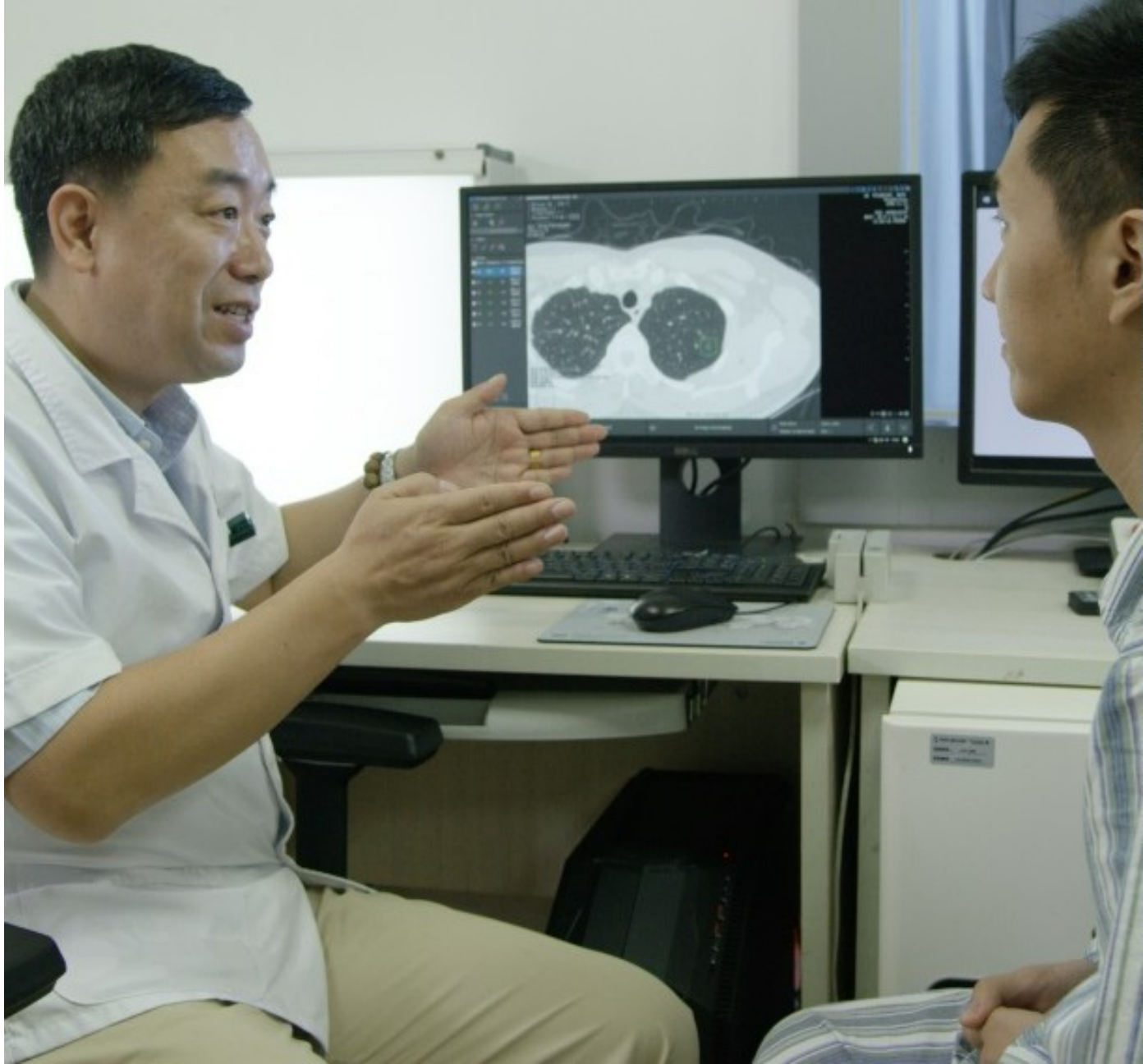
# DEEP LEARNING HEALTHCARE CUSTOMER STORIES

Rochelle Silveira, Voice of the Customer | February 2019

# AI TO SPOT LUNG CANCER EARLY

Doctors typically use their eyes to examine CT scan images, looking for small nodules in an attempt to deduce whether they're benign or malignant. When the nodules are small, they're harder to spot. And the result is that lung cancer is often detected too late, leading to a dismal 17% survival rate.

Trained on DGX Station, 12 Sigma Technologies could reduce the time-consuming workload for both diagnostic and reporting, as well as change the existing lung disease diagnostic practice from being dependent on the subjective experience of radiologists to being based on objective clinical data.



# 16 BIT.AI
# RSNA BONE AGE CHALLENGE WINNER

In the healthcare industry, there exists mountains of underutilized data. 16 Bit is using AI to unlock the value hidden in this data to augment diagnostics and improve the quality and accessibility of healthcare.

16 Bit is using GPU-accelerated deep learning and big data to assist radiologists in detecting breast cancer, analyze CT scans of the brain to exclude acute diseases, and accurately measure pediatric bone age. Their Bone Age analyzer has an accuracy rate of +/- 4 months and returns results in milliseconds — earning 16 Bit 1st place in the 2017 RSNA Machine Learning Challenge.

16BIT

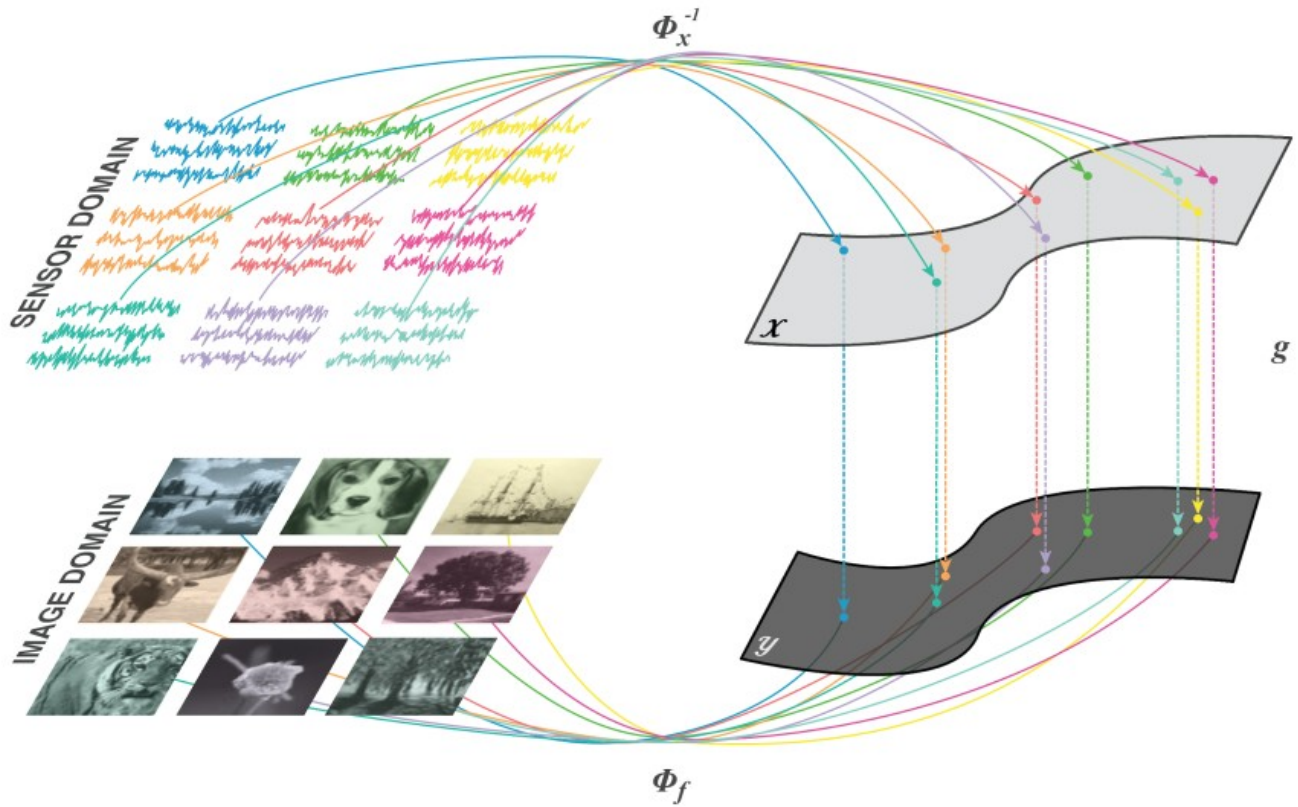
*Try the 16 Bit algorithm: 16bit.ai/bone-age*

# AI IMPROVES DIAGNOSTIC SPEED AND ACCURACY

MRIs can take 20 minutes to 2 hours. Subsampled data speeds scanning time but contributes to inaccurate image reconstruction and diagnostics.

Researchers from the MGH/Martinos Center for Biomedical Imaging and Harvard University are working to speed MRI image reconstruction. Powered by the NVIDIA DGX-1 AI supercomputer, they've created AUTOMAP (Automated Transform by Manifold Approximation).

AUTOMAP uses deep learning to reconstruct images directly from sensor data using a cascade of densely connected and sparse convolutional neural network layers—it filters out noise and defects to reconstruct images 100x faster and with 5x higher accuracy to deliver more accurate diagnostic outcomes.




Athinoula A. Martinos Center For Biomedical Imaging

# AUTOMATING THE DIAGNOSIS OF INFANT BLINDNESS

Retinopathy of prematurity (ROP) affects preterm babies born before 31 weeks, weighing <2¾ pounds. It's treatable if caught early but diagnosing the severity of ROP is subjective—doctors compare the infant's retina with photos selected by experts in the 1980s.

Using a dataset of 6,000 images matched with expert ROP diagnoses and a DGX-1 with cuDNN-accelerated DL frameworks, researchers at Athinoula A. Martinos Center for Biomedical Imaging trained a deep neural network to differentiate ROP severity.

Still work in progress, this method could be deployed in countries where access to specialists is lacking, and help make a difference in reversing preventable blindness worldwide.

Athinoula A. Martinos Center For Biomedical Imaging

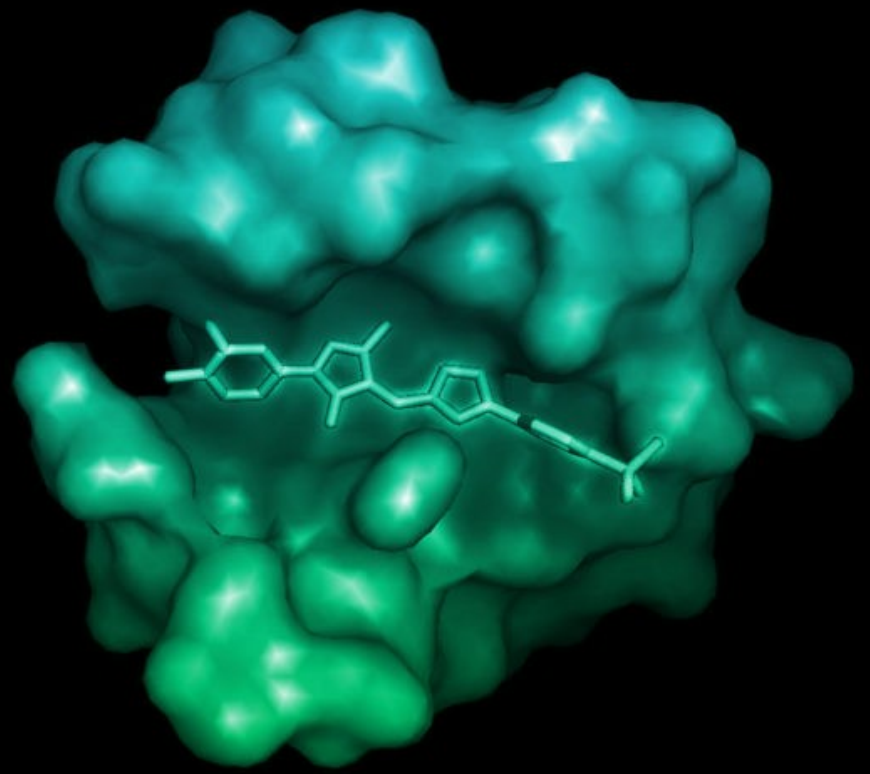
# SPEEDING THE PATH TO MARKET

New drug development can cost billions and take up to 14 years—and still only ~8% of drugs make it to market. Atomwise helps its customers make smarter decisions about which potential medicines to develop.

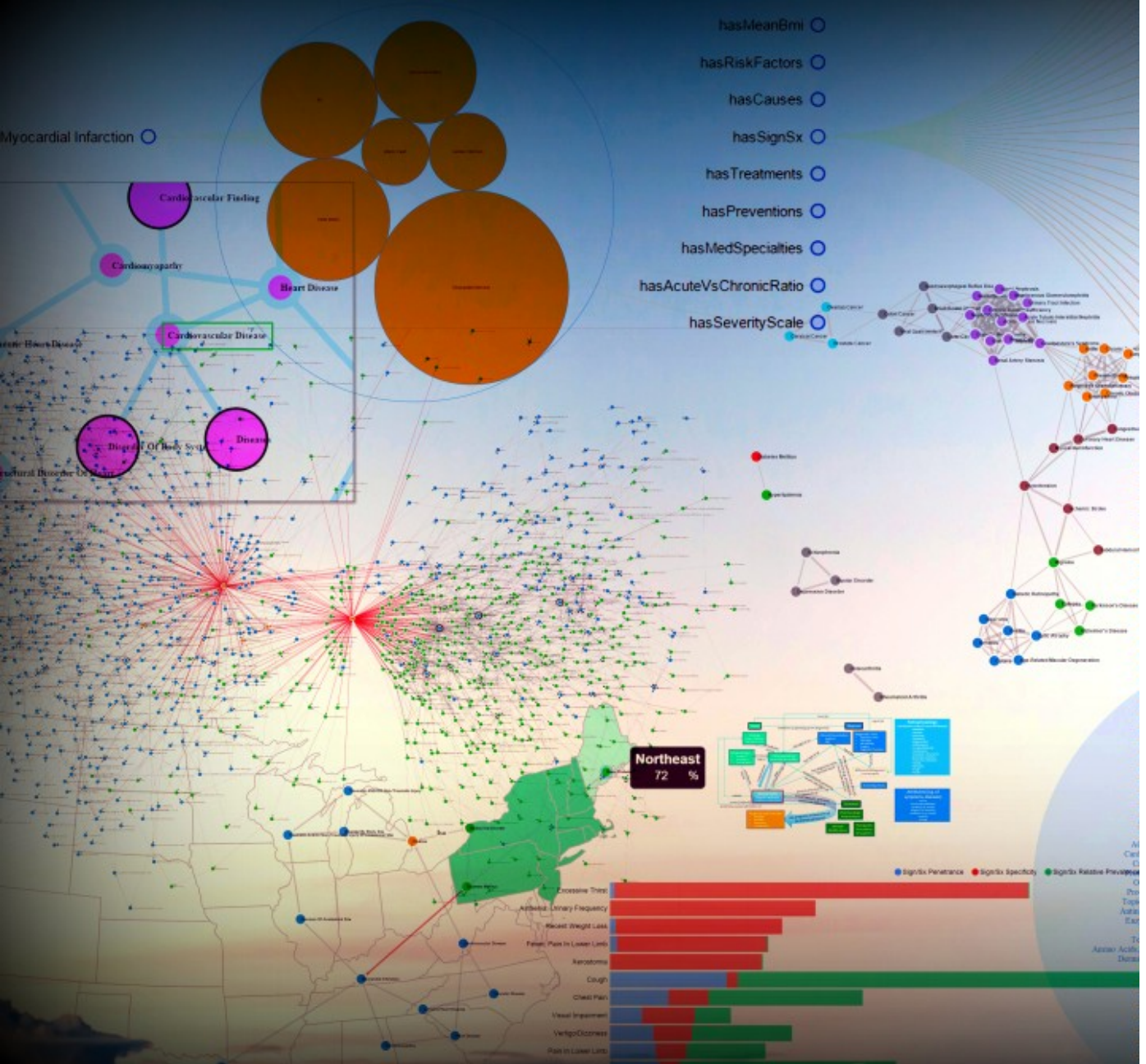
With NVIDIA GPUs to power training and inference, Atomwise's AtomNet deep learning software understands the interactions of millions of molecules and analyzes simulations to determine whether a potential treatment works against a target.

AtomNet explored 8.2 million molecules and identified several candidates that could prove to be cures for Multiple Sclerosis. Effective in animal trials, those candidates are now undergoing further exploration.

Atomwise
Better medicines faster.



*The Janus kinas 3 protein, which has been implicated in cancer and immune function. Image courtesy of Atomwise.*




# AI POWERED INSIGHTS FOR EFFECTIVE MEDICAL DECISION MAKING

Electronic health records (EHR) offer huge volumes of data that doctors can combine with real-time analytics to improve their patient outcomes. Using NVIDA GPUs with CUDA, CloudMedx is creating a clinical AI platform that leverages both structured and unstructured data fields from EHRs, reads doctors' patient-specific clinical notes and using evidence based guidelines, helps identify risks and correlates  treatments. It's a combination of machine learning and natural language processing that gives doctors the power to make time-critical decisions that has the potential to save lives.

CLOUD MEDX®

# HEART SMART: AI TO DETECT HEART DISEASE

Heart disease, the world's biggest killer, is responsible for ~9 million deaths annually. Until recently, the best test to diagnose heart disease was an angiogram—an invasive and costly procedure.

HeartFlow applies GPU-accelerated deep learning to the analysis of coronary blood vessels to deliver non-invasive diagnostics. Trained on CT scans and computational fluid dynamics, HeartFlow's AI creates a personalized 3D model of a patient's coronary arteries and analyzes the impact of blockages.

With HeartFlow, clinicians can provide personalized treatment for each patient and improve quality of life. It also means 61% of patients can avoid an angiogram, reducing healthcare system costs by 26%.

HeartFlow®

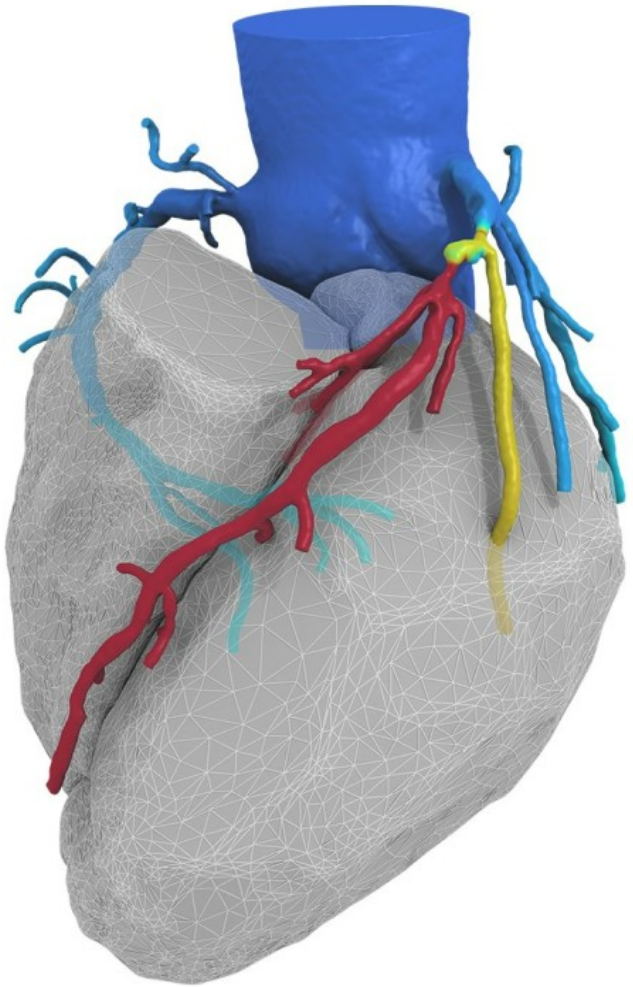
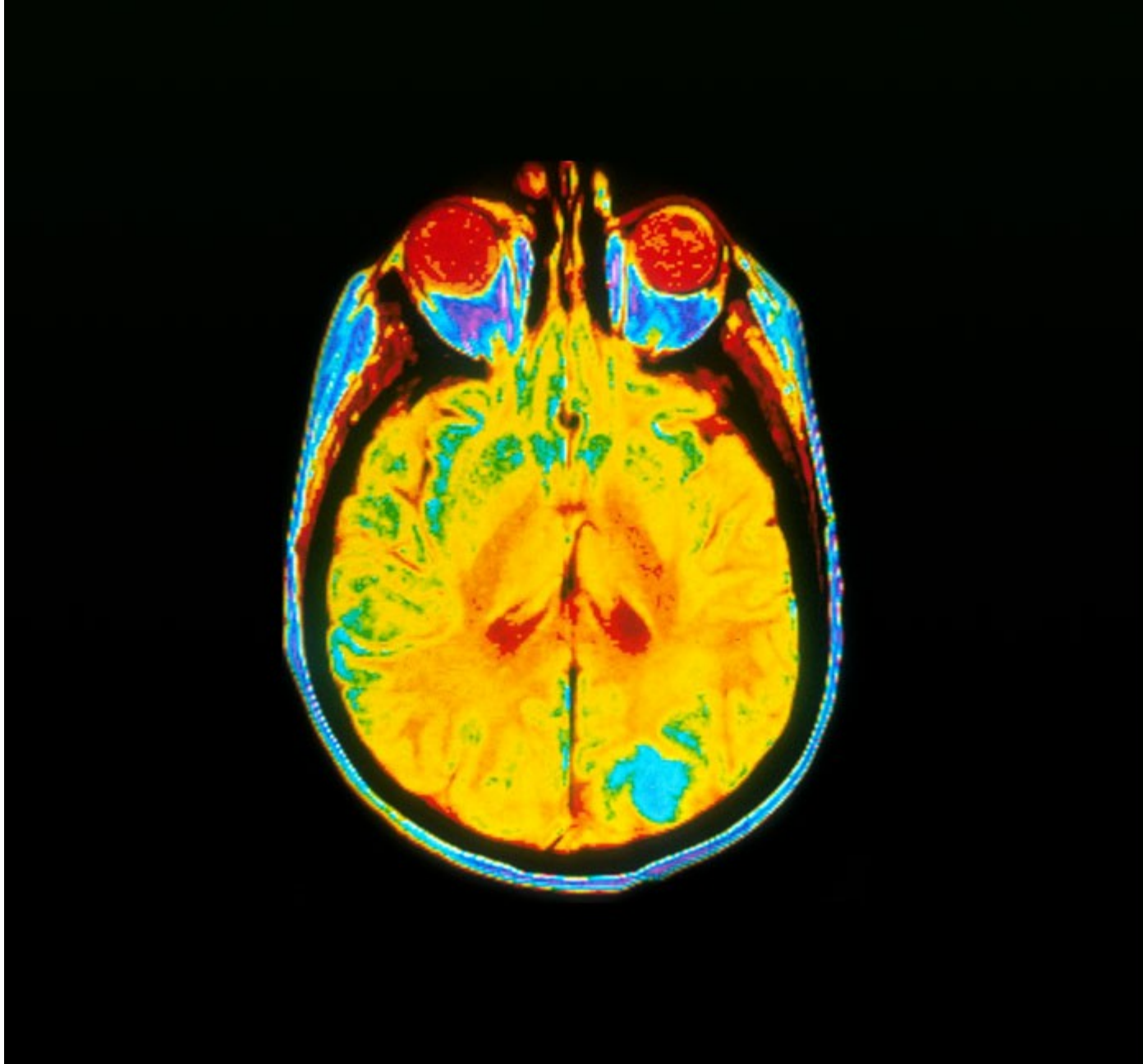


*Image is not representative of actual product. Courtesy of HeartFlow, Inc.*

# NOT ENOUGH DATA? NO PROBLEM

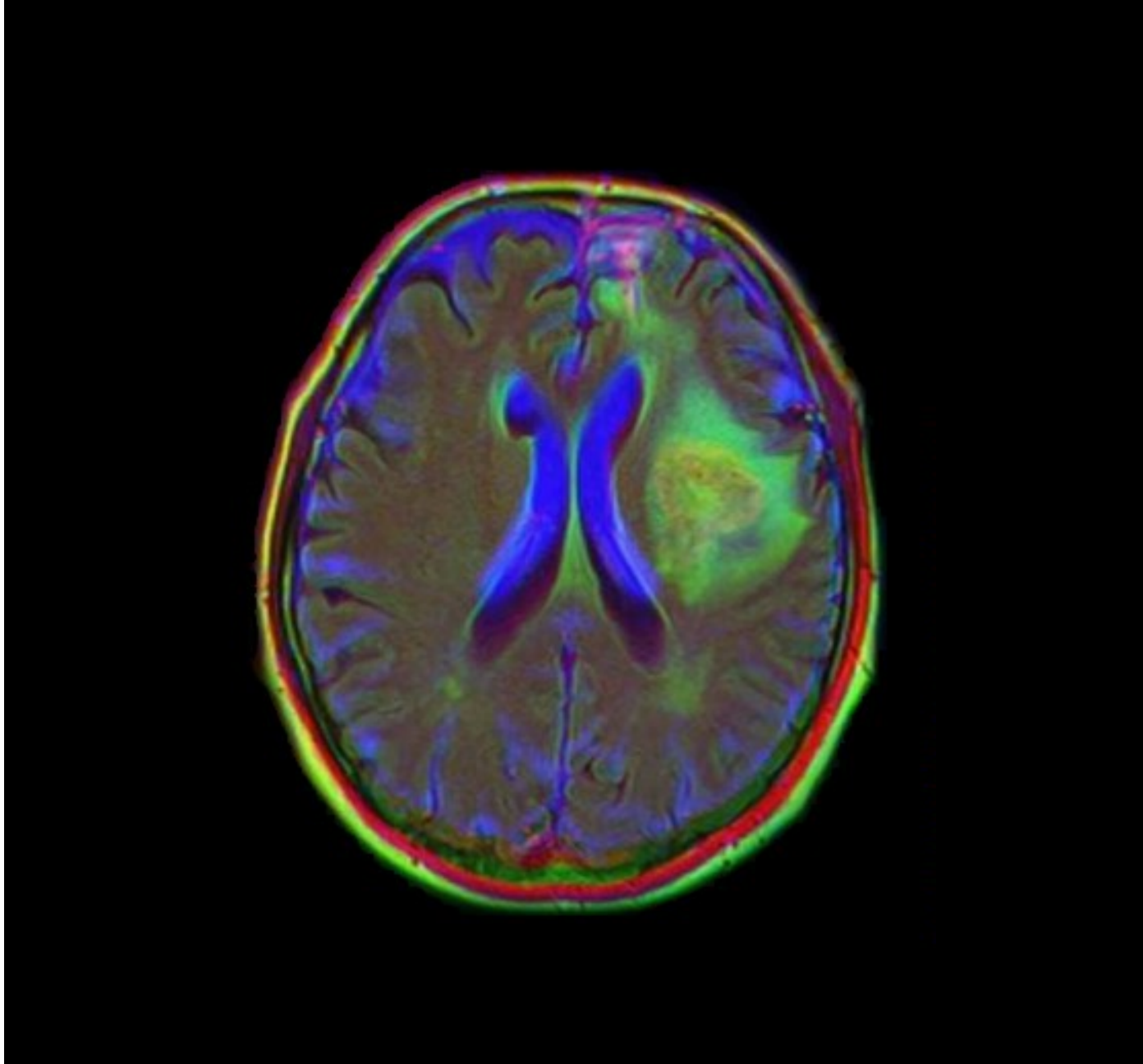
Deep Learning holds enormous promise to advance medical discoveries, but adequate training data can be a challenge. Scientists at the MGH & BWH Center for Clinical Data Science are using the NVIDIA DGX Station to power GANs that create and validate synthetic brain MRI images. Combining the manufactured images with real MRI images enables the team to train its neural network with 75% less data.

NVIDIA. MASSACHUSETTS GENERAL HOSPITAL



# AI SEES THE UNSEEN — COULD REDUCE THE NEED FOR BRAIN BIOPSIES

Brain tumors can be spotted by today's MRIs, but determining the right way to treat them requires information about the tumor's genomic makeup — data that can only come from highly invasive brain biopsies. Researchers at the Mayo Clinic may have found another way. Using AI, Mayo discovered that the same genomic data can be found in the MRIs themselves, hidden from traditional analysis methods. Mayo used GPU-accelerated deep learning with CUDA to train its systems where to look and how to extract the information. The new system has greater than 90% accuracy and has the potential to greatly reduce the need for brain biopsies.



# GENOMICS SIMULATION AT EXASCALE SPEED

Opioid addiction was linked to ~50,000 U.S. deaths in 2017. Understanding more about how genes contribute to traits such as chronic pain and addition could help scientists address the opioid epidemic.
A team at ORNL is comparing genetic variations to uncover hidden networks of genes that contribute to these complex traits. Using the Summit supercomputer, the team processed ~300 quadrillion element comparisons/second at a peak throughput of 2.36 exaops—the fastest science application ever reported.

NVIDIA

OAK RIDGE National Laboratory

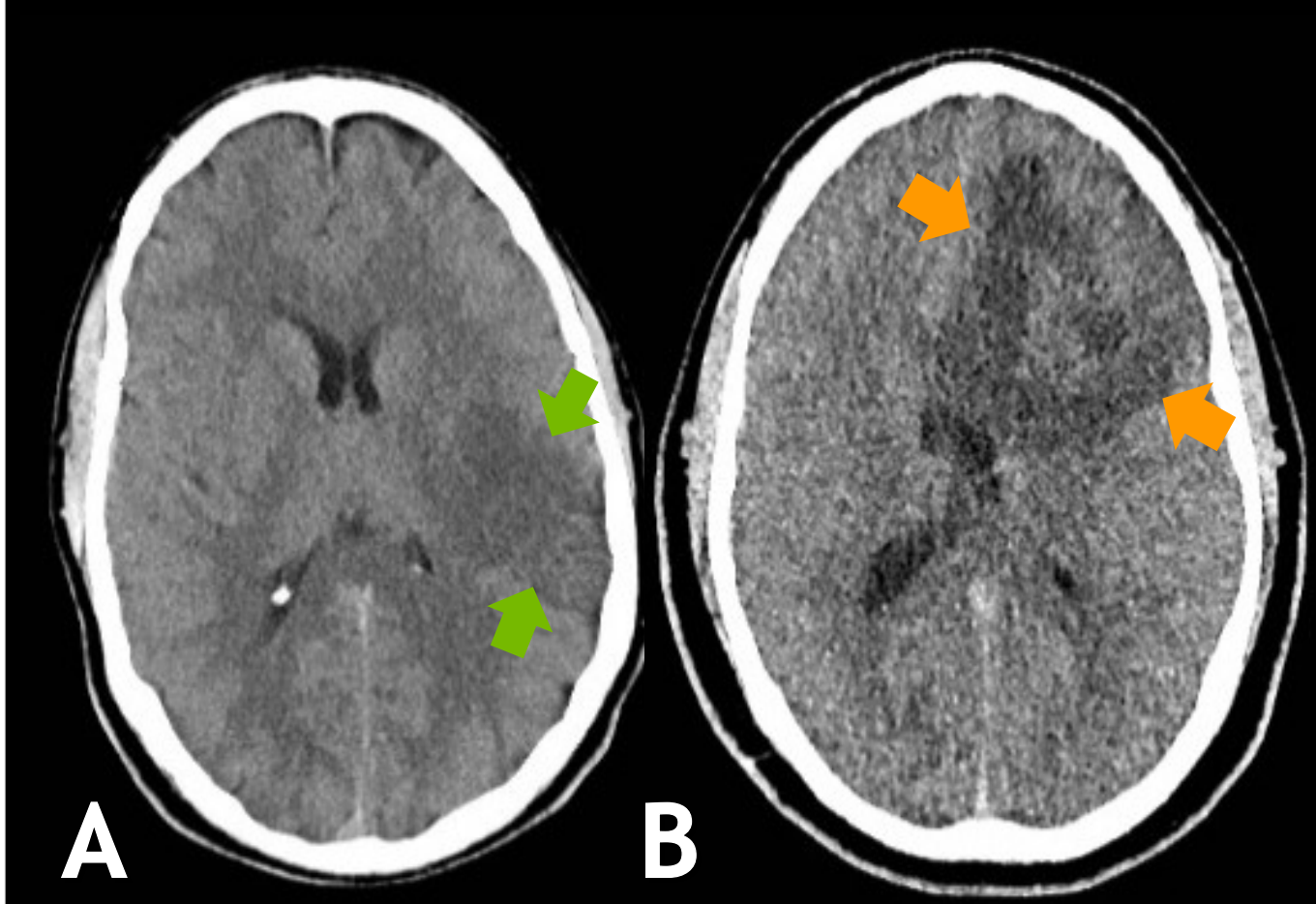
*Image credit: CC-BY-2.0 via Wikimedia Commons*

# AI SPEEDS TIME TO CRITICAL CARE

The phrase “Time is Brain” means every minute counts after a stroke. A typical patient loses almost 2 million neurons per minute in which a stroke is untreated. Immediate treatment minimizes brain damage.

To help Radiologists diagnose the most urgent cases and enhance critical care, the OSU Department of Radiology used GPU-accelerated deep learning to develop an Automated Critical Test-Findings Identification and Online Notification System (ACTIONS). With GPUs, ACTIONS was trained in minutes vs. days. It identifies in seconds the most urgent cases of stroke, hydrocephalus, hemorrhage, and large tumors with an accuracy rate of 81% (stroke) and 91% (hydrocephalus, hemorrhage, large tumors), speeding time to critical care.

THE OHIO STATE UNIVERSITY




Examples of head CT examinations containing critical findings.

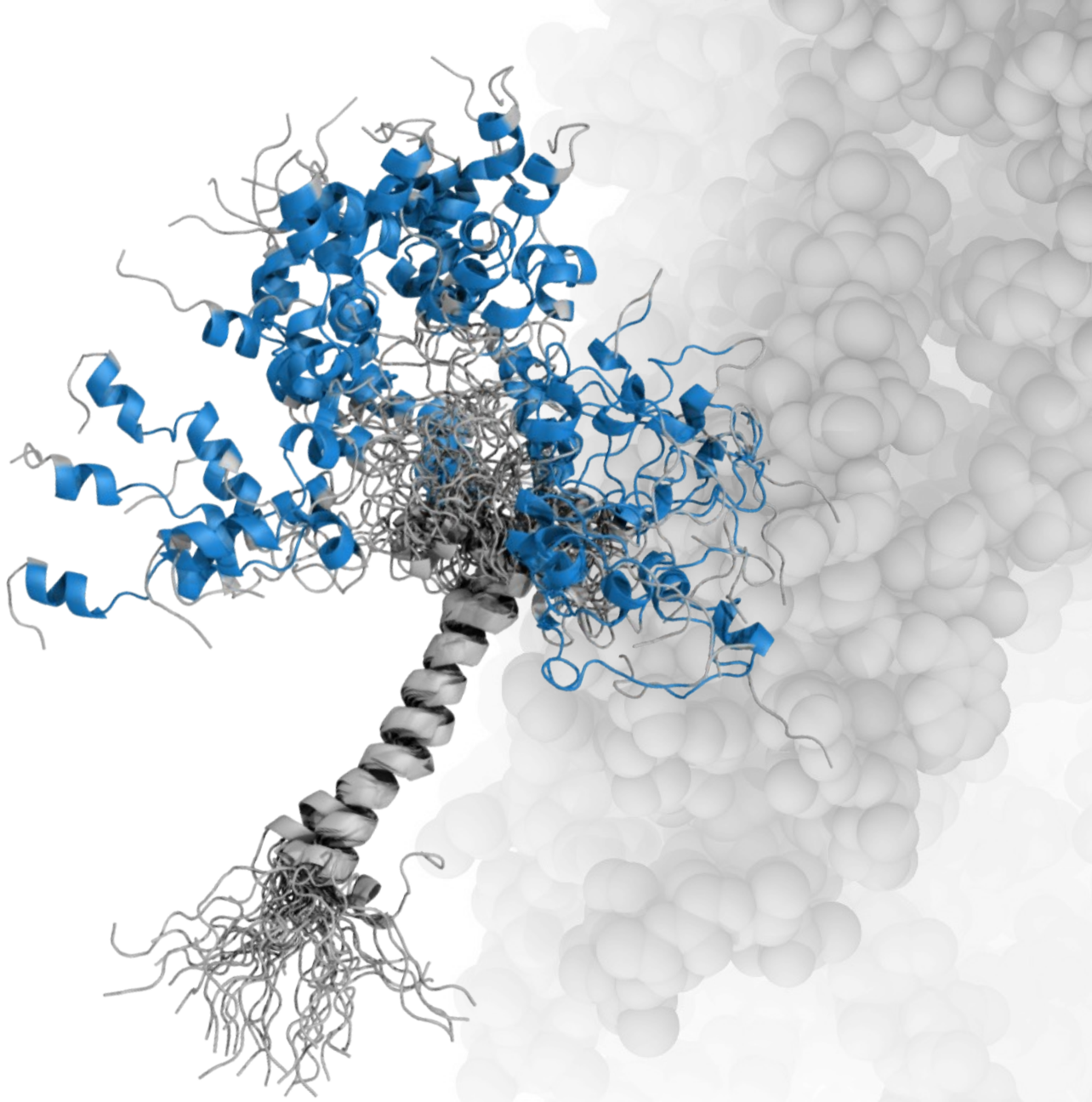
A) A patient with a recent stroke involving the left cerebral hemisphere (green arrows).
B) A patient with a large left frontal tumor compressing adjacent structures (orange arrows).

http://pubs.rsna.org/doi/pdf/10.1148/radiol.2017162664

# AI ACCELERATES PROTEIN RESEARCH

Understanding protein structural variability and disorder is paramount for advancements in protein applications and drug design. Researchers at Peptone recently unleashed the power of big data and AI to understand protein structural variability at the building block level through statistical analyses of protein NMR data. Peptone's dSPP, is the world's first interactive repository of structure features of proteins for the next generation machine learning problems with seamless integration for Keras and Tensorflow frameworks.

Researchers harnessed the computational power of the DGX-1 with CUDA to unravel the sequence-dynamics relationships in 7200+ proteins of medical significance through Bayesian Deep Learning and Hybrid Statistical Thermodynamics.



_peptone

# AI-POWERED HEALTHCARE AT SCALE

The human retina contains diagnostic markers for many diseases, but testing requires the skills of specialists who are in short supply.  Built on GPU deep learning with CUDA, the Mobile Autonomous Retinal Evaluation (MARVIN), from SocialEyes, can help transform healthcare systems worldwide. With MARVIN, tens of millions of community healthcare workers and physicians can diagnose a wide range of conditions immediately with low-cost mobile devices for timely and effective intervention.

SocialEyes

# FIGHTING TB WITH GPU-POWERED AI

According to the World Health Organization, TB is one of the top 10 causes of death worldwide. 1.7M people died from the disease in 2016 with 95% of those deaths occurring in developing countries where access to radiological expertise is limited.

Armed with >1,000 TB images, NVIDIA GPUs, Caffe, CUDA, and cuDNN, scientists at Philadelphia's Thomas Jefferson University trained a deep learning model to read chest x-rays.

With GPUs delivering a 40x increase in speed up over CPUs, the research could expand to include other lung diseases and possibly lead to the development of a centralized global chest x-ray library for healthcare providers in developing countries to use to accurately diagnose anomalies.

Jefferson
Philadelphia University + Thomas Jefferson University

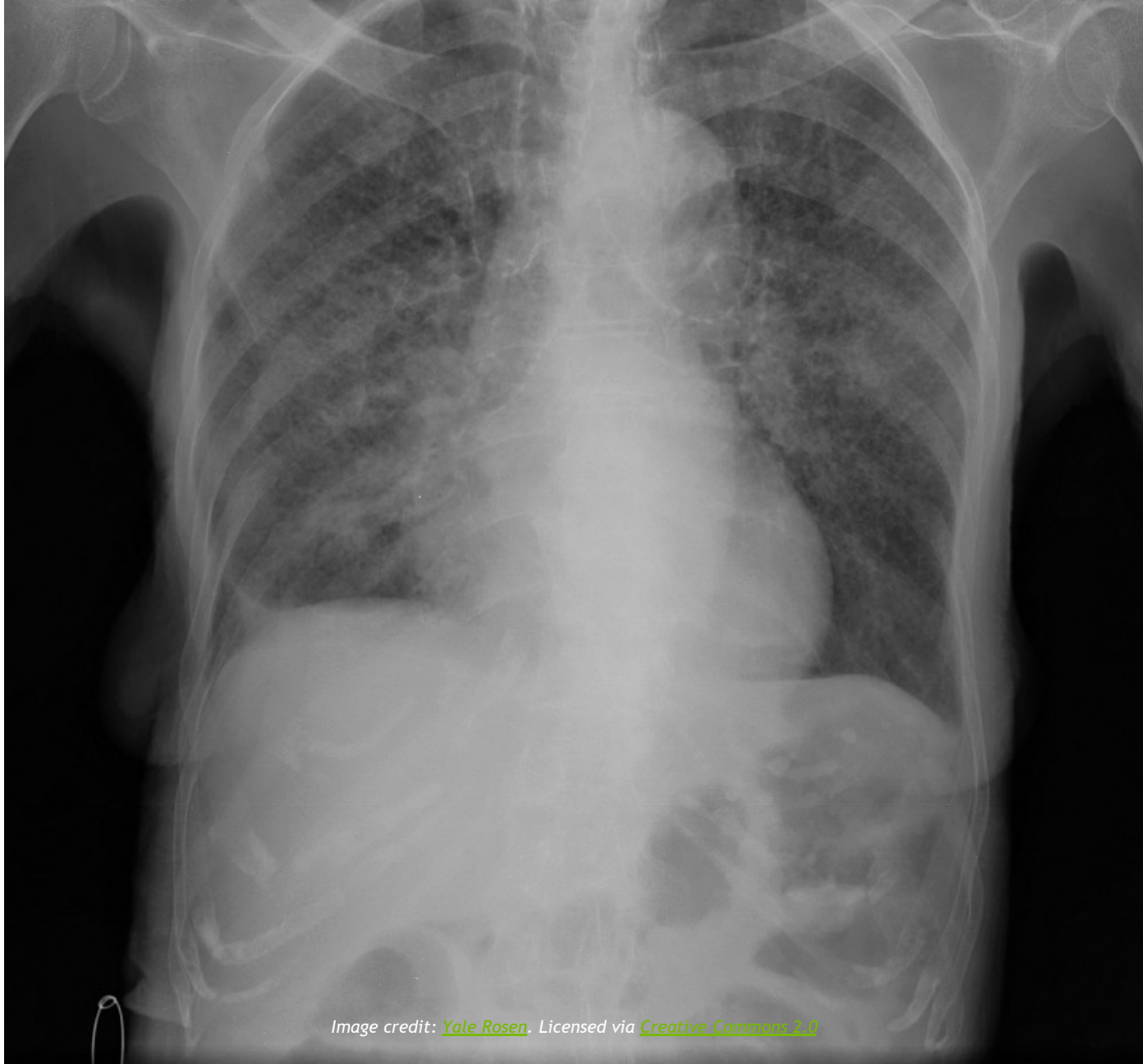
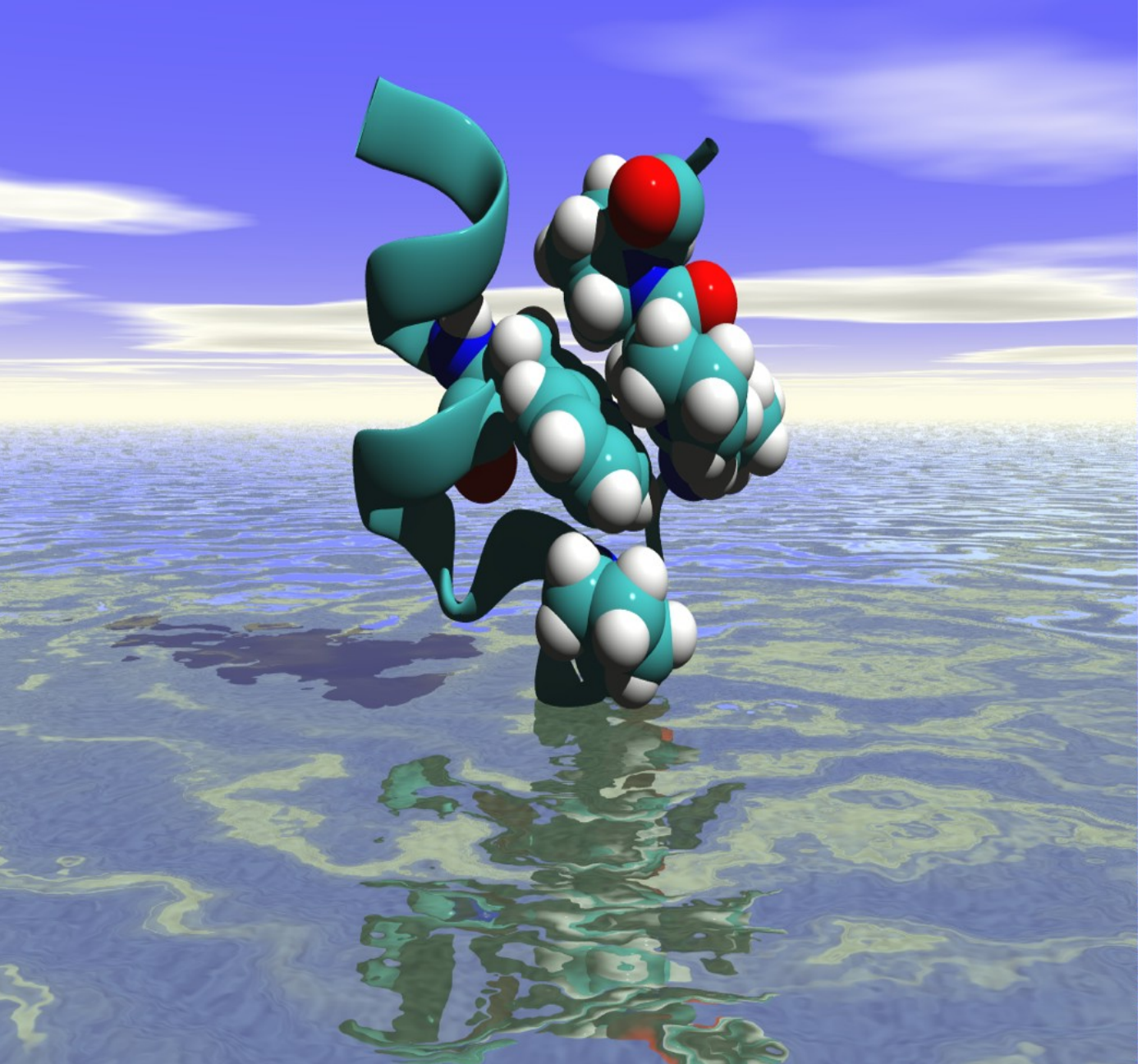


*Image credit: Yale Rosen. Licensed via Creative Commons 2.0*

# DGX 3 NODE CLUSTER TO ADVANCE GENOMIC RESEARCH

In 2003 the Human Genome Project successfully decoded the human genome and unlocked the door to new genetic discoveries. With 3 billion nucleotide pairs in the human DNA, genome analysis is computationally intensive. The Tohoku Medical Megabank Organization (ToMMo) is using the power of its DGX-1 AI supercomputer cluster to accelerate understanding the complicated correlations between human genotype and phenotype.

And, to further deep learning based genomics research, ToMMo will open its DGX-1 supercomputer cluster to external contracted researchers.



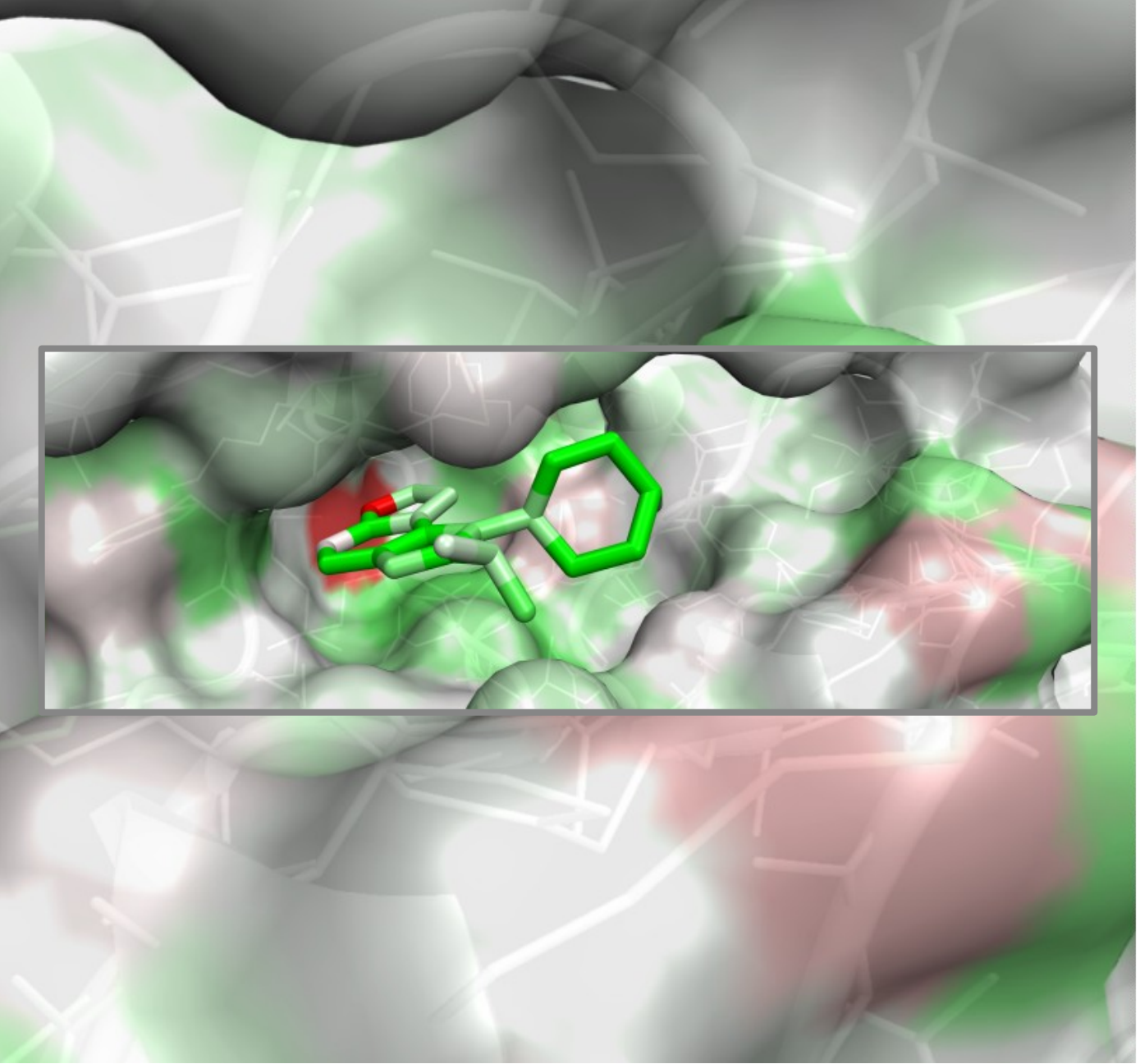
# AN AI QUANTUM BREAKTHROUGH

Molecular energetics studies can lead to breakthroughs in drug discovery and materials science, but traditional computing approaches are time-consuming and expensive. Researchers at the University of Florida and the University of North Carolina leveraged GPU deep learning and CUDA to develop ANAKIN-ME, which can reproduce molecular energy surfaces with super speed, extremely high accuracy, and at 1-10/millionth the cost of current computational methods.

UF UNIVERSITY of FLORIDA

ANI-1: An extensible neural network potential with DFT accuracy at force field computational cost
(link to: https://arxiv.org/abs/1610.08935)

Smith, J. S., Isayev, O. & Roitberg, A. E.



# AI ACCELERATES DRUG DISCOVERY

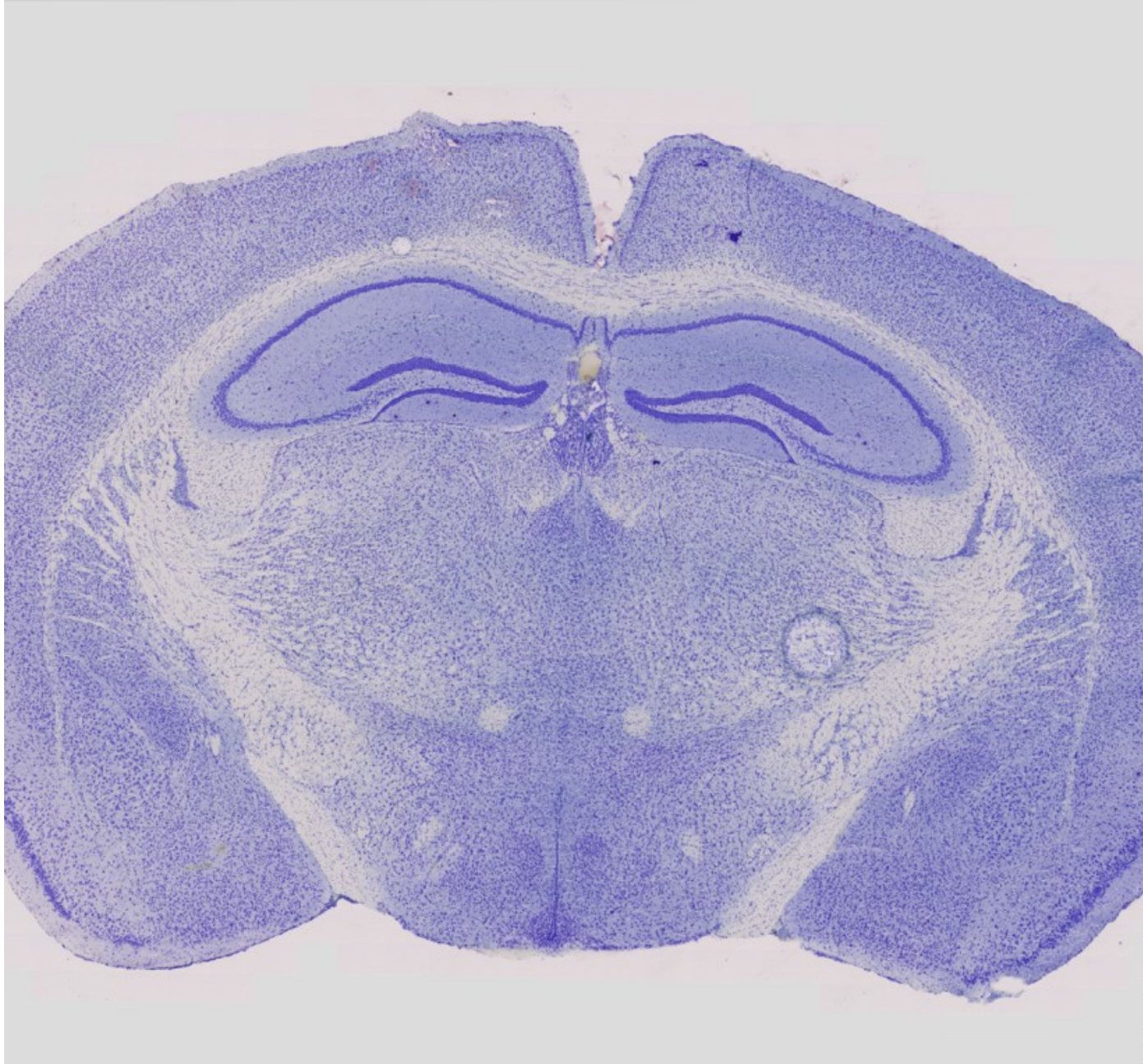
The discovery phase of drug development involves exploring different possible combinations of protein molecules (targets) and drug chemical compounds to ensure a drug will do what it's being designed to do. Classic Molecular Dynamics simulations are time-consuming and expensive. Machine Learning models help predict probability of the target molecules interacting with the drug chemical compounds, but still require significantly greater performance to deliver improved accuracy.

Researchers at the University of Pittsburgh are improving model performance and prediction accuracy. Their convolutional neural network, accelerated with NVIDIA GPU's and CUDA, improved prediction accuracy from ~52% to 70% compared to other machine learning-based models.

# ACCELERATING TREATMENT FOR ALZHEIMER'S DISEASE

Neurodegenerative diseases like Alzheimer's affect nearly 50 million people worldwide but still lack a cure. Researchers at the Université de Reims created GPU-powered software that analyzes the effects of potential drug treatments. The interactive interface processes hundreds of petabytes of brain scan data at ~50 frames/second enabling scientists to more efficiently annotate key cells for a much faster analysis workflow.

NVIDIA. UNIVERSITE DE REIMS CHAMPAGNE-ARDENNE

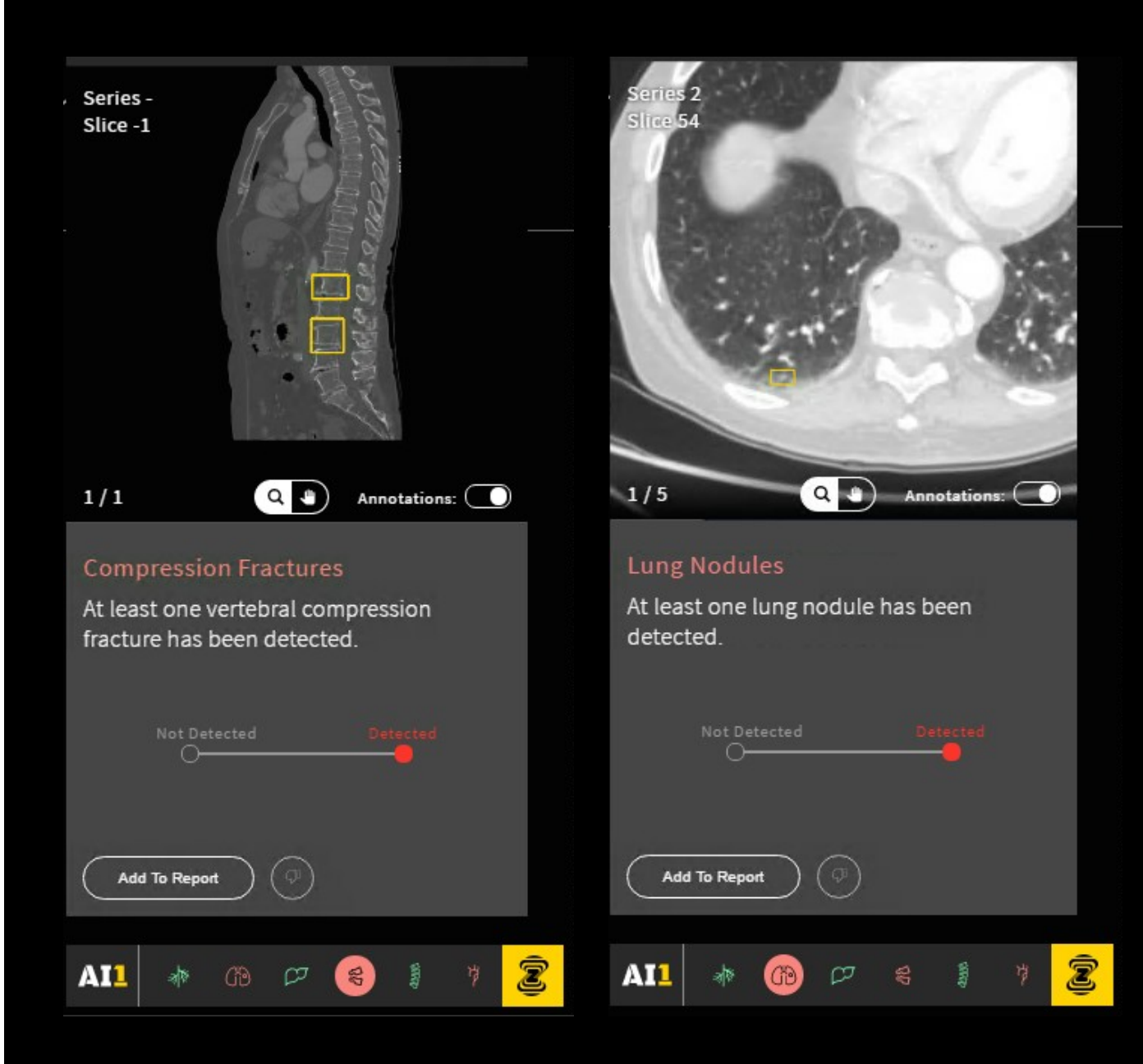


# AI TRANSFORMS PATIENT CARE

The demand for medical imaging services is continuously increasing, outpacing the supply of qualified radiologists and stretching them to produce more output, without compromising patient care. It's not atypical for hospitals to have a large backlog of x-rays waiting to be routed.

Zebra is using GPU-powered AI to augment the capabilities of radiologists. Its low-cost AI1 assistant instantly detects diseases of the lung, breast, liver, cardiovascular system, and bones to help radiologists manage the ever increasing workload while continuing to deliver quality care.

zebra MEDICAL VISION




NVIDIA