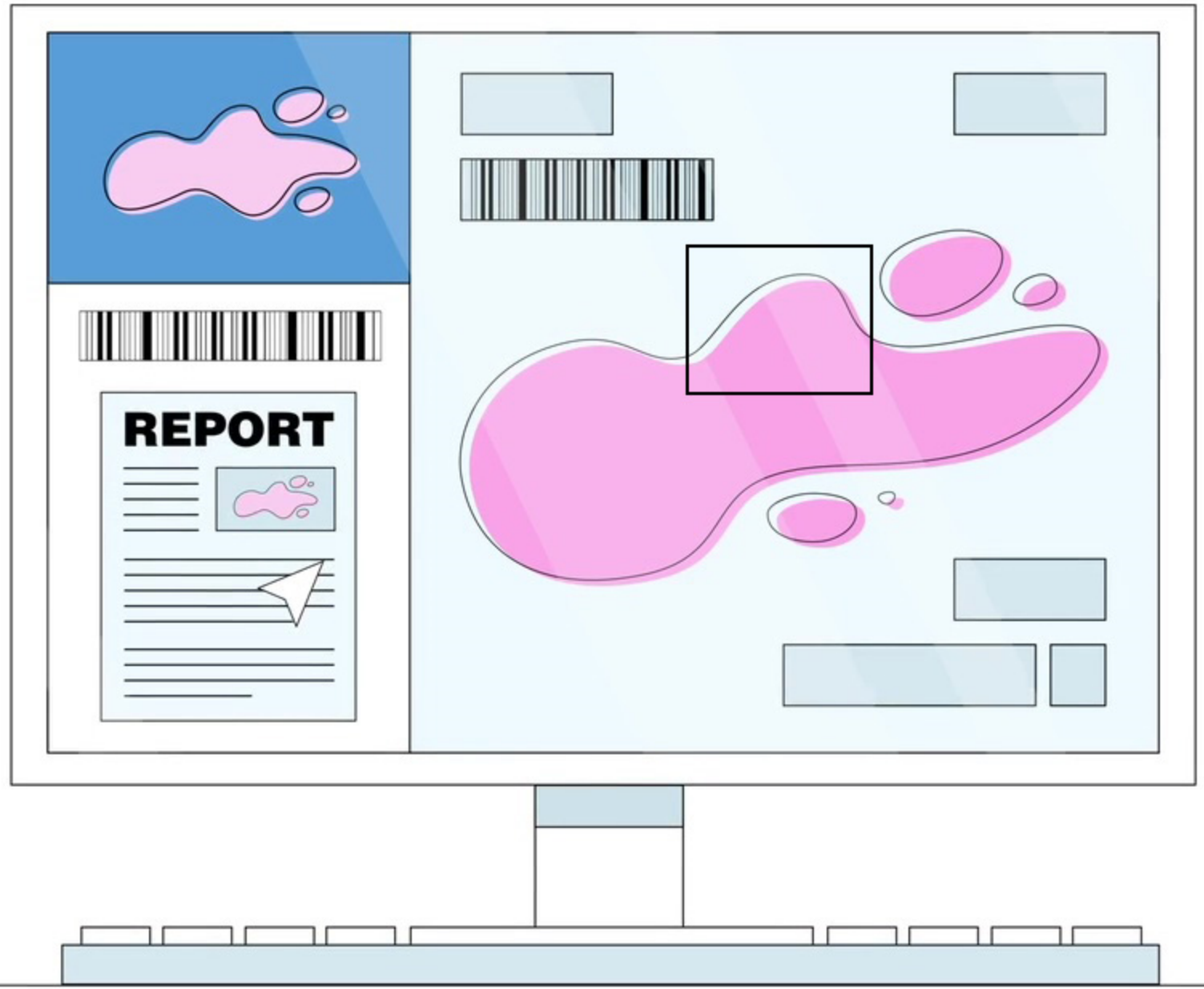


Indexing = compact representation



1 GB **10-15 KB**


REPORT

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Live Image Search Demo

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IMAGE SEARCH FOR PATHOLOGY

Applications for Image Search

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“Virtual Peer Review”

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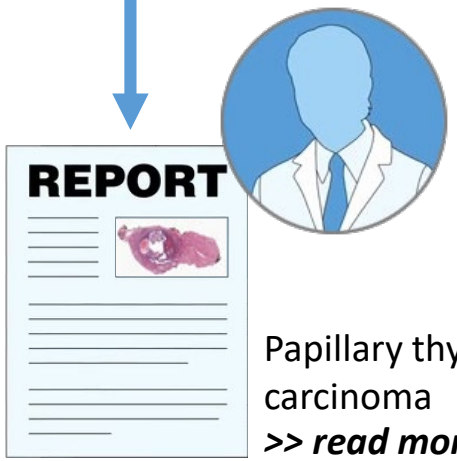
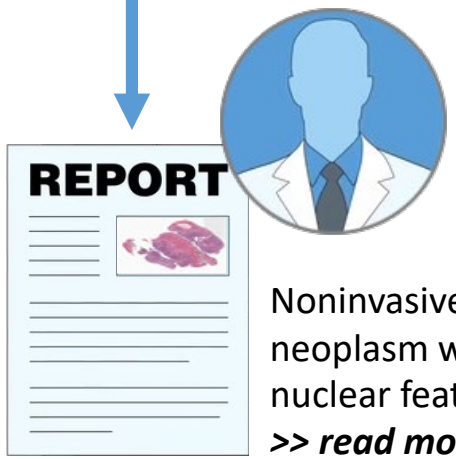
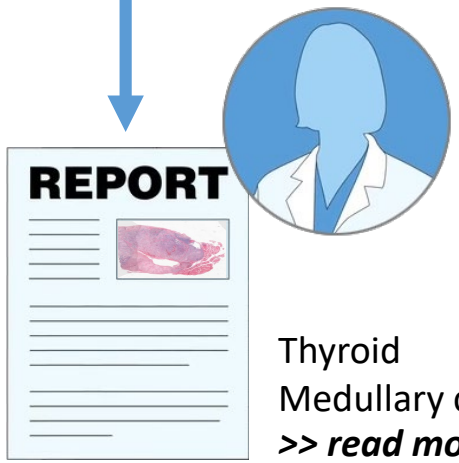
Computational Consensus:
Papillary Thyroid Carcinoma



Papillary thyroid carcinoma
>> read more



Noninvasive follicular thyroid neoplasm with papillary-like nuclear features
>> read more



Thyroid Medullary carcinoma
>> read more

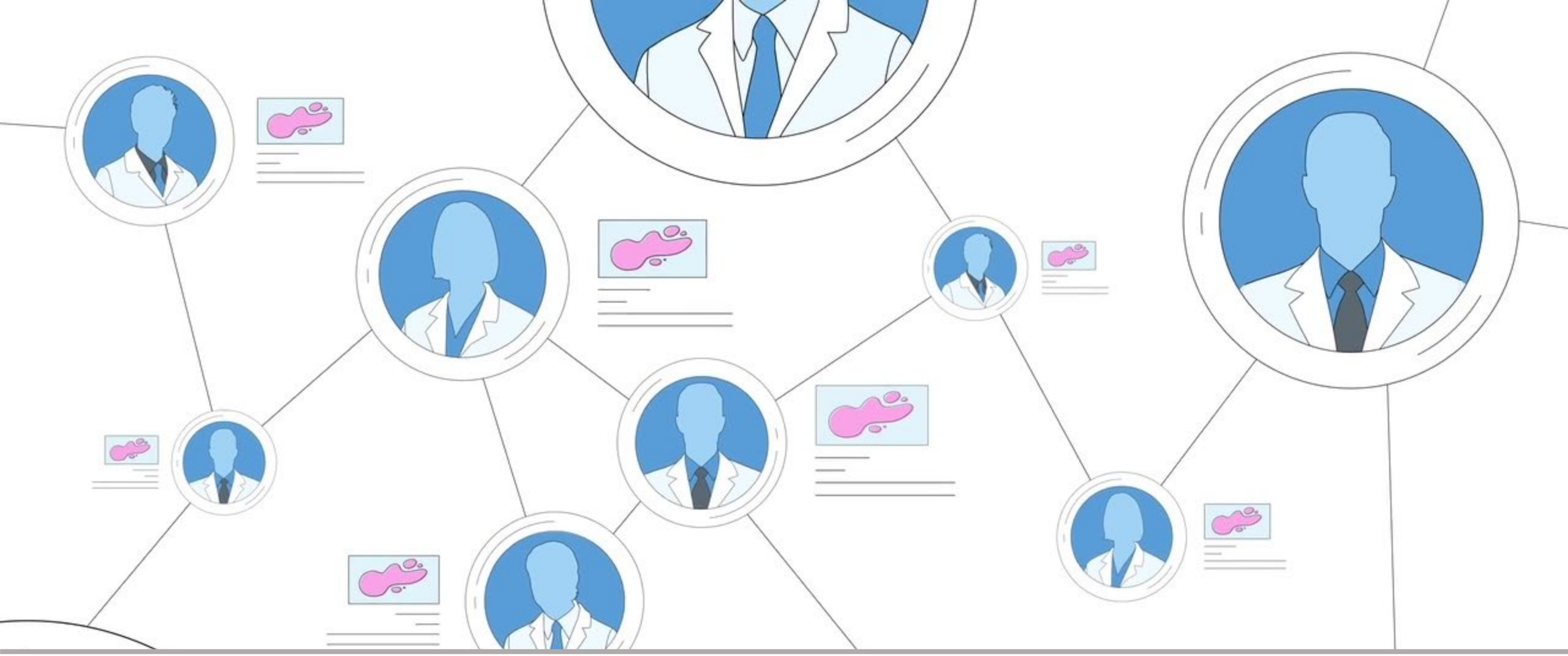


Image search connects pathologists to the vast knowledge of their colleagues

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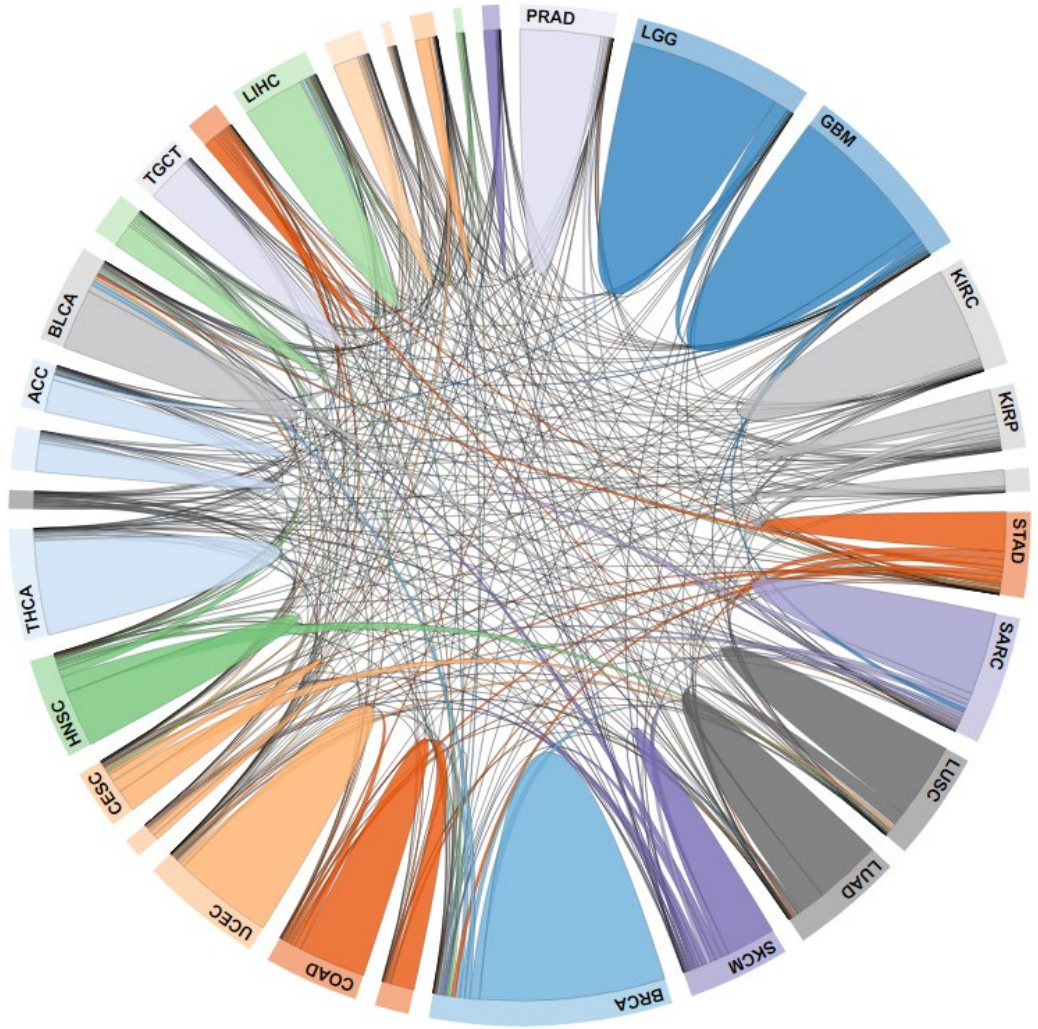
Discovery Research

Relationships between cancer subtypes

Ultimately, connections to the genome



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Augmenting/Automating AI

Pathologist Annotates WSI

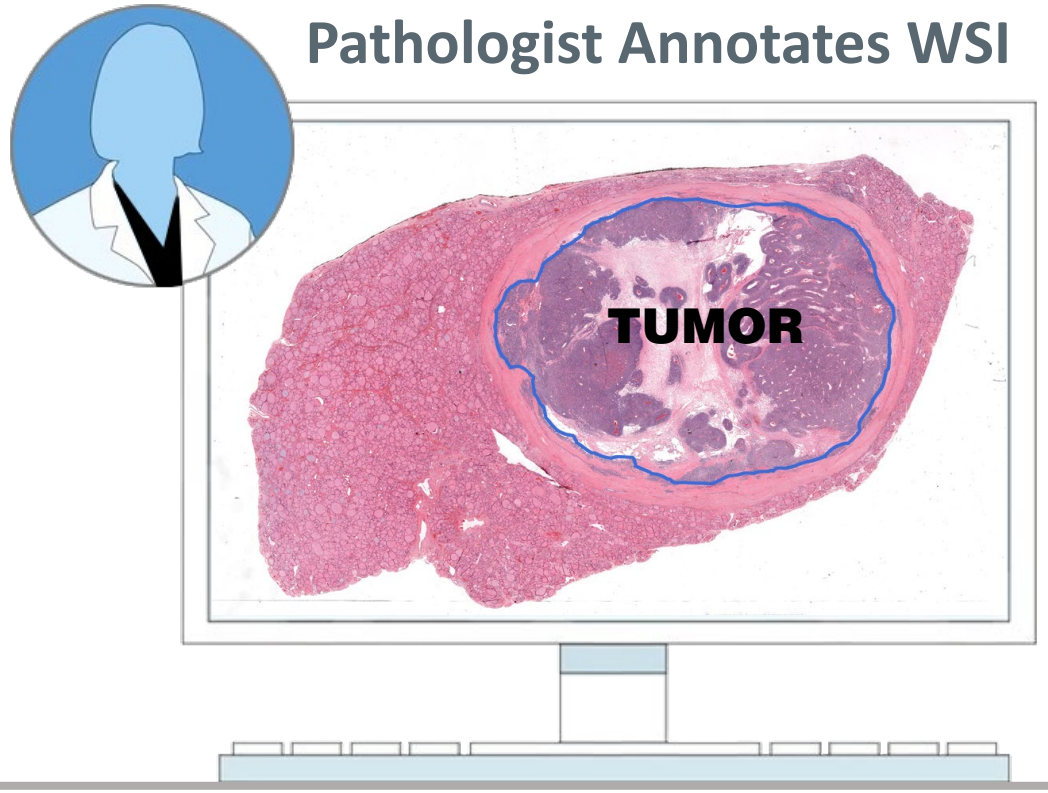

Image Search Engine Finds Similar Slides

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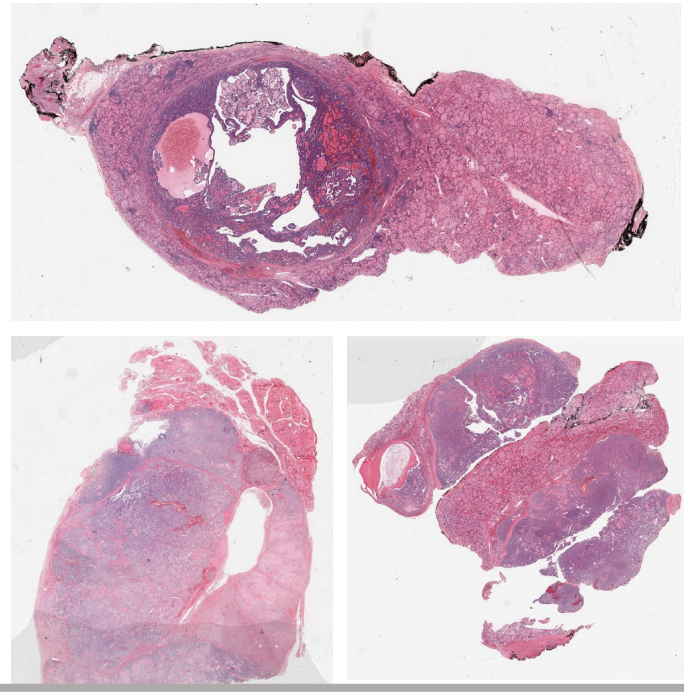
IMAGE SEARCH FOR PATHOLOGY



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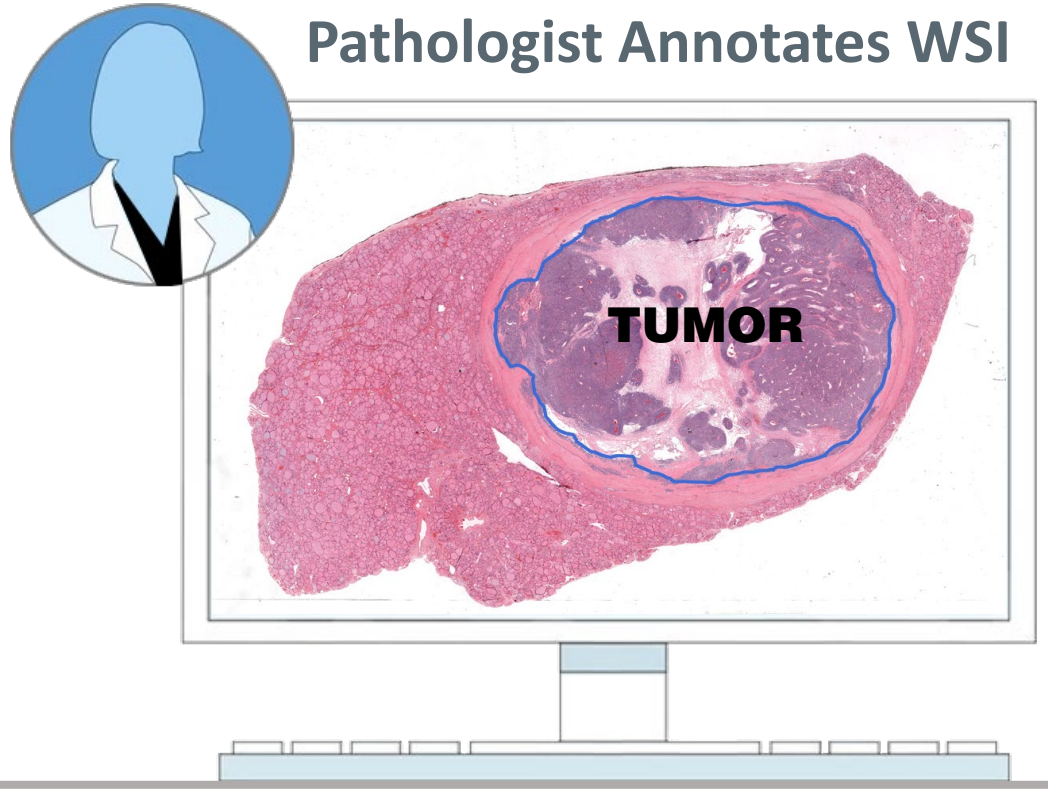
Augmenting/Automating AI

Pathologist Annotates WSI



Automatically Applies Annotations

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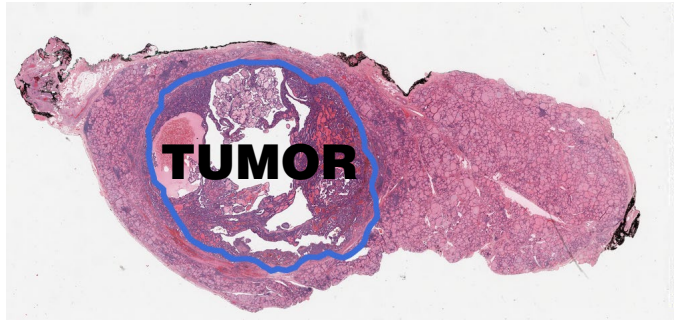
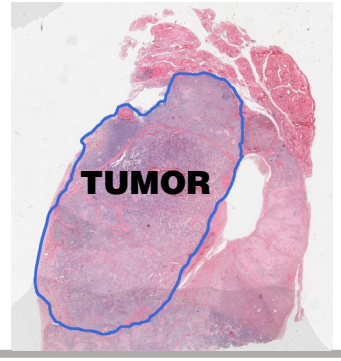
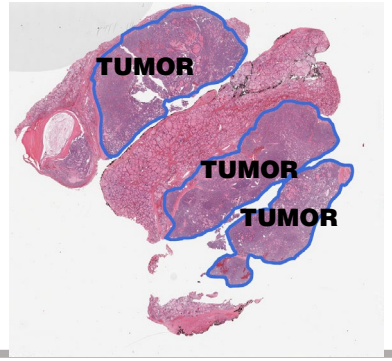






Auto-reporting

University of Waterloo's Kimia Lab and Huron Digital Pathology to participate in $126M industry consortium led by Sunnybrook Research Institute

Waterloo, Ontario, May 27, 2019 – University of Waterloo's Kimia Lab announced today that it will participate in the $126 million Industry Consortium for Image Guided Therapy (ICIGT) led by the Sunnybrook Research Institute, with investment partnership from the Canadian government. Together with its industry partner Huron Digital Pathology, Kimia Lab will manage a significant, new artificial intelligence project for digital pathology within the network, with almost half of funds coming from the Canadian government.

The Canadian government, through its Strategic Innovation Fund, will invest up to $49 million to support the ICIGT initiative, which, in addition to Kimia Lab and Huron Digital Pathology, consists of more than 70 partners from industry, academia, government organizations and not-for-profits. The consortium's mandate is to accelerate the application of artificial intelligence and machine learning technologies to deliver better health outcomes, faster diagnoses and safer treatments that minimize side effects and the length of hospital stays.

Kimia and Huron's project within ICIGT aims to develop intelligent algorithms for consensus building and auto-reporting in digital pathology to improve the speed, cost and accuracy of diagnosis. Huron, in technical partnership with the Kimia Lab, recently introduced the world's first image search engine that connects pathologists to the vast knowledge contained in the world's pathology reports.

"This is a historic opportunity to initiate a major change in diagnostic pathology," says professor Hamid Tizhoosh, Director of Kimia Lab at University of Waterloo. "The AI-driven auto-reporting will be the main output of the project enabling diagnostic consensus by accessing large archives of histopathology images and learning from evidently diagnosed cases of the past."

Reference Architecture with Dell EMC

Huron TissueScope iQ

Index

Huron WSI

LAGOTTO™ on **PowerEdge GPU Server**

Digital Slide Archive on **Isilon**

3rd Party Scanners

3rd Party WSI

3rd Party Viewers/PACS through API

Lab Information System

NCI/NIH Dataset: TCGA Project

Harmonized Cancer Datasets

Genomic Data Commons Data Portal

Get Started by Exploring:

Projects | Exploration | Analysis | Repository

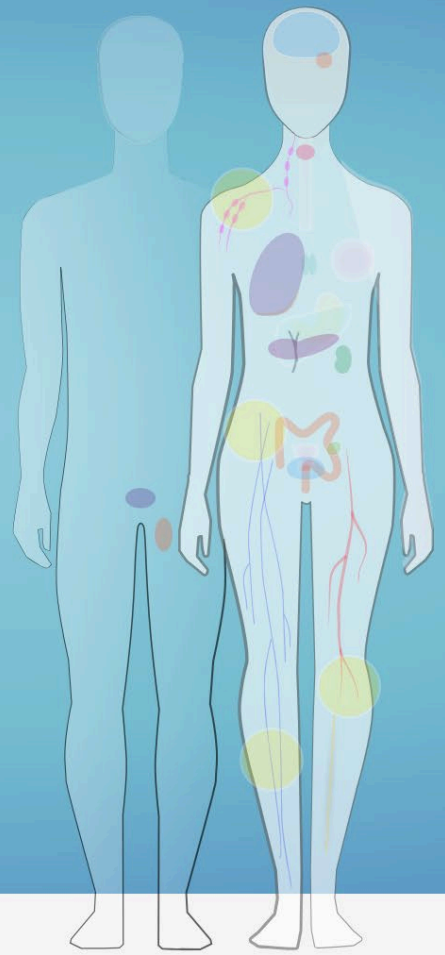
e.g. BRAF, Breast, TCGA-BLCA, TCGA-A5-A0G2

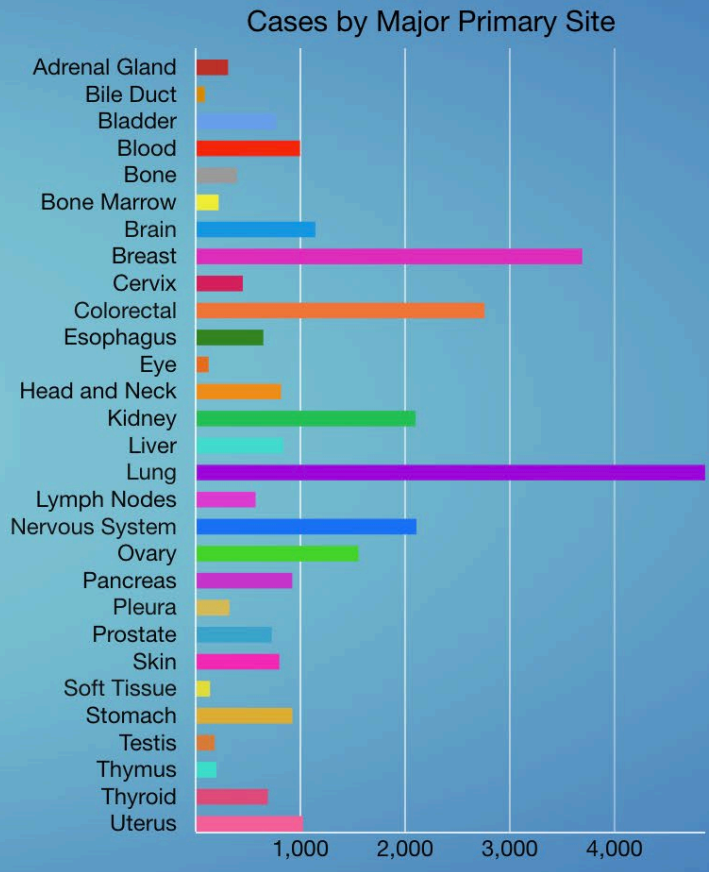
Data Portal Summary

Data Release 13.0 - September 27, 2018

PROJECTS	PRIMARY SITES	CASES
43	69	33,096

FILES	GENES	MUTATIONS
358,092	22,872	3,142,246





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NCI/NIH Dataset: TCGA Project

DELL EMC

TEKNICOR

- 30,072 whole-slide images from the TCGA project
- We removed 952 WSIs due to low quality
- We processed 29,120 WSIs at 20X magnification
- From the 29,120 WSIs, 26,564 specimens were tumorous.
- A total of 17,425 files depict frozen sections
- A total of 11,579 files are diagnostic slides
- Approx. 20,000,000 patches

Validation Summary

- **Building diagnostic consensus with high confidence is possible**
  Frozen sections (e.g., BLCA 93%, KIRC 97%, and OV 99%)
  Diagnostic slides (e.g., PRAD 98%, SKCM 99%, and THYM 100%)

- **The more the better**
  [positive correlation of 80% between number of patients and the accuracy of majority consensus]

The Future: wherever there are large images

Aerial Photography/
Photogrammetry

Precision Agriculture

Space Imaging

Questions and Discussion

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