

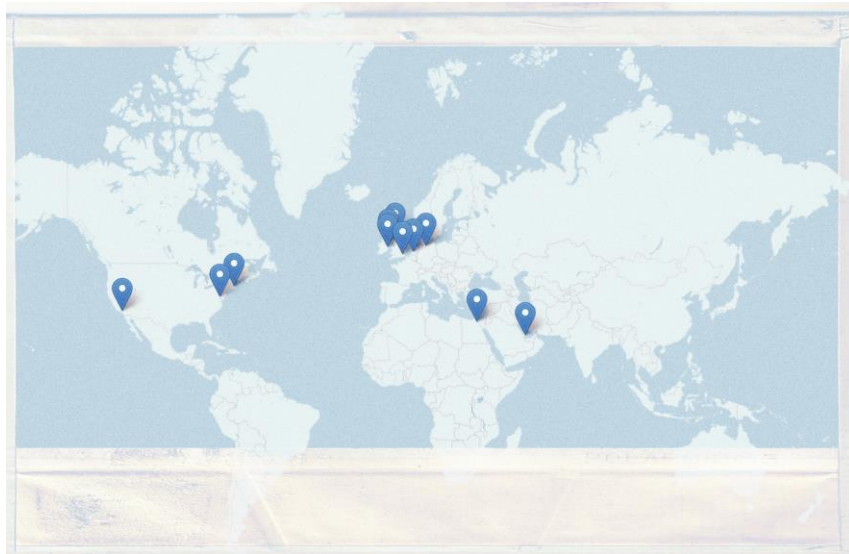
AI Innovations in Healthcare

Ahmed Serag, PhD
Professor & Director, AI Innovation Lab
Weill Cornell Medicine



About

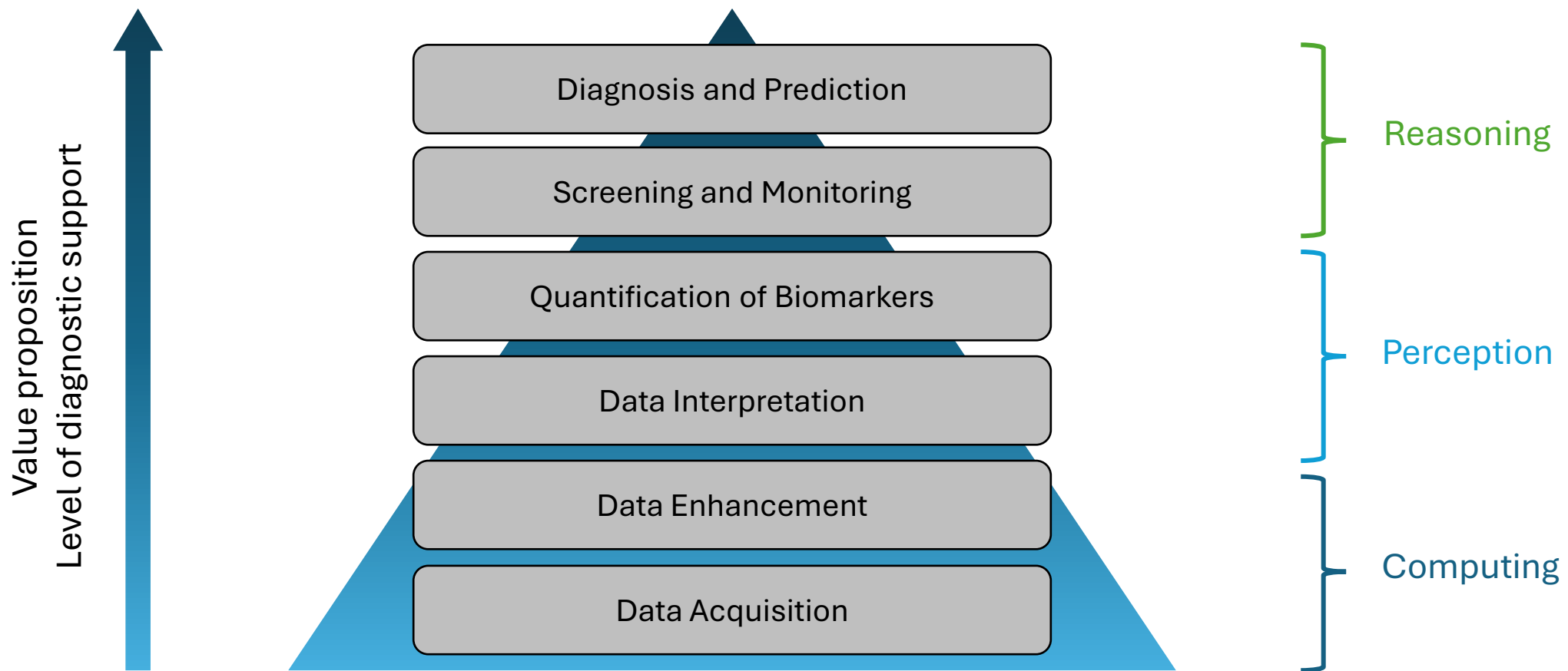
Around **20** years of experience developing and commercializing innovative AI solutions in medicine and healthcare





Weill Cornell Medicine in Qatar

AI in Medicine & Healthcare

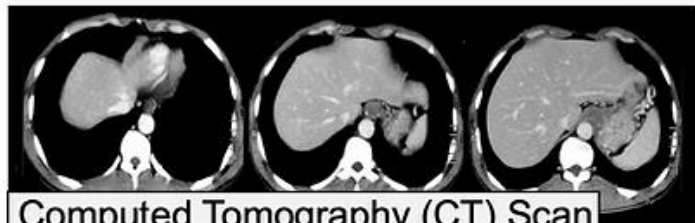




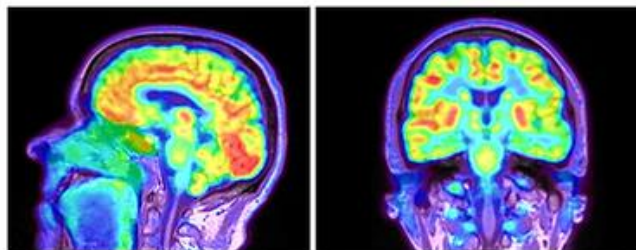
X-Ray



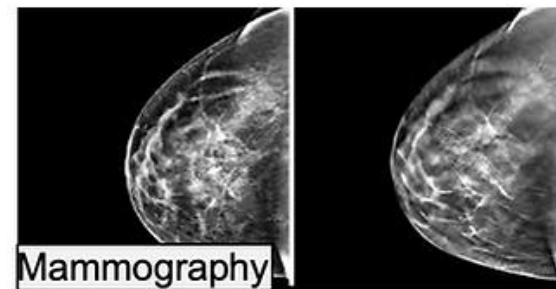
Magnetic Resonance Imaging (MRI)



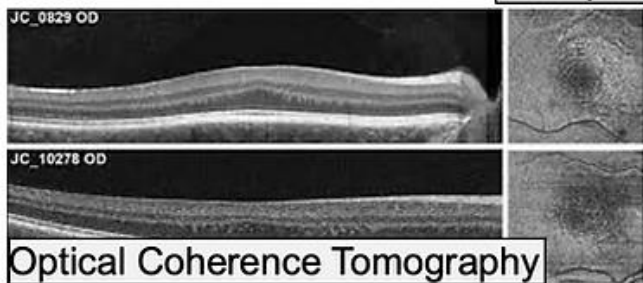
Computed Tomography (CT) Scan



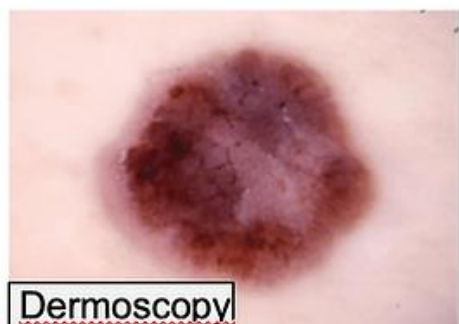
Positron Emission Tomography (PET)



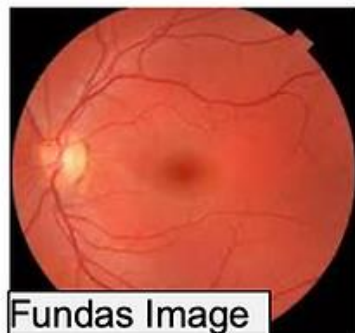
Mammography



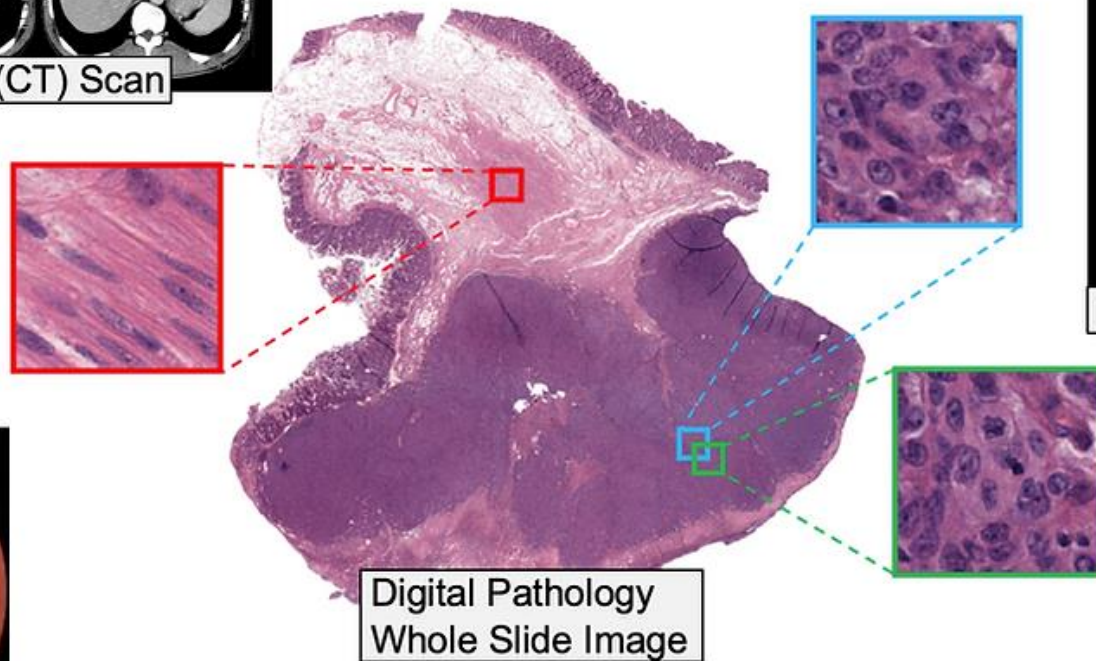
Optical Coherence Tomography



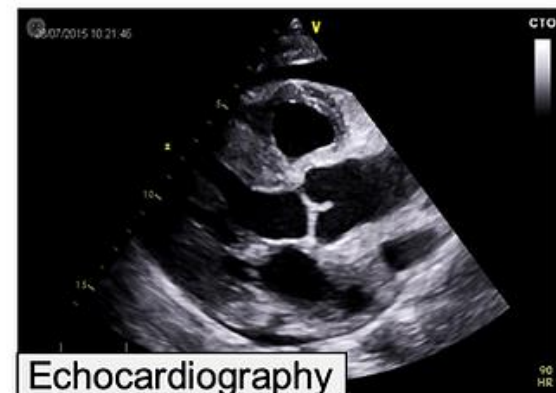
Dermoscopy



Fundas Image



Digital Pathology
Whole Slide Image

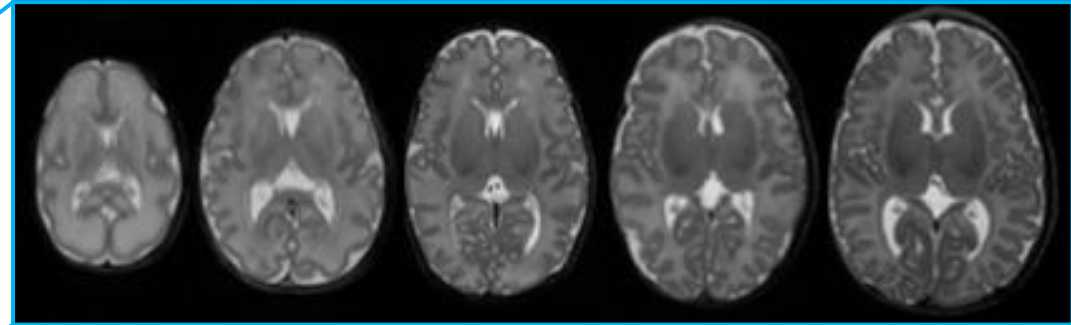


Echocardiography



Colonoscopy

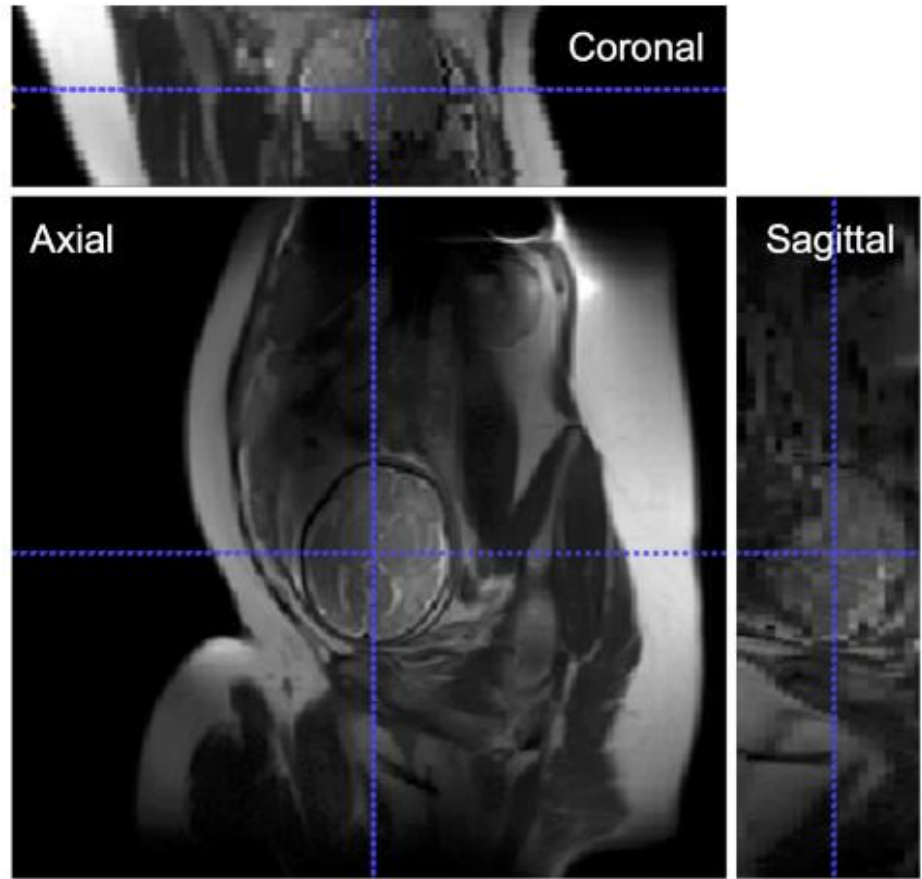
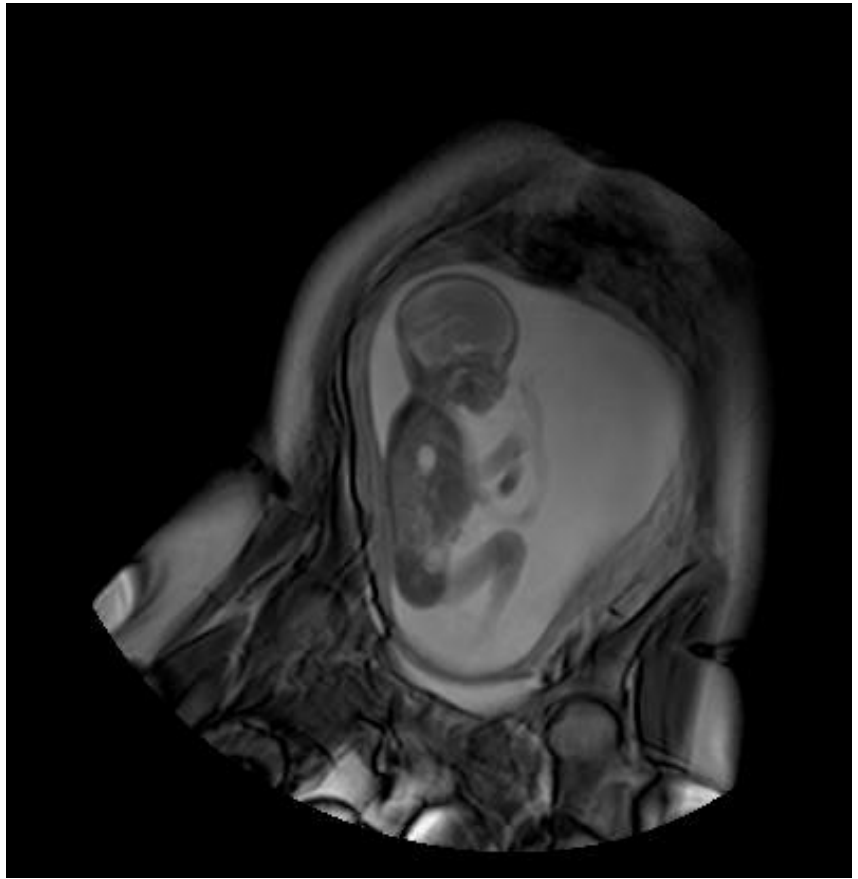
Brain development



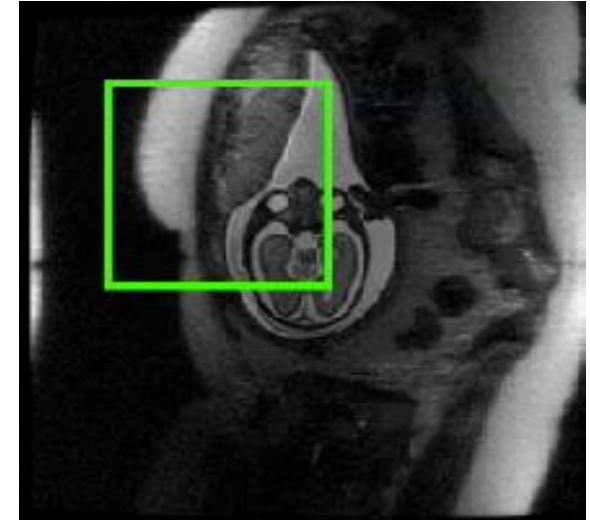
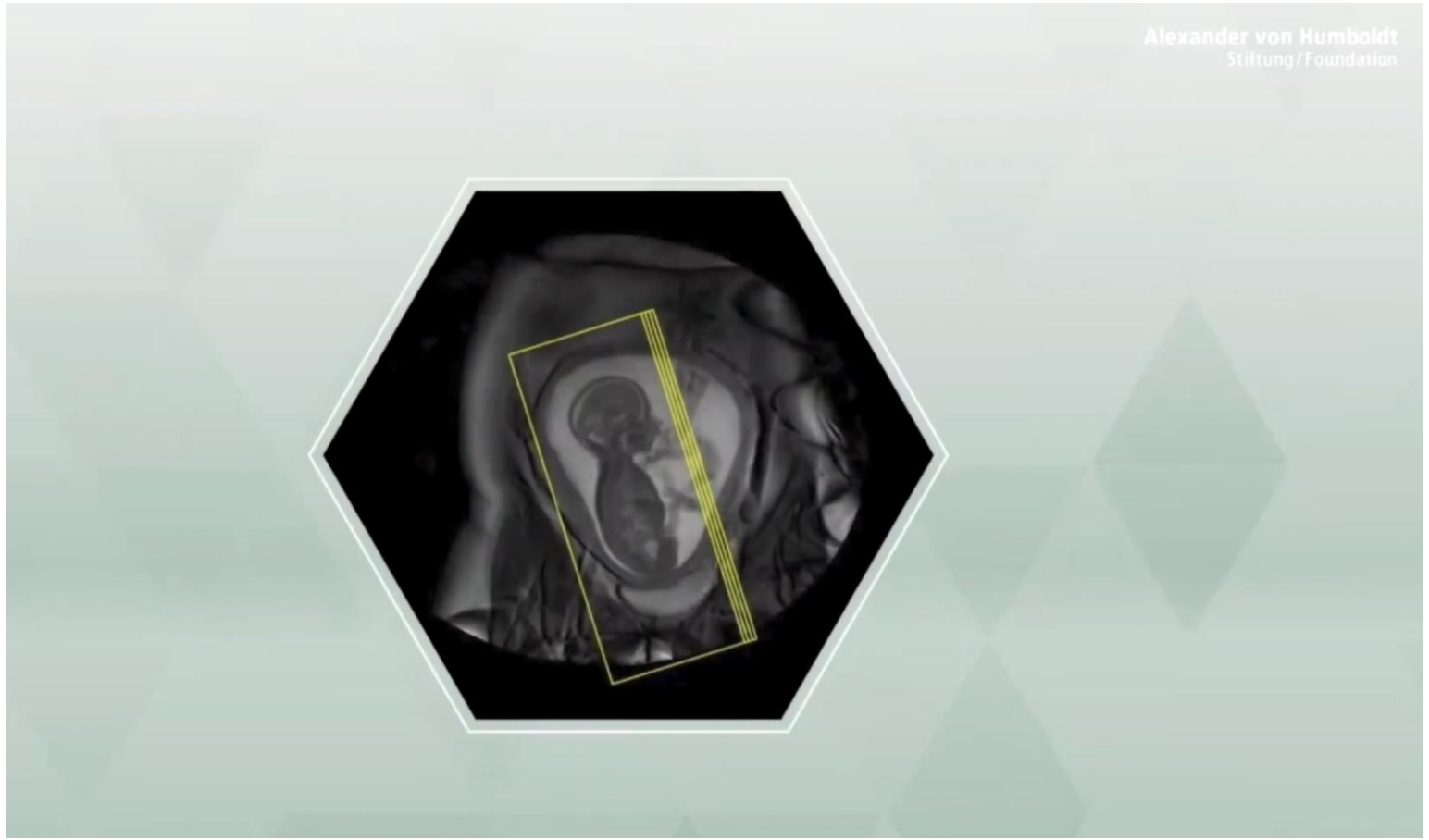
T2 weighted MR images of a preterm developing brain from left to right: Baby at 29, 33, 37, 41 and 44 weeks of gestation at time of scan.



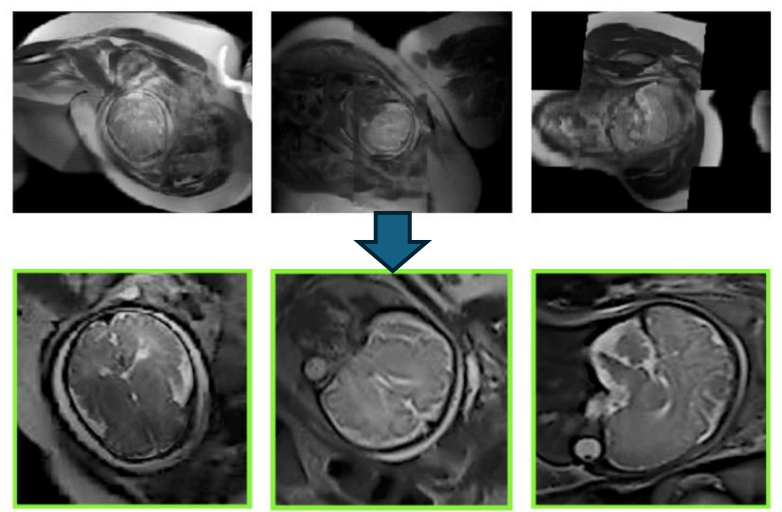
Fetal brain development



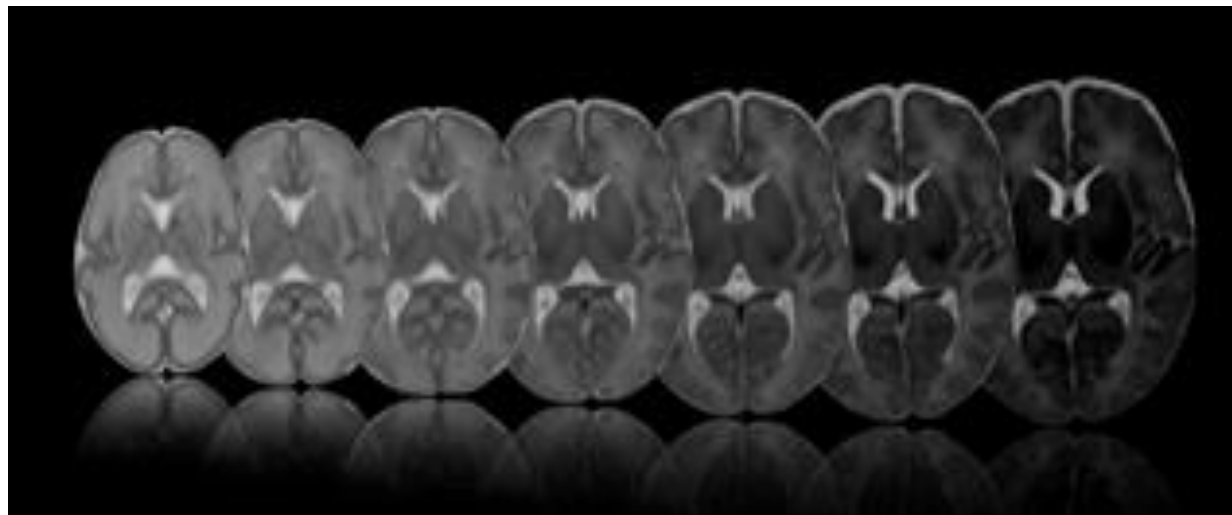
Fetal brain development



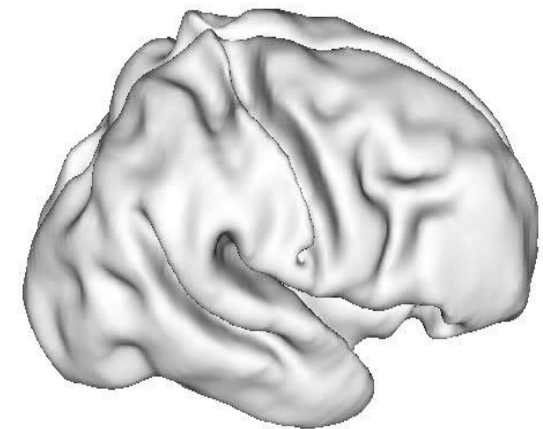
Serag et al.



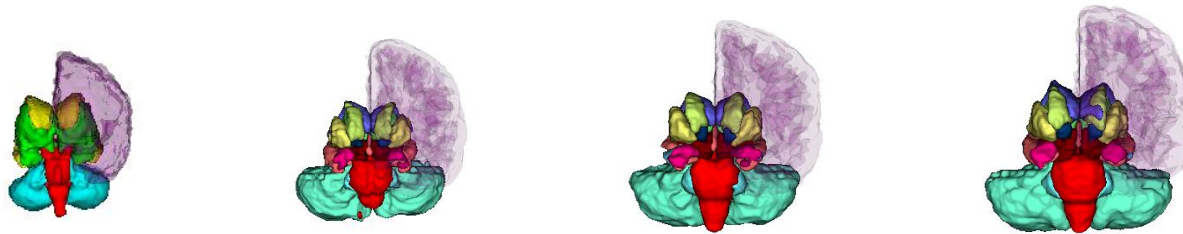
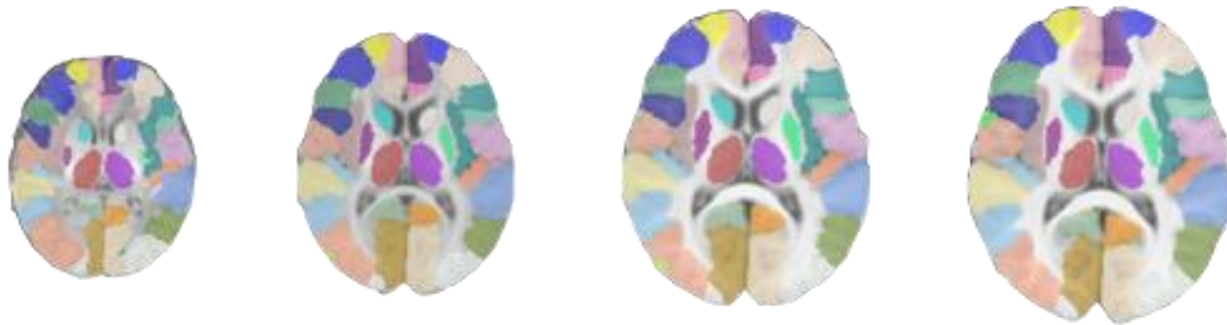
Neonatal brain development



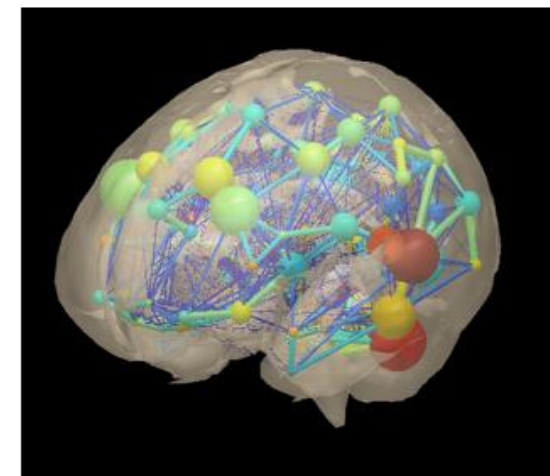
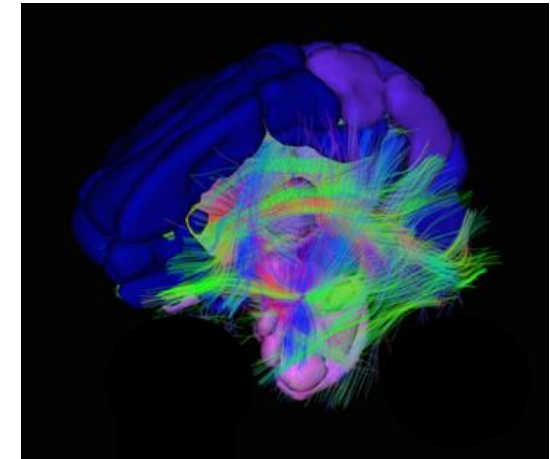
28 —————> 44 weeks



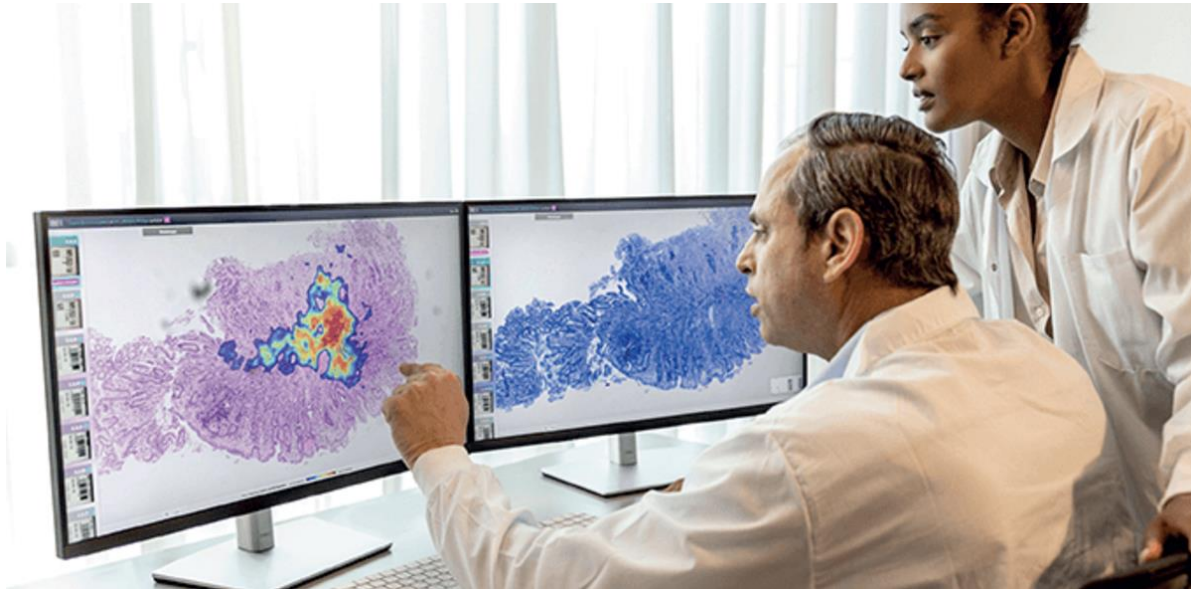
Multi-modal modeling of the human brain from birth to adulthood



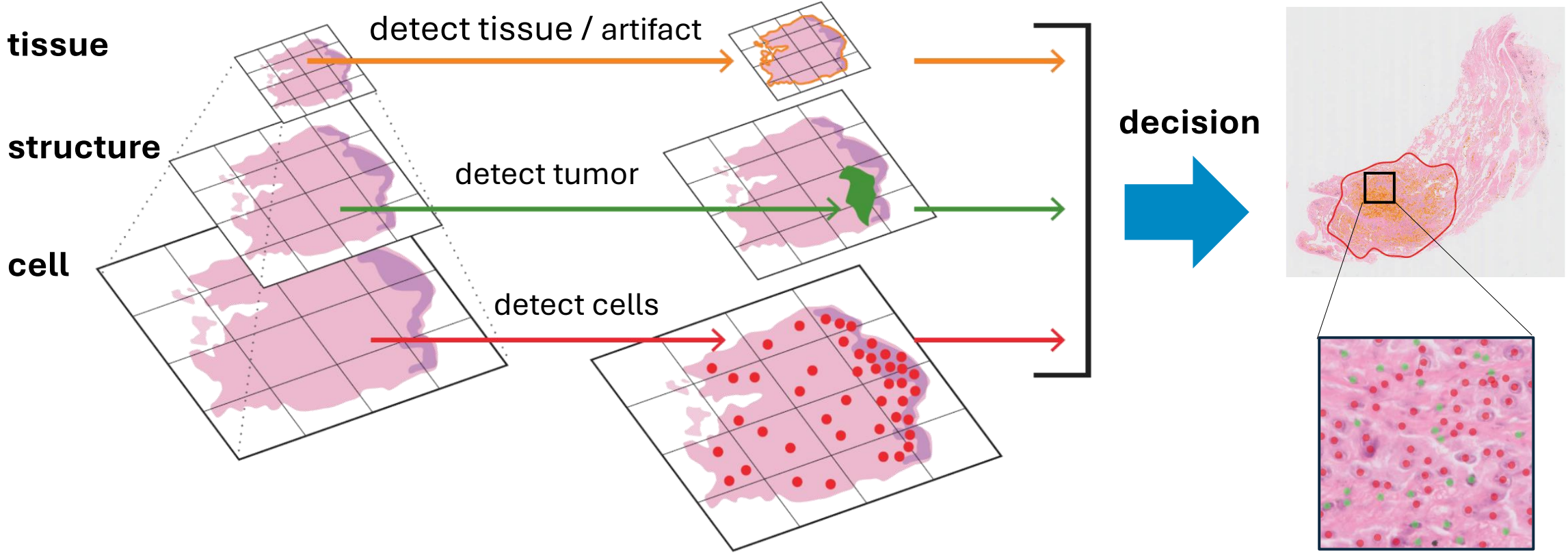
Birth —————→ *Adulthood*



AI in Pathology

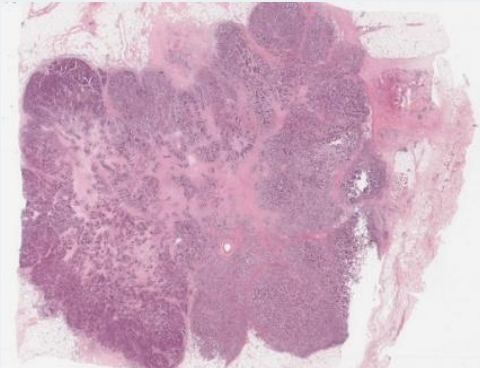


Deep Learning in Diagnostic Pathology

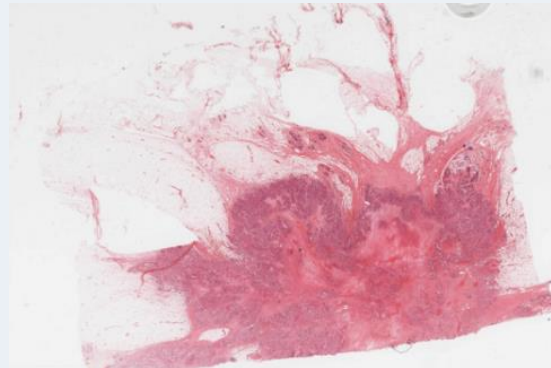


Cancer Detection

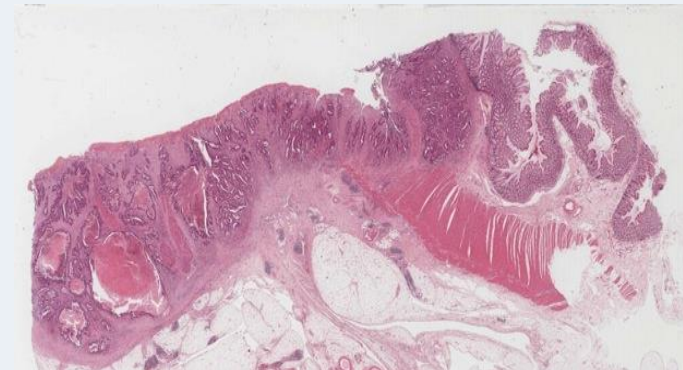
Automated *identification of tumour* and *calculated tumour percentage* in digital H&E tissue sections using image analysis



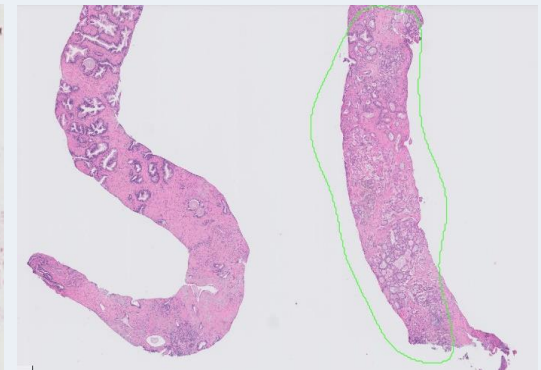
Original lung



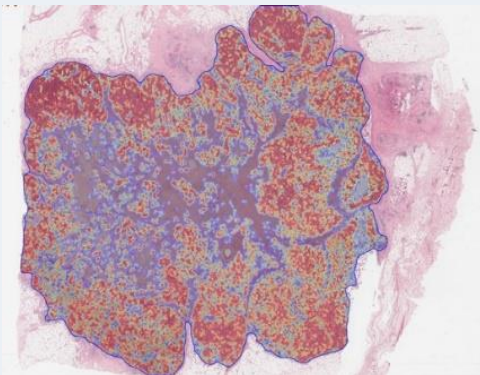
Original breast



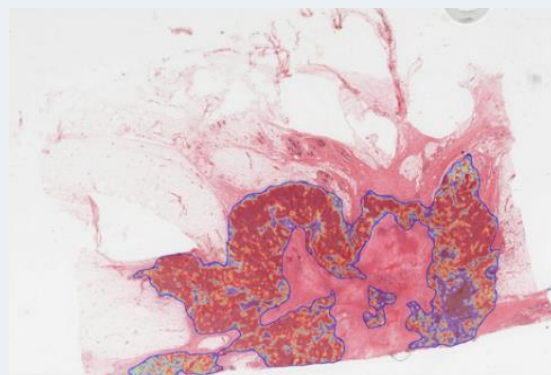
Original colon



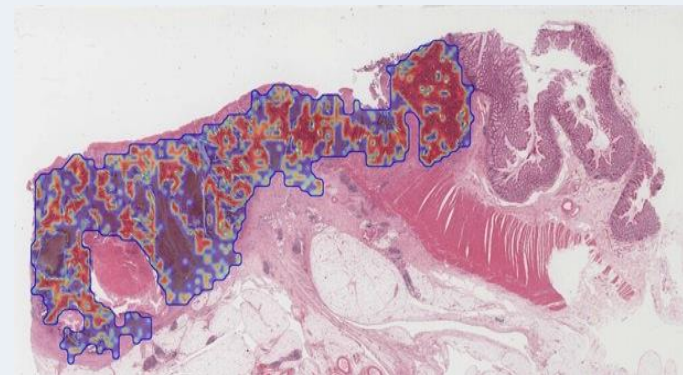
Original prostate



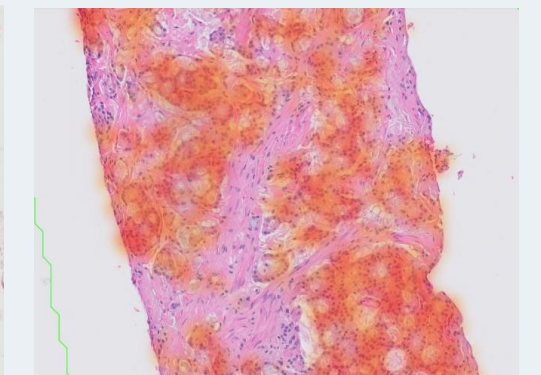
TissueMark Lung



TissueMark Breast



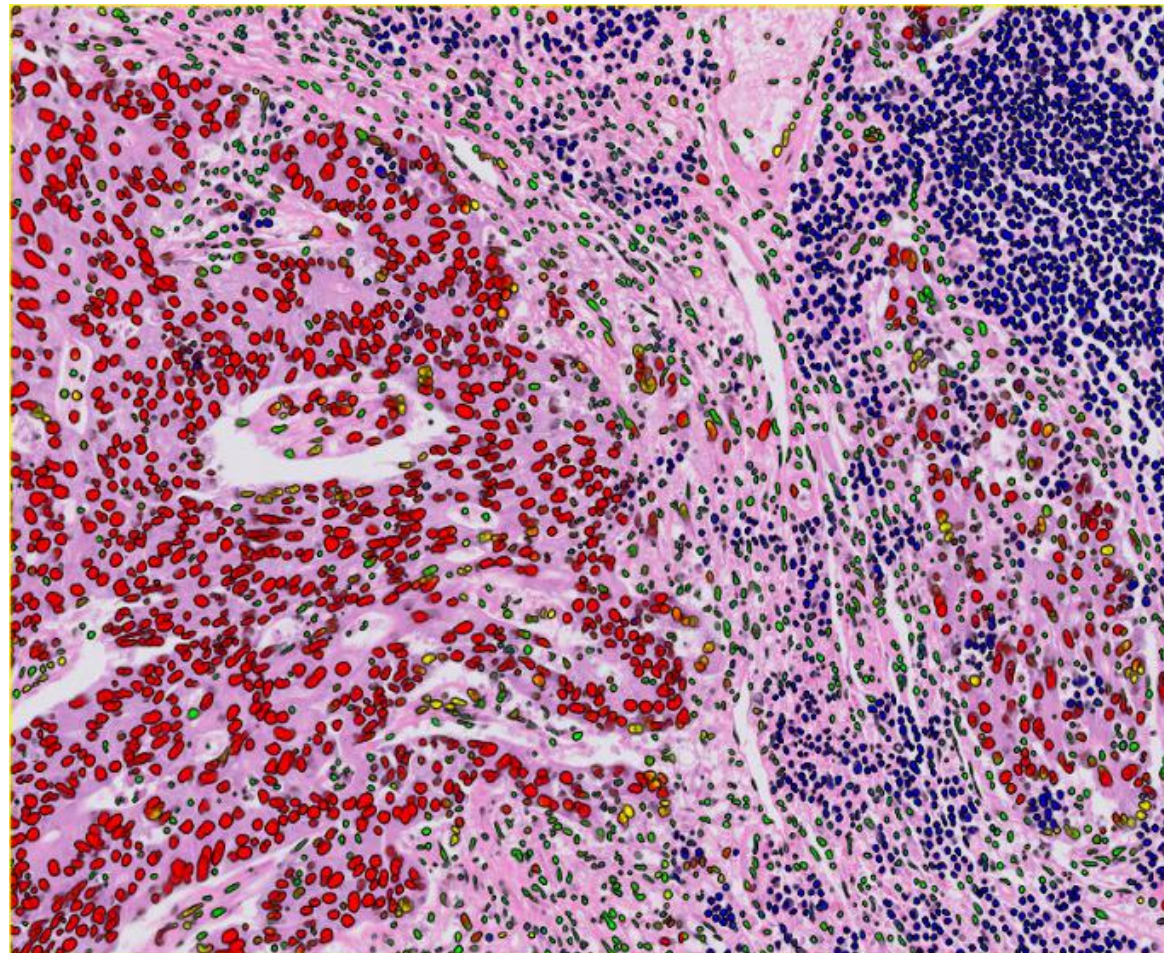
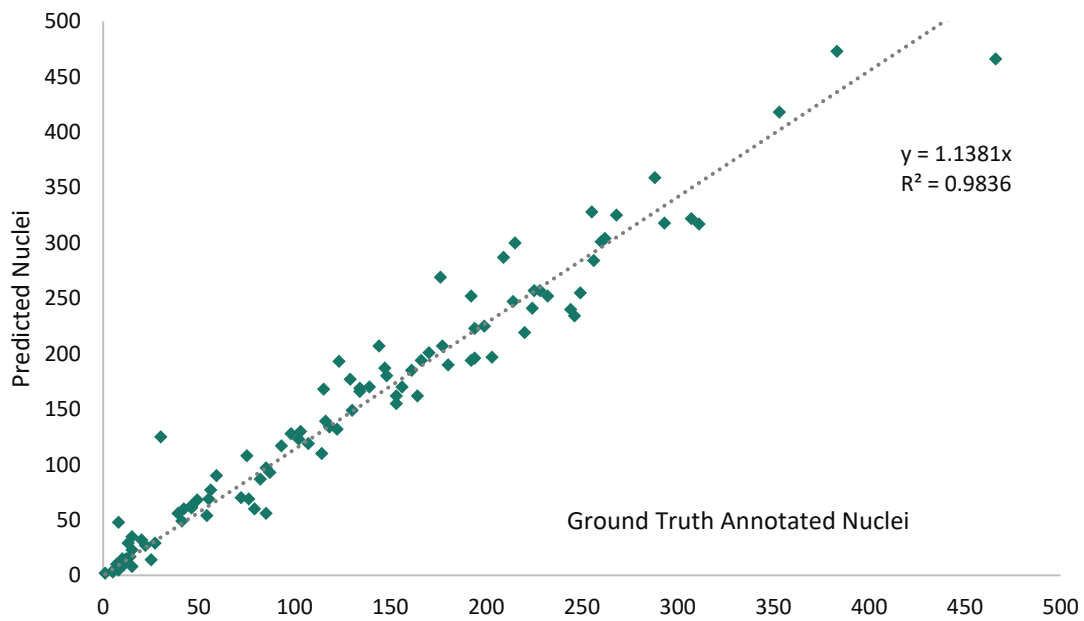
TissueMark Colon



TissueMark Prostate

High resolution cellularity assessment

Deep learning to identify and segment cells at high resolution, classify them into tumour and non-tumour and count the relative numbers of cells to derive a quantitative percentage threshold of sample quality



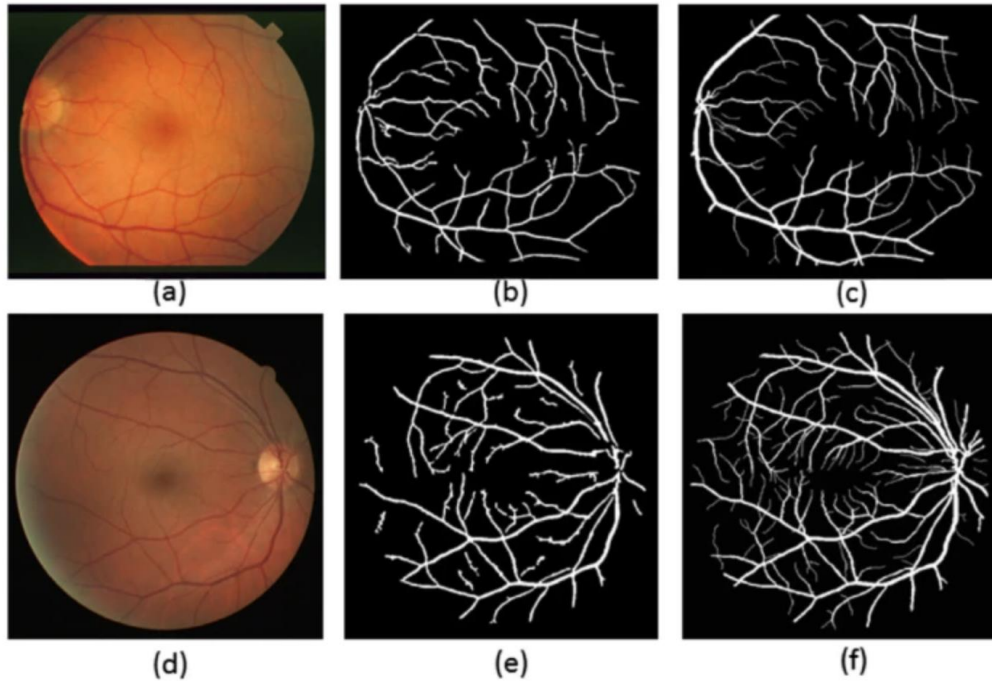
Confidential

¹ TissueMark is not intended for diagnostic, monitoring or therapeutic purposes or in any other manner for regular medical practice. PathXL is the legal manufacturer and is a Philips company

² Philips internal validation data

These slides detail early-stage internal research projects and intermediate output and do not make any claims pertaining to current Philips products.

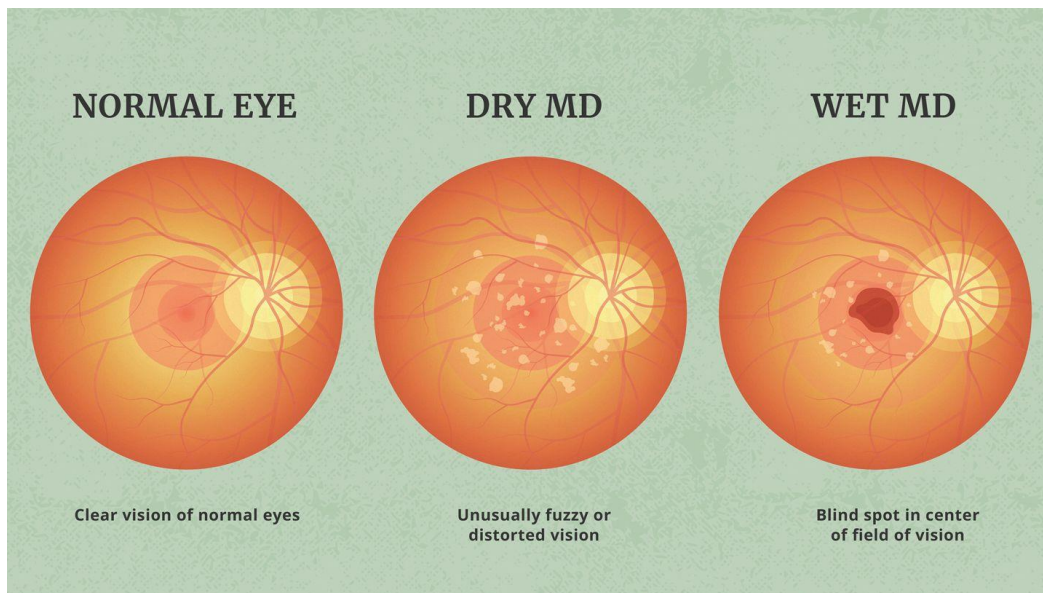
Quantification of Biomarkers



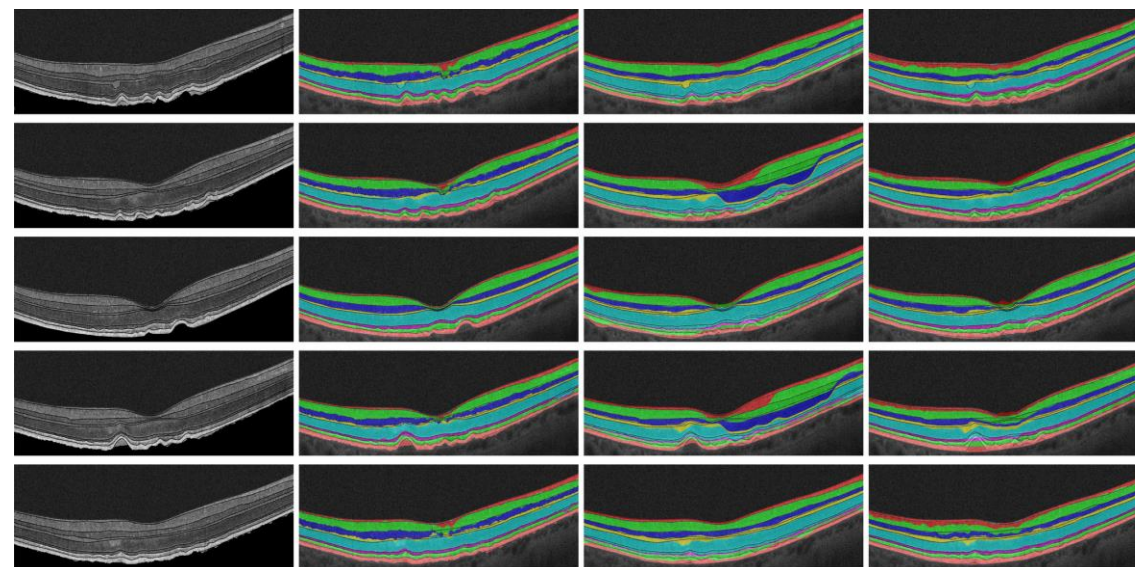
The sample results of our method. (a) STRARE fundus image. (b) Our method result. (c) Ground truth. (d) DRIVE fundus image. (e) Our method result. (f) Ground truth.

	STARE	DRIVE
Human Observer	0.9354	0.9473
AI-driven Method	0.9456	0.9410

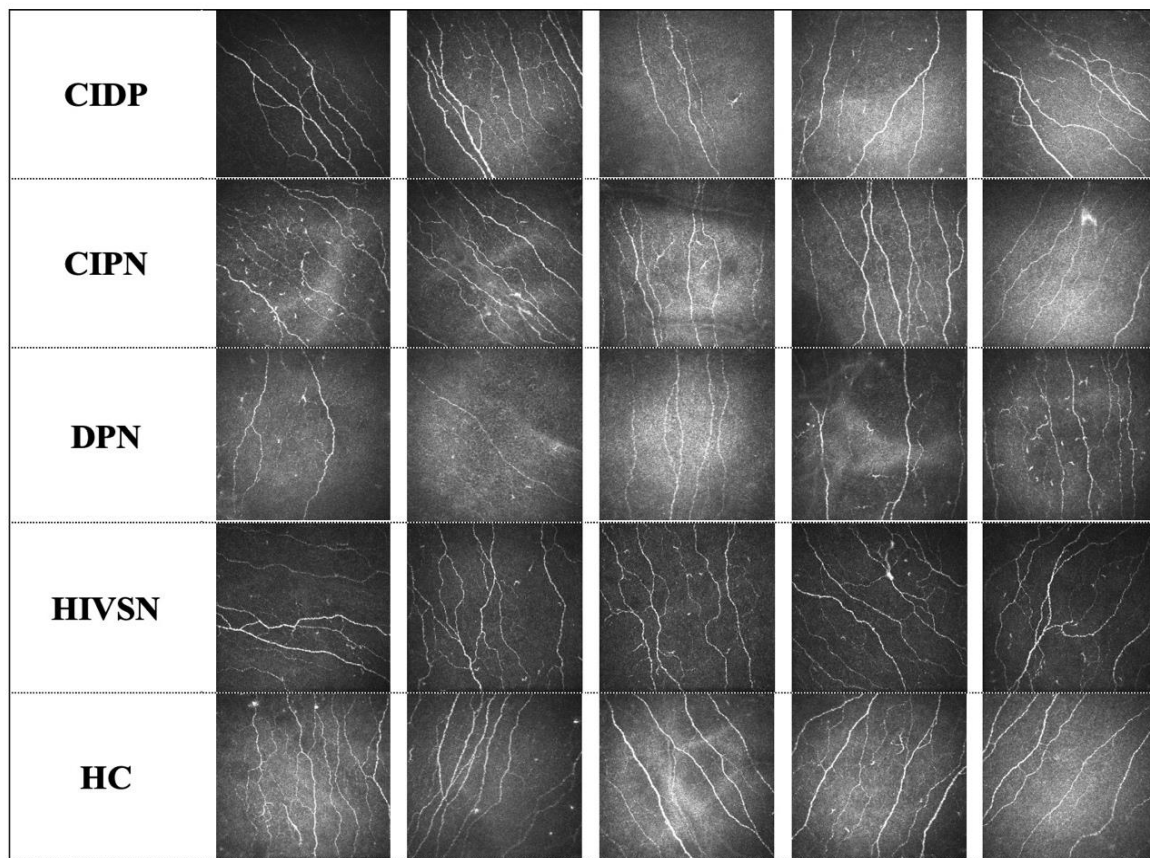
Personalized Drug Dosing



Optical Coherence Tomography (OCT)



AI-driven Disease Diagnosis



Diabetic Peripheral Neuropathy (DPN)

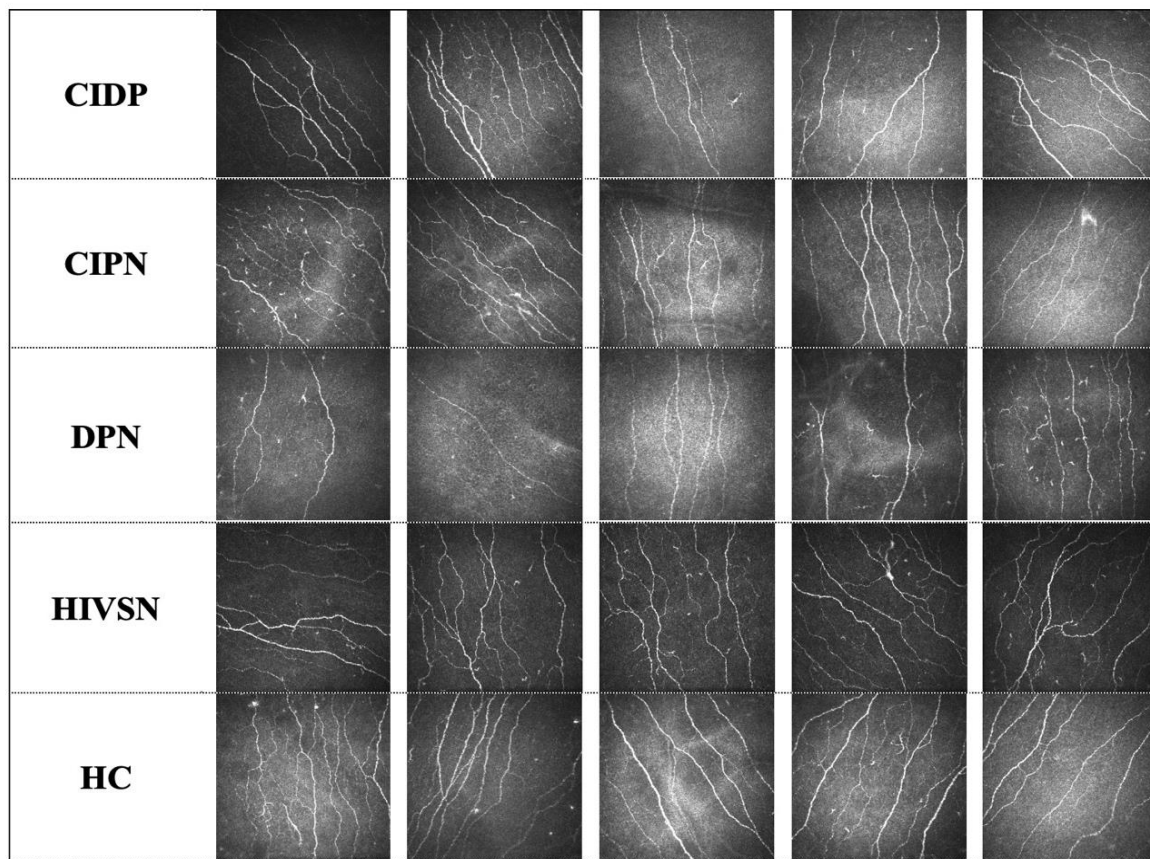
Chemotherapy-Induced Peripheral Neuropathy (CIPN)

Chronic Inflammatory Demyelinating Polyneuropathy (CIDP)

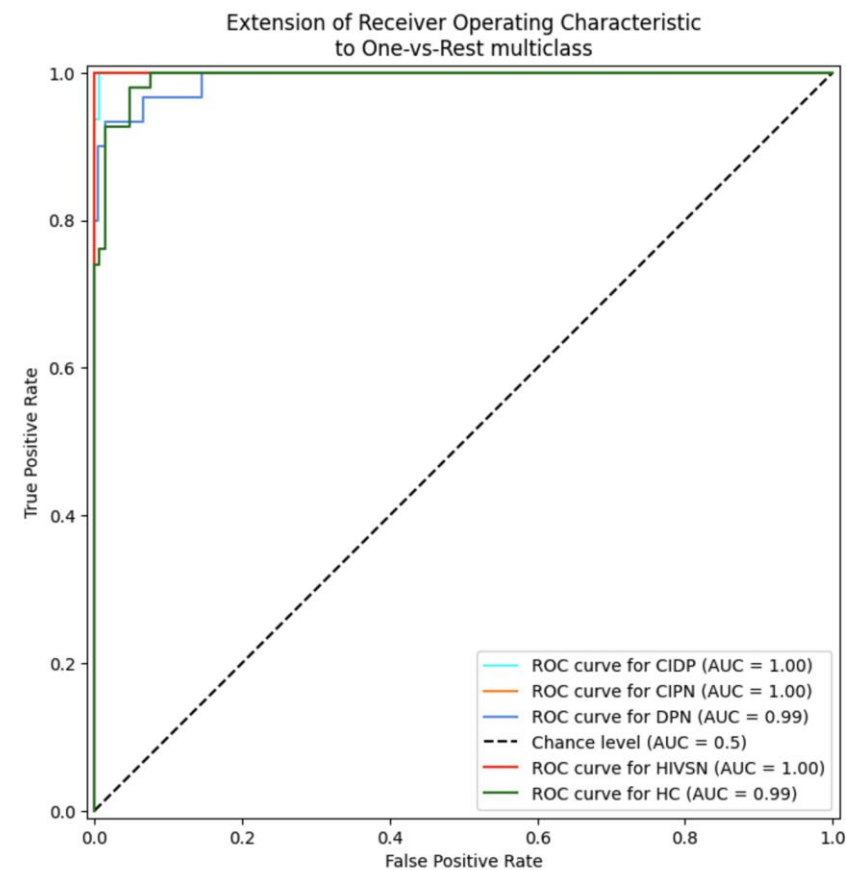
Human Immunodeficiency Virus-Associated Sensory
Neuropathy (HIV-SN)

Healthy controls (HC)

AI-driven Disease Diagnosis



CCM Images, in collaboration with Prof. Rayaz Malik



Generative AI is not ...

ChatGPT

Examples

Token game: complete it
simple form →

"Got any creative ideas for a 15
year old's birthday?" →

"You do it make an MVP required
to launch?" →

Capabilities

Remembers what user said
earlier in the conversation

Allows user to provide follow-up
comments

Trained to decline inappropriate
requests

Limitations

May occasionally generate
incorrect information

May occasionally produce
harmful instructions or biased
content

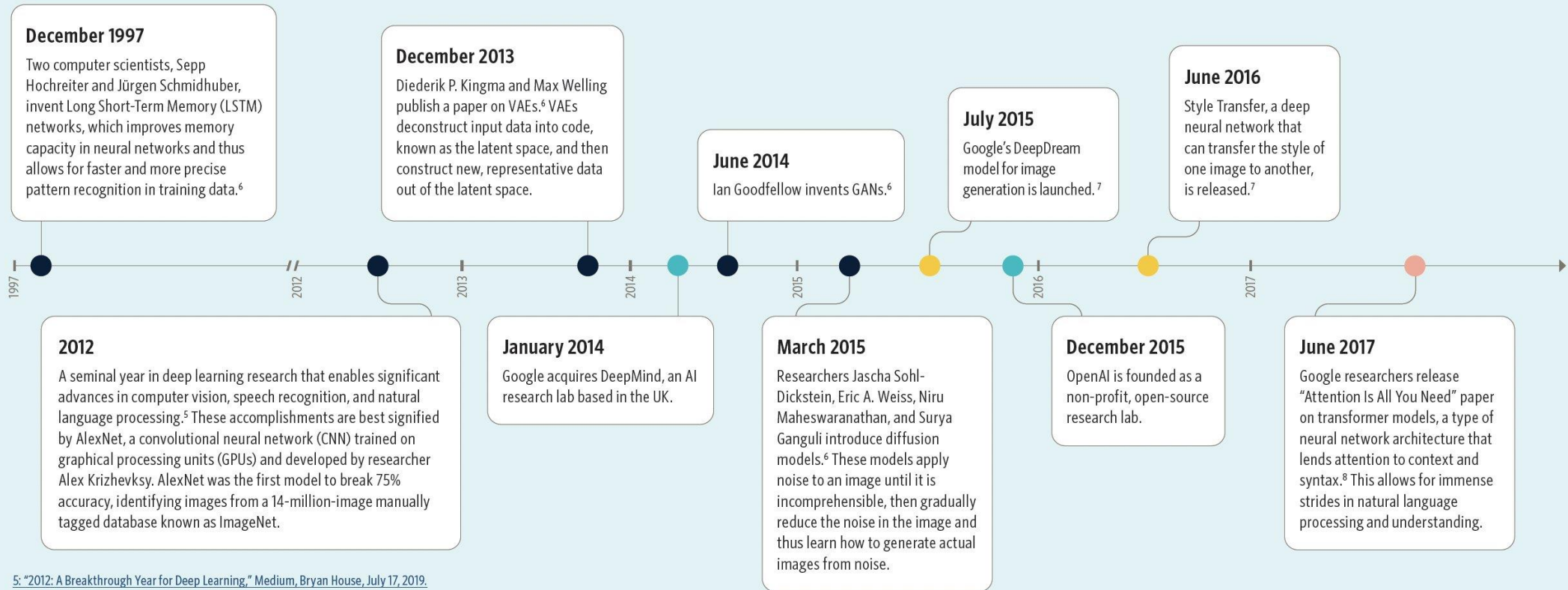
Limited knowledge of world and
events after 2021

Send a message

For Research Purposes: ChatGPT may produce inaccurate results about people, places, or facts. © 2022 OpenAI

Generative AI timeline

● General model research ● Image / video models ● Text models ● Business events



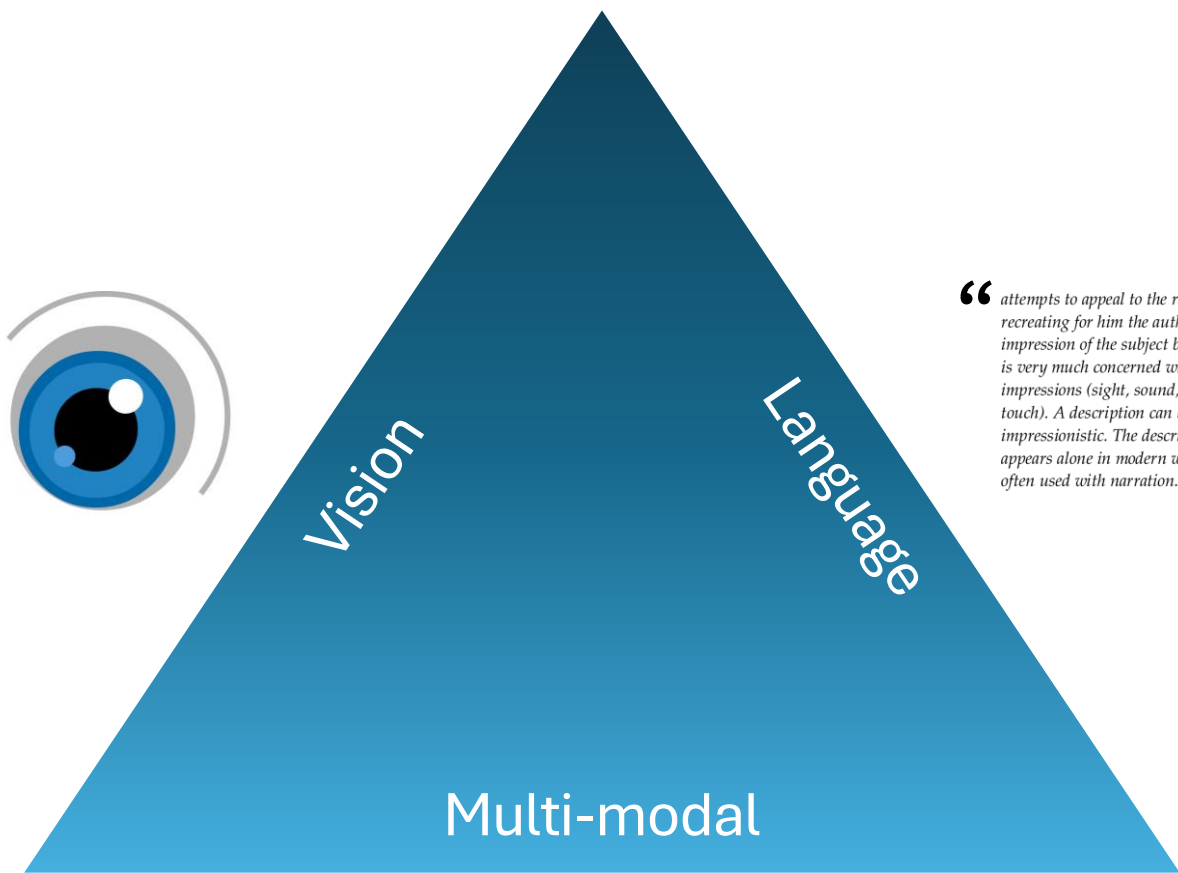
5: "2012: A Breakthrough Year for Deep Learning," Medium, Bryan House, July 17, 2019.

6: "The Generative AI Revolution Has Begun—How Did We Get Here?," Ars Technica, Haomiao Huang, January 30, 2023.

7: "Timeline of Text-To-Image Machine Learning Models," Fabian Mosele, n.d., accessed March 9, 2023.

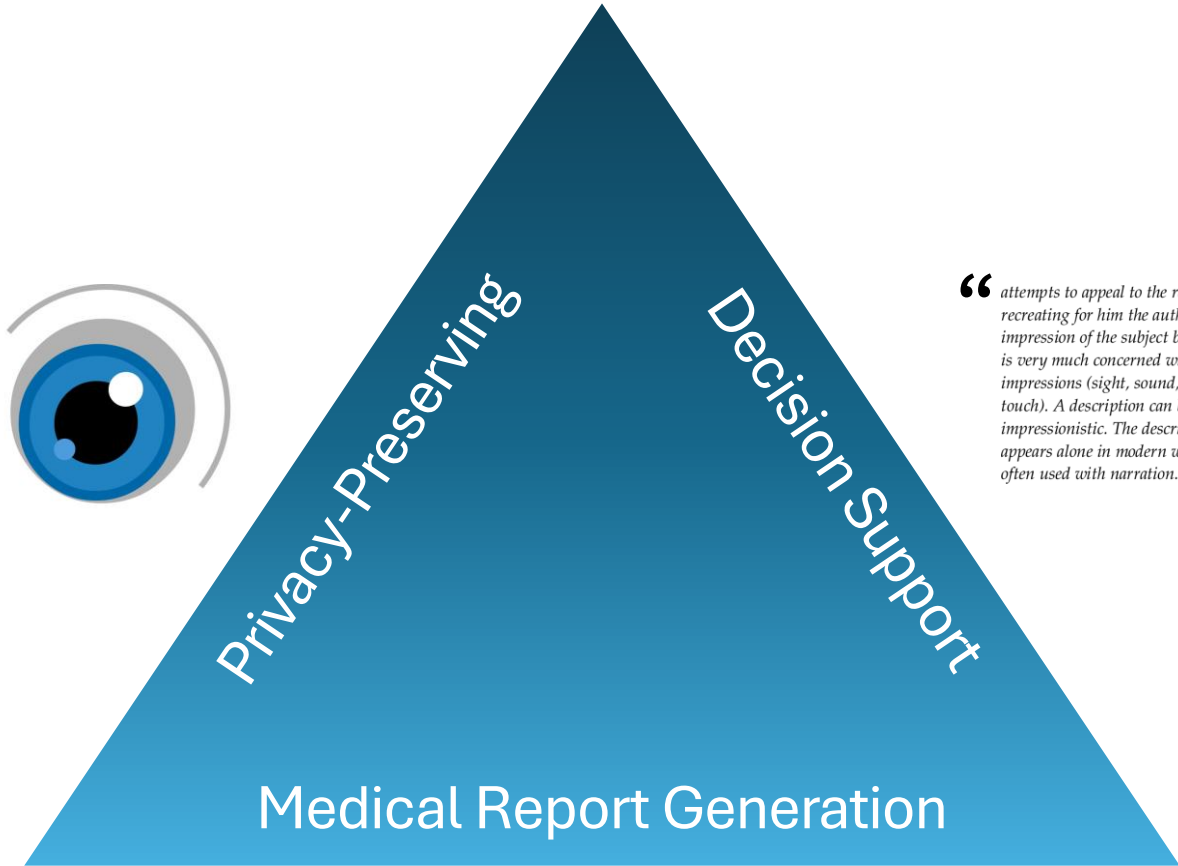
8: "Timeline of AI and Language Models," Life Architect, Alan D. Thompson, n.d., accessed March 9, 2023.

Generative AI in Medicine & Healthcare



“ attempts to appeal to the reader’s sense, recreating for him the author’s original impression of the subject being described. It is very much concerned with sensory impressions (sight, sound, smell, taste, touch). A description can be objective or impressionistic. The description rarely appears alone in modern writing. It is most often used with narration. ... ”

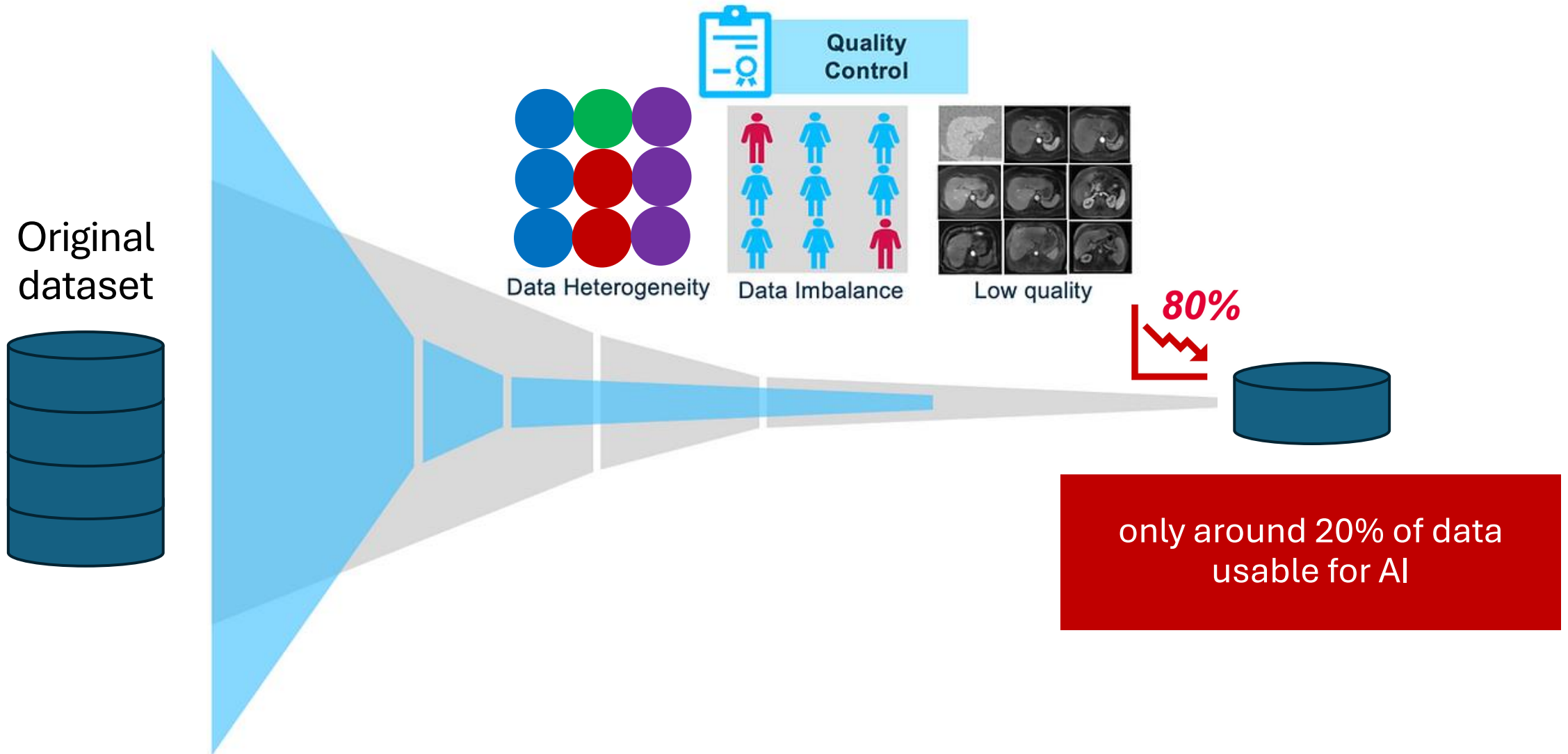
Generative AI in Medicine & Healthcare



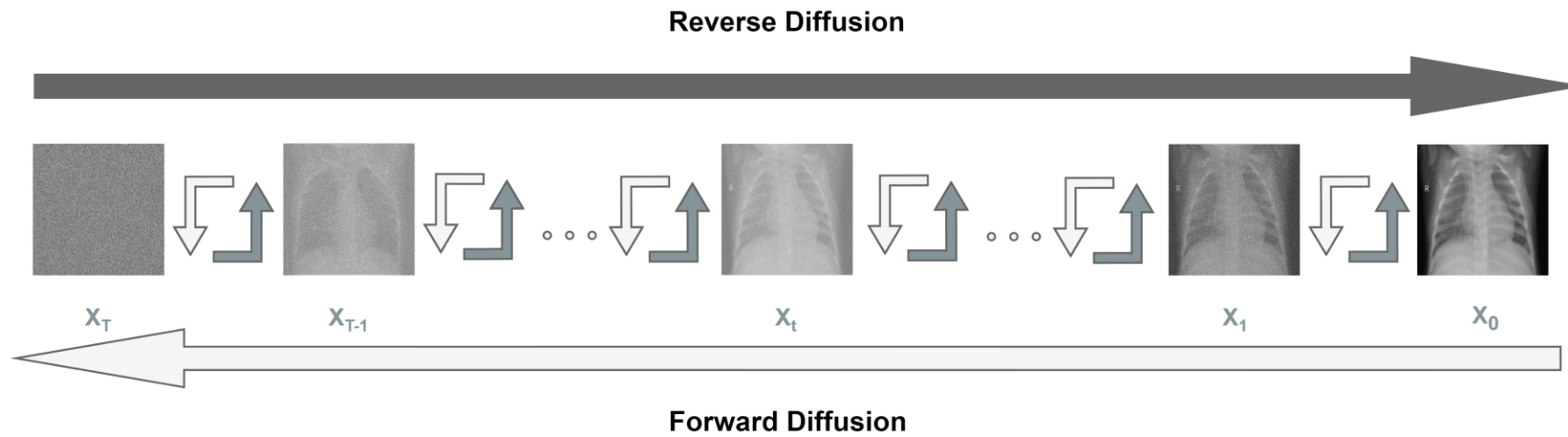
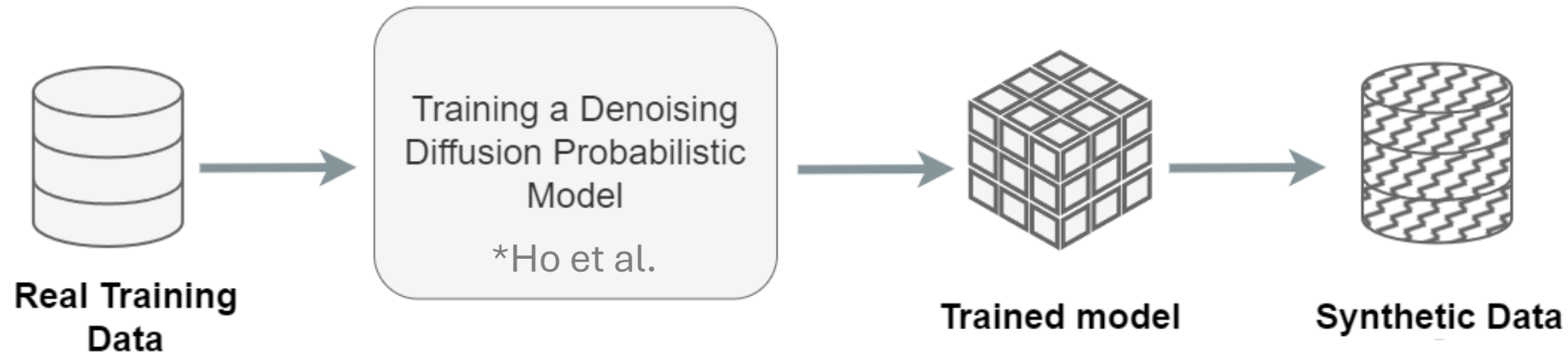
“ attempts to appeal to the reader’s sense, recreating for him the author’s original impression of the subject being described. It is very much concerned with sensory impressions (sight, sound, smell, taste, touch). A description can be objective or impressionistic. The description rarely appears alone in modern writing. It is most often used with narration. ... ”



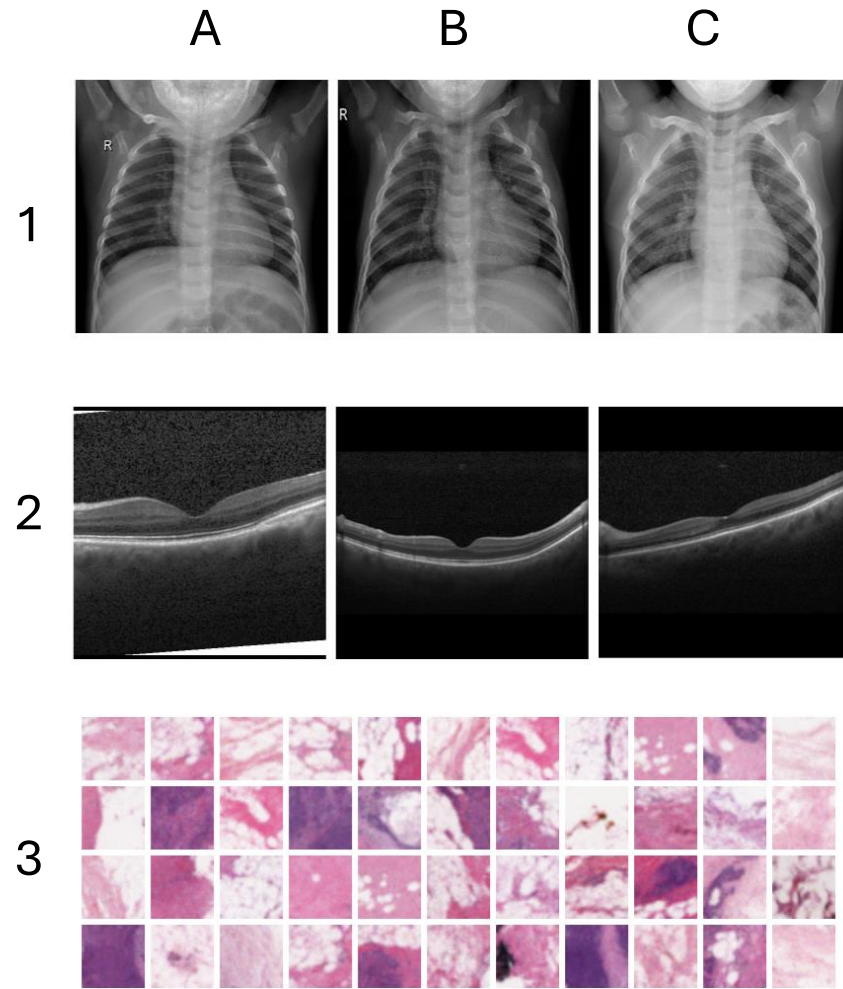
Privacy-Preserving & Data Access



Privacy-Preserving & Data Access



Privacy-Preserving & Data Access

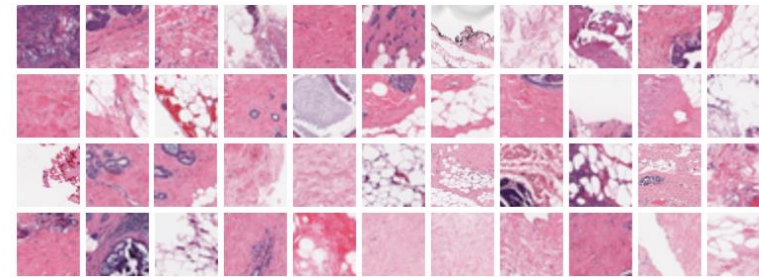
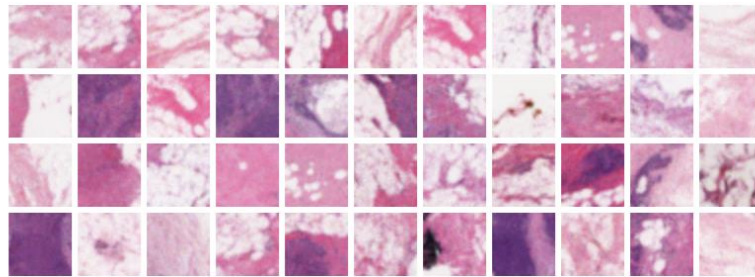
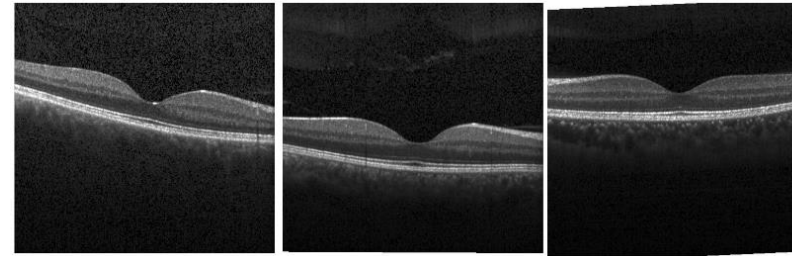
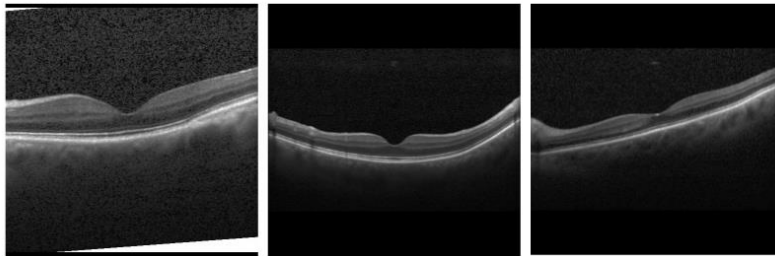
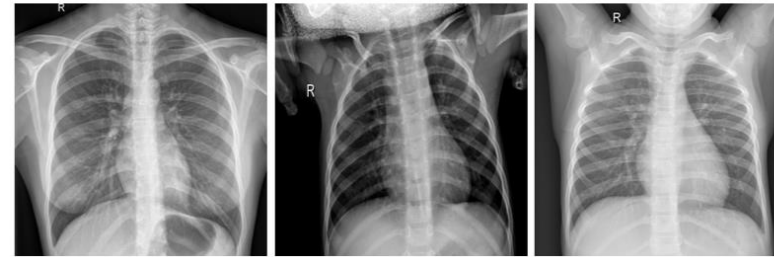
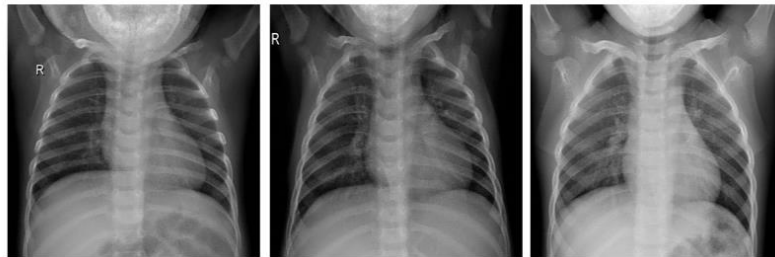


Privacy-Preserving & Data Access



Synthetic

Real



Decision Support & Risk Management

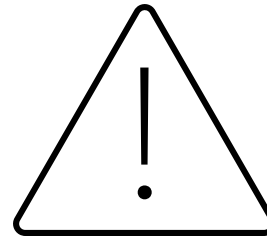


Intensive Care Units



equipped with
advanced monitoring
technology

staffed by
highly trained
specialists



Unplanned Re-admission

Additional pressure on healthcare systems

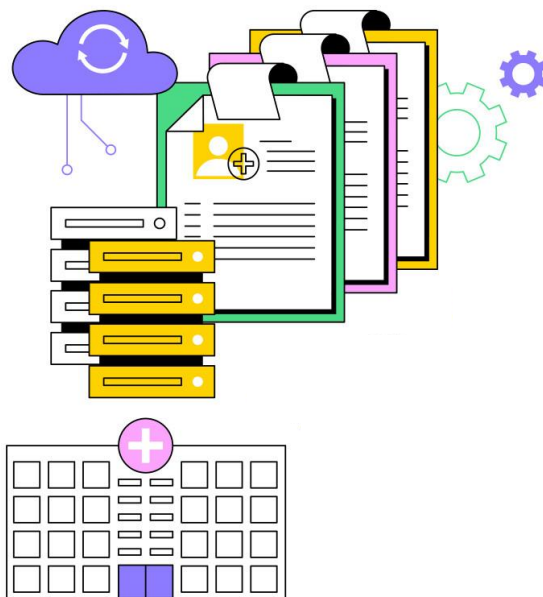
Threat to patient health

Increases mortality rates

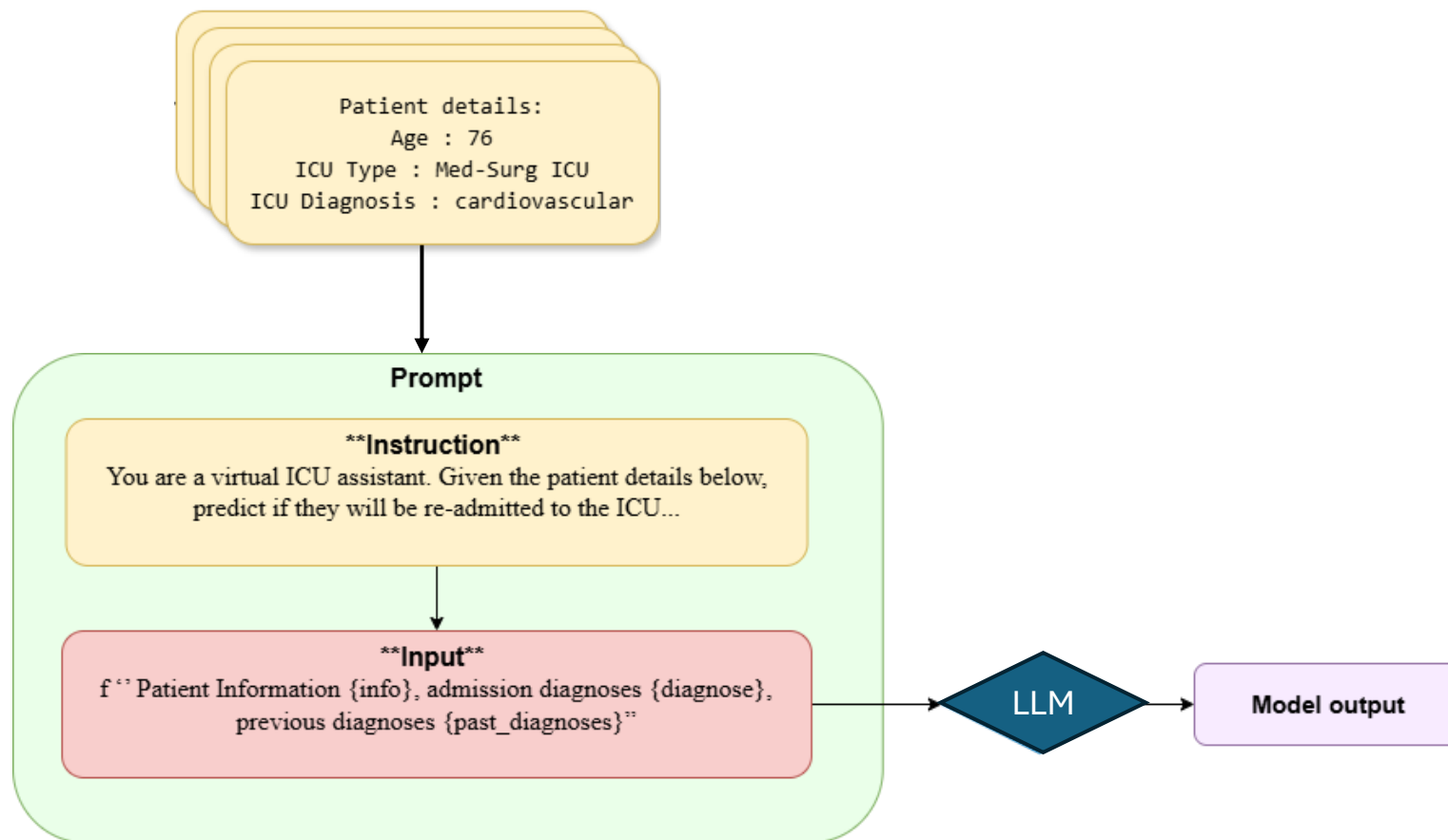
Extended hospital stays

Escalated costs and resource utilization

Decision Support & Risk Management



Electronic
Health
Records



Decision Support & Risk Management



Input: {Patient_information}, Based on his admission diagnoses, will this patient get readmitted to Intensive Care Unit?

True Answer

No, this patient is not likely to get re-admitted to the ICU

Predicted Answer

No, this patient is not likely to get re-admitted to the ICU.
Explanation:
The patient was admitted to the ICU for pneumonia, a potentially infectious medical condition. Although the patient had past diagnoses of pulmonary and neurologic conditions, these diagnoses are not related to the current admission. Additionally, the patient's respiratory system appears to be fully recovered.

Yes, this patient has a possibility to get re-admitted to the ICU.

Yes, this patient has a possibility to get re-admitted to the ICU.

He has many diagnoses that are typically associated with conditions that require monitoring, such as renal failure, pulmonary infections, hepatic disease...

No, this patient is not likely to get re-admitted to the ICU

No, this patient is not likely to get re-admitted to the ICU.
It is possible that this patient could get re-admitted if there was a blockage in a pulmonary artery.

Decision Support & Risk Management



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Hello! I can help you with making a decision. Give me patient information.

Type your message here...

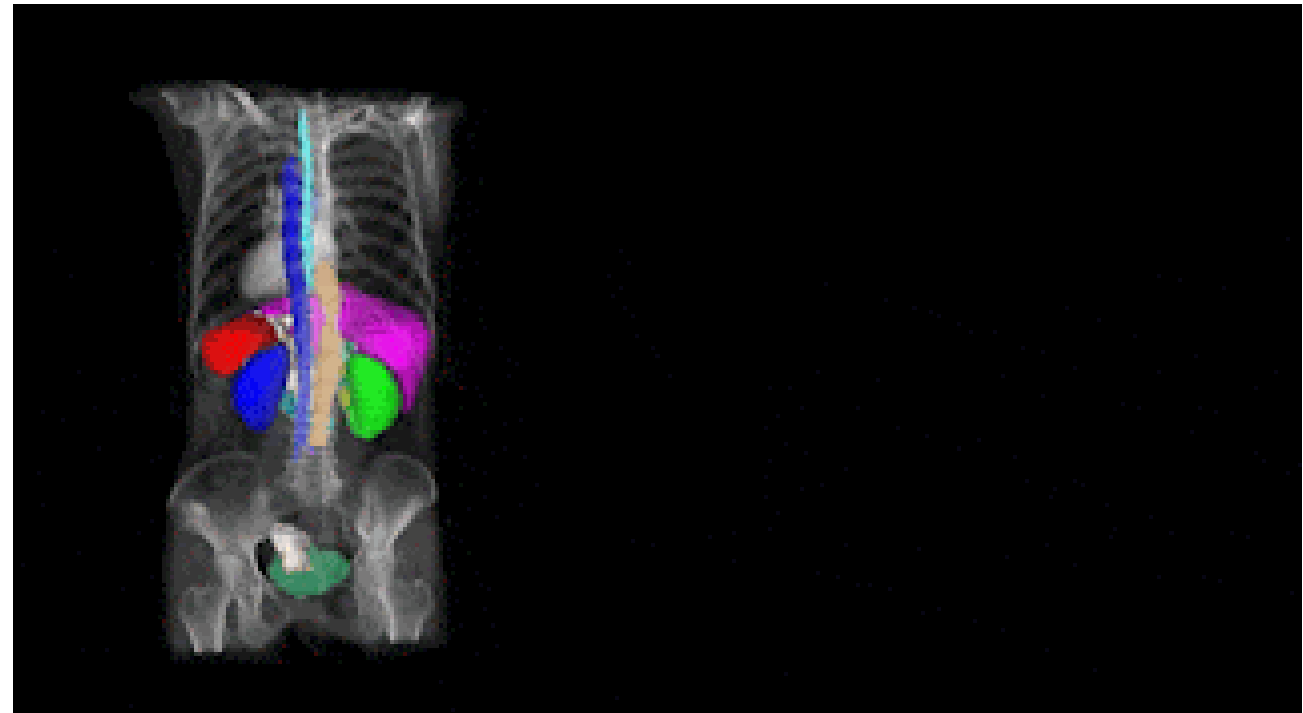
Send



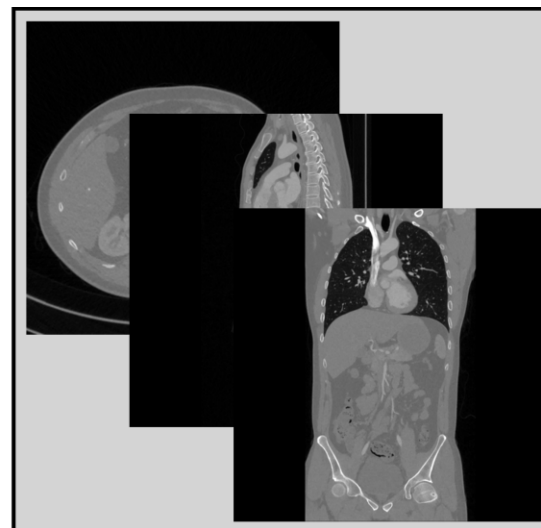
Medical Report Generation



Medical Report Generation



Medical Report Generation



VQA

Question: What can be inferred about the texture of the liver viewed on the CT scan?

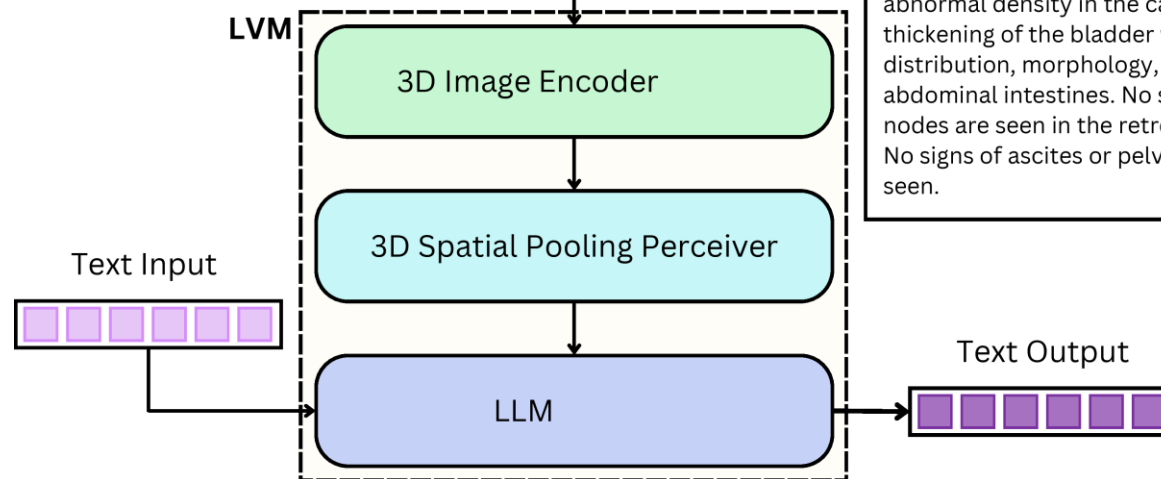
- Choice A: Irregular liver surface
- Choice B: Uniform liver parenchyma density
- Choice C: Non-uniform liver parenchyma density
- Choice D: Signs of fibrosis in liver tissue

Answer: B. Uniform liver parenchyma density

Captioning

Question: Describe the findings of the pelvis organs in the CT scan you see.

Answer: The bladder is partially filled, with no clear abnormal density in the cavity and no significant thickening of the bladder wall. No abnormal distribution, morphology, or density is seen in the abdominal intestines. No significantly enlarged lymph nodes are seen in the retroperitoneum or pelvic cavity. No signs of ascites or pelvic fluid accumulation are seen.



Medical Report Generation



AMOS-MM: Abdominal Multimodal Analysis Challenge

Ground Truth

Both sides of the chest are symmetrical. Scattered point-like translucence are seen in both lungs, and a few patchy high-density foci are seen in the low lobe of left lung. No other abnormal are seen in the lungs. The trachea and bronchi are unobstructed. The mediastinum and trachea are centered, and multiple slightly enlarged lymph nodes with higher density are seen in the mediastinum and bilateral pulmonary hila. The pleura is normal. The morphology and size of the heart and great vessels are normal, with a small amount of fluid in the pericardium. A high-density shadow is seen in the upper part of the esophagus. No obvious abnormal enhancement is seen in the chest.

Prediction

Bilateral chest contour is normal. Mediastinum and trachea are normal. No air cavities are seen adjacent to the trachea. Increased lung texture and multiple small round translucent shadows are seen in the lungs. Bronchial walls thicker than 2mm. Scattered multiple nodular high-density shadows are seen in the lungs, with unclear edges. Trachea and bronchi are unobstructed. No enlarged lymph nodes are seen in the hilum and mediastinum. No abnormalities are seen in the morphology and size of the heart and great vessels are normal. A few liquid shadows are seen in the bilateral pleural cavity.

AMOS-MM: Abdominal Multimodal Analysis Challenge

MICCAI2024, MOROCCO

Presents

Special Award

in

Medical Visual Question Answering

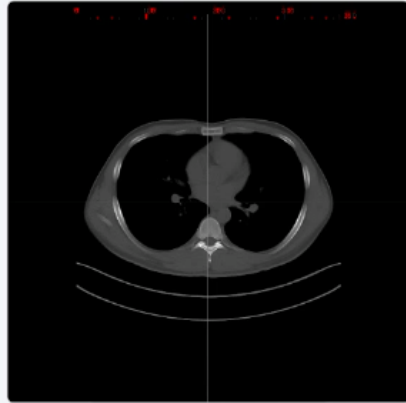
to

Ahmed Serag, Ahmed Ibrahim, Abdullah Hosseiny

AI Innovation Lab,
Weill Cornell Medicine - Qatar, Doha, Qatar



Medical Report Generation



Enter your prompt

Generate

Awaiting input...

**AMOS-MM: Abdominal Multimodal Analysis Challenge
MICCAI2024, MOROCCO**

Presents

Special Award

in

Medical Visual Question Answering

to

Ahmed Serag, Ahmed Ibrahim, Abdullah Hosseiny

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Generative AI in Healthcare



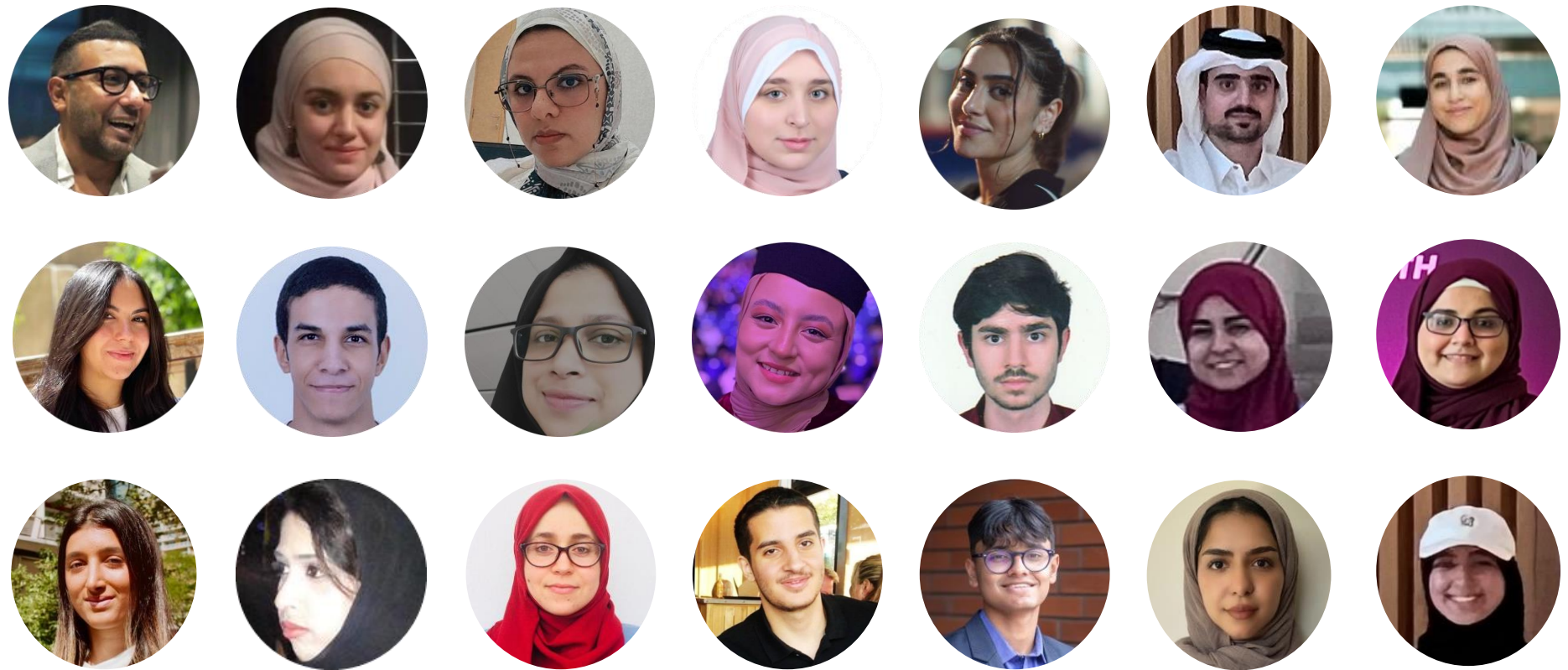
- **Generative AI systems are great but ...**
 - Do not really **reason**, do not really **plan**
- **Humans and many animals**
 - Can learn new tasks very quickly
 - Understand how the world works
 - Can reason and plan
- **Humans and animals have common sense, current machines don't**

Generative AI in Healthcare





AI Innovation Lab Team





Ahmed Serag, PhD

 Top Artificial Intelligence (AI) Voice

Talks about #ai, #innovation, #computervision, #machinelearning, and #artificialintelligence

LinkedIn
TOP
VOICES



serag.net