HR&A + Friends of Empire AI

Empire AI Impact Analysis

Supporting New York State's Economic Competitiveness

December 2025

INTRODUCTION

"With Empire AI, New York is leading in emerging technology and ensuring the power of AI is harnessed for public good and developed right here in this great state."

- Governor Kathy Hochul

Source: New York State Governor's Office.

Image source: New York State, Governor Kathy Hochul

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Executive Summary

EXECUTIVE SUMMARY

Empire AI is a consortium of New York's leading public and private universities that have come together to establish a state-of-the-art artificial intelligence compute center at the University at Buffalo.

The State, consortium universities, and leading philanthropies are spearheading this effort to make New York a global leader in developing and deploying artificial intelligence (AI).

Empire AI plans to establish its facilities across three initial project phases between 2024 and 2027: the Alpha, Beta, and Gamma.

These are just the beginning of the project. Empire AI will fully realize its vision over the coming decade.

Governor Kathy Hochul launched Empire AI in April 2024

*"The [Alpha and Beta] combined will propel Empire AI to become one of the **most advanced academic computers in the world."***

- Governor Kathy Hochul

Source: University at Buffalo.

EXECUTIVE SUMMARY

Empire AI's goals are to serve public-interest technology, increase New York's competitiveness, and benefit New Yorkers and the economy.

Creating a powerful compute cluster that is accessible to researchers across the state provides a critical asset for New York State's AI community working across a range of key sectors, including climate change, healthcare, economic development, and more.

Empire AI's Consortium and Initial Research

10
Consortium institutions

130+
Research projects

500+
Researchers

Source: Empire AI.

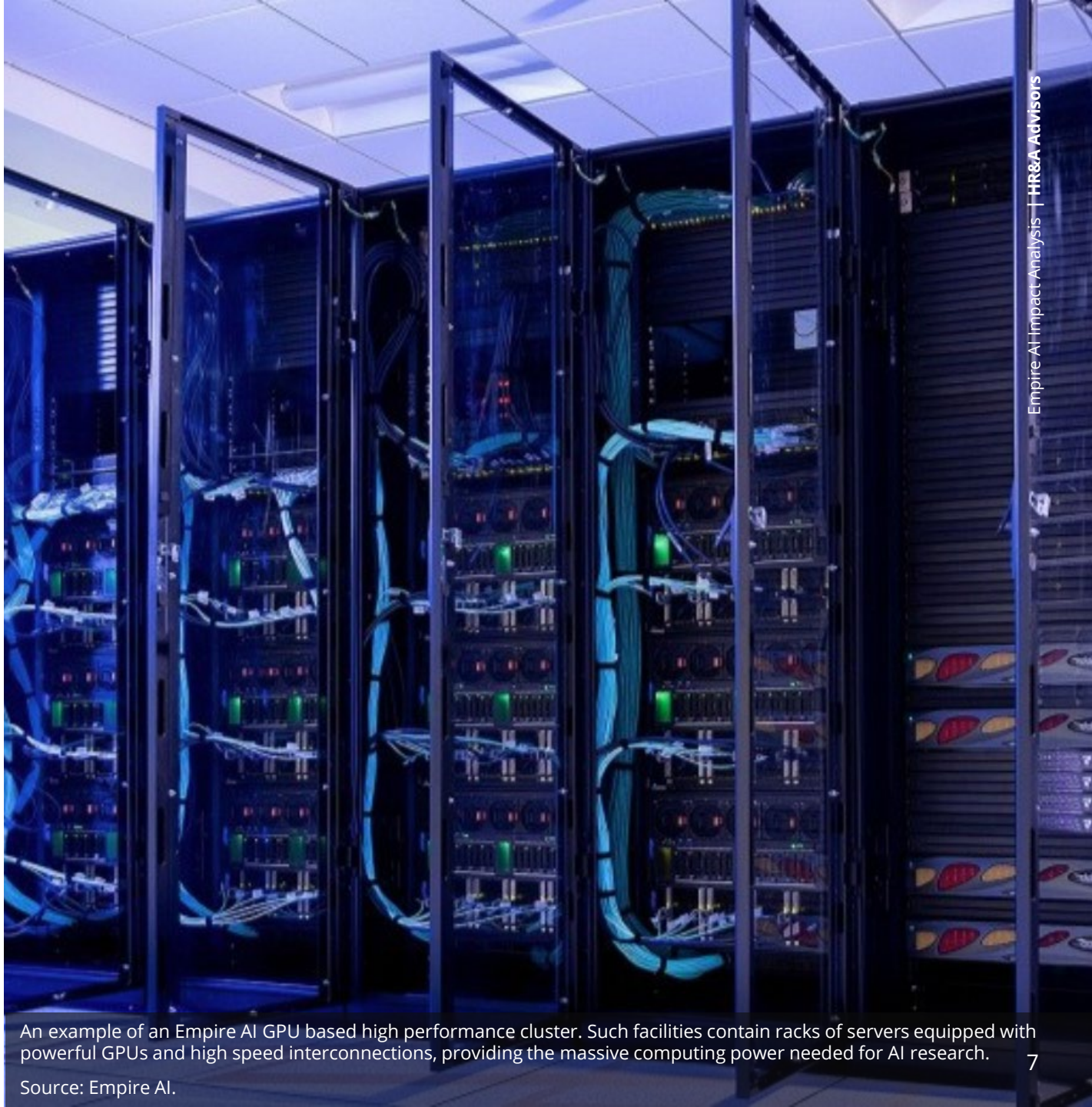
EXECUTIVE SUMMARY

Empire AI will enhance the consortium's ability to develop technology to serve the public interest.

Since October 2024, Empire AI has been using a compute cluster named Alpha, donated by the Simons Foundation, to support AI research.

A compute cluster is a network of linked computer systems that enables users to run high-performance applications such as AI and big data analytics.

Access to high-performance computing technology at the scale provided by Empire AI is typically only available to large technology companies.



An example of an Empire AI GPU based high performance cluster. Such facilities contain racks of servers equipped with powerful GPUs and high speed interconnections, providing the massive computing power needed for AI research.

Source: Empire AI.

EXECUTIVE SUMMARY

On behalf of Friends of Empire AI, HR&A assessed the impacts of Empire AI's initial investments and of the research it is enabling.

Components of this Report

Increasing Competitiveness
Why is compute such an important factor in modern research and development and economic activity, and how does Empire AI enable New York to remain highly competitive?

Benefiting New Yorkers and the Economy
What can we learn from case studies of research happening at Empire AI about how it can generate economic and societal benefits?

Investing in Leading Facilities & Equipment
What are the direct economic impacts of Empire AI's development of its compute clusters?

About HR&A

HR&A Advisors, Inc. (HR&A) is an employee-owned company whose Tech and Innovation Practice works with governments, technology companies, institutions, advocates, and developers to leverage innovation to increase economic competitiveness, improve quality of life, and broaden economic opportunity.

HR&A is a national leader in conducting rigorous impact analyses of transformative technologies. With nearly 50 years of experience, HR&A has worked on relevant projects across New York State and with many leading companies and institutions, including Airbnb, Con Edison, Cornell Tech, Empire State Development, Google, New York Blood Center, Uber, and WeWork.

Our current analysis only captures the beginning. As Empire AI expands to support more research with more powerful facilities, its impacts will only grow.

EXECUTIVE SUMMARY | BENEFITING NEW YORKERS AND THE ECONOMY

Empire AI turns shared supercomputing into real-world benefits for New Yorkers by accelerating breakthroughs in R&D and strengthening industries statewide.

130+

PROJECTS SUPPORTED BY EMPIRE AI TO DATE ON THE ALPHA SUPERCOMPUTER

$266 million

POTENTIAL ANNUAL INCREASE IN R&D PRODUCTIVITY

$2.7 billion

POTENTIAL INCREASE IN R&D PRODUCTIVITY OVER 10 YEARS

Research Projects

Since its launch in 2024, Empire AI has supported academic research projects related to the following sectors: Advanced Manufacturing and Cleantech, Biotech & Life Sciences, and Technology & Digital Media.

Economic Value

AI models and infrastructure can raise productivity by speeding and scaling analyses. Empire AI could help NYS-based researchers increase their R&D productivity by more than 2x and produce value across the economy.

Assuming adoption of new tools and techniques in high-impact sectors, the annual $266M in added R&D productivity could amount to more than $2.7B over 10 years, a more than 5x return on investment for Empire AI.

Empire AI, New York's landmark, high-performance computing initiative expands what researchers can achieve and positions the state as a model for responsible and open AI.

243RD

ALPHA WAS THE 243RD MOST POWERFUL SUPERCOMPUTER IN THE WORLD WHEN IT LAUNCHED IN 2024

Expanding Scale

Empire AI enables researchers to conduct work that was previously impossible, to think bigger, and to vastly expand their analyses. Upcoming upgrades will further enhance New York's leadership.

From Months to Days

ACCELERATING RESEARCH BY ORDERS OF MAGNITUDE

Time Savings

Empire AI helps researchers to dramatically accelerate the research process, completing tasks that previously took months in just a few days, accelerating research project timelines significantly.

Recruiting & Retaining AI Talent to NYS

Attracting AI Talent

Access to powerful supercomputers has a proven track record for attracting and retaining premier AI talent, including professors, postdoctoral researchers, and students.

EXECUTIVE SUMMARY | INVESTING IN LEADING FACILITIES & EQUIPMENT

Empire AI's direct investments into facilities and equipment for the Alpha, Beta, and Gamma supercomputers generate economic benefits in New York State.

$196 million

TOTAL CONSTRUCTION & EQUIPMENT INVESTMENTS

$155 million

ECONOMIC IMPACT FROM CONSTRUCTION & EQUIPMENT INVESTMENTS

200

ANNUAL JOBS CREATED FROM CONSTRUCTION & EQUIPMENT INVESTMENTS BETWEEN 2024 AND 2027

Total Investment

Empire AI is investing $196M between 2024 and 2027 to build Alpha, Beta, and Gamma in Buffalo. Of this amount, $90M will go to in-state suppliers and contractors.

Economic Impact

Empire AI's in-state spending will generate $155M in one-time economic output in NYS in direct and multiplier activity in construction, equipment, and other sectors.

Labor Impact

These investments will support nearly 200 annual jobs between 2024 and 2027 and produce $67M in labor income, or $89,200 on average per worker.

Increasing Competitiveness

INCREASING COMPETITIVENESS

Empire AI is New York State's landmark public investment in responsible and powerful artificial intelligence (AI).

Launched in 2024 with more than $500 million in state, university, and philanthropic funding, Empire AI provides shared high-performance computing infrastructure to a growing consortium of public and private universities across New York State.

Unlike commercial AI initiatives, Empire AI is explicitly focused on the public good. By expanding access to advanced compute and supporting ethical, open research, Empire AI positions New York as a national model for how states can lead in AI development without compromising safety, equity, and transparency.

Sources: Top500, "Alpha" (link); and Stacie Bloom et al., "Empire AI: A new model for provisioning AI and HPC for academic research in the public good," (link).

Timeline

2024 **Alpha Cluster**

Launched October 2024

- Housed in existing facility
- Powered by Simons Foundation hardware
- Ranked 243rd of top 500 supercomputers globally

2025 **Beta Cluster**

Expected early 2026

- Significant tech upgrades and expanded compute capacity will make Beta at least 11 times more powerful than Alpha

2027+ **Gamma**

Expected 2027

- New, purpose-built facility
- Full-scale AI operations across consortium
- Expected to be at least 5 times more capable than Alpha and Beta

INCREASING COMPETITIVENESS

With the completion of Beta and Gamma, Empire AI will become a world-class supercomputing resource that rivals the top private and public facilities globally.

Alpha (2024)

243rd most powerful supercomputer in the world at launch (late 2024)

Beta (2026)

Beta is expected to be at least 11x more powerful than Alpha
If Beta launched today, it would rank among the world's top 50 supercomputers

Gamma (2027)

Gamma expected to be at least 5x more powerful than Alpha & Beta
If Gamma launched today, it would rank among the world's top 20 supercomputers

NVIDIA DGX SuperPOD with 288 B200 GPUs for AI Applications

Once Beta launches in early 2026, **Empire AI will be the first academic deployment** of the state-of-the-art NVIDIA DGX SuperPOD system.

Sources: Top500, "Alpha" (link); NVIDIA; and Stacie Bloom et al., "Empire AI: A new model for provisioning AI and HPC for academic research in the public good," (link).

INCREASING COMPETITIVENESS

Empire AI is a statewide research consortium featuring seven founding institutions and a new cohort of three additional members.

2024 Founding Members

Columbia University in the City of New York

Cornell University

The City University of New York

Flatiron Institute

NYU

RPI

SUNY

2025 New Members

Icahn School of Medicine at Mount Sinai

RIT Rochester Institute of Technology

University of Rochester

INCREASING COMPETITIVENESS

A compute center provides the massive computing power needed to train, test, and run advanced AI models efficiently.

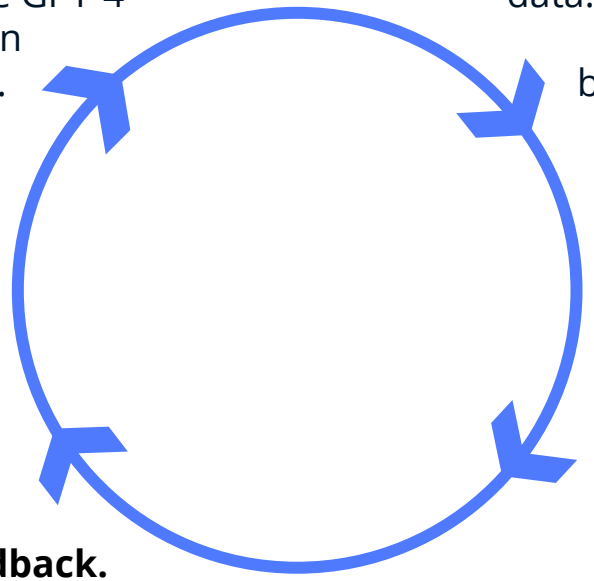
Compute centers operate with specialized graphics processing units (GPUs), which are chips that can process thousands of tasks at once, making them ideal for AI workloads like training large models or analyzing massive datasets.

Shared compute centers like Empire AI allow institutions to "borrow" powerful computing capacity—like a public library for data science—rather than requiring every researcher or university to build their own system. This expands access to more powerful tools than a single institution can afford and avoids redundant infrastructure spending.

Compute Powers the AI Model Development Cycle

Pretraining. Large models are trained on vast datasets using massive compute power. A language model like GPT-4 trains for months on thousands of GPUs.

Fine-Tuning & Alignment. Some models may be refined on more specific data. It is often faster computationally but may be more costly due to human input.



Monitoring & Feedback. Engineers and scientists analyze and monitor usage and outputs and make adjustments as needed.

Deployment. The model is integrated into apps or workflows, or used in a research setting.

Source: IBM, "Fine-Tuning."

INCREASING COMPETITIVENESS

With Empire AI, New York State joins a growing number of other governments investing in supercomputer resources to advance science, innovation, and economic development.

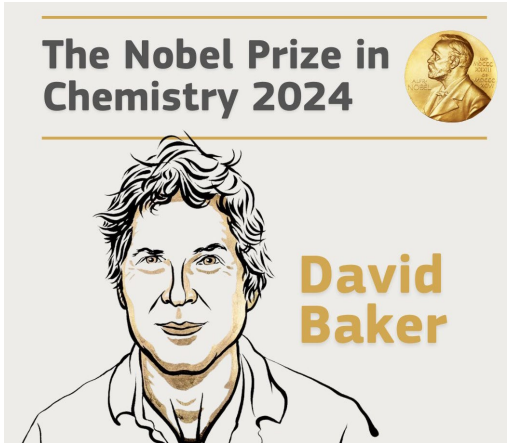
Empire AI positions New York State as a leader in the artificial intelligence revolution, putting New York State on par with other public entities around the world that have already recognized investing in public computing is one of the most powerful tools to drive economic development and innovation.

Supercomputer	Alpha	HiPerGator 4.0	Frontera	Fugaku	Archer2
Host Organization	Empire AI and the University at Buffalo	University of Florida	Texas Advanced Computing Center (TACC) at the University of Texas at Austin	RIKEN Center for Computational Science (R-CCS)	Edinburgh Parallel Computing Centre (EPCC) at the University of Edinburgh
Organization Type	Consortium supported by State government	Public university	Public university	Research institution supported by national government	Public university
Location	Buffalo, NY	Gainesville, FL	Austin, TX	Kobe, Japan	Edinburgh, United Kingdom
Primary Users	Academic researchers at NYS consortium members	Academic researchers associated with UF	Academic researchers associated with the UT system	Government-sponsored research at key Japanese universities	UK-based academic researchers and industry

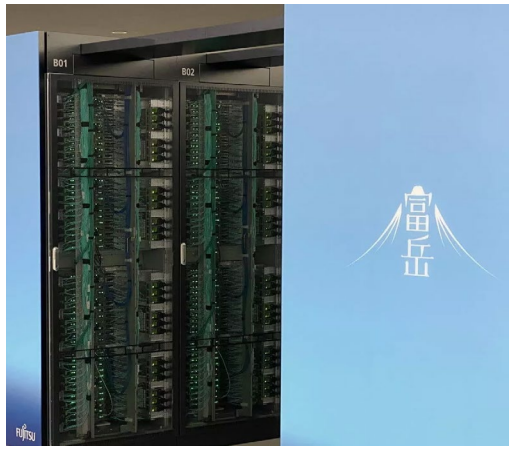
Sources: Empire AI, University of Florida, Texas Advanced Computing Center, RINKEN Center for Computational Science, and Edinburgh Parallel Computing Centre.

INCREASING COMPETITIVENESS

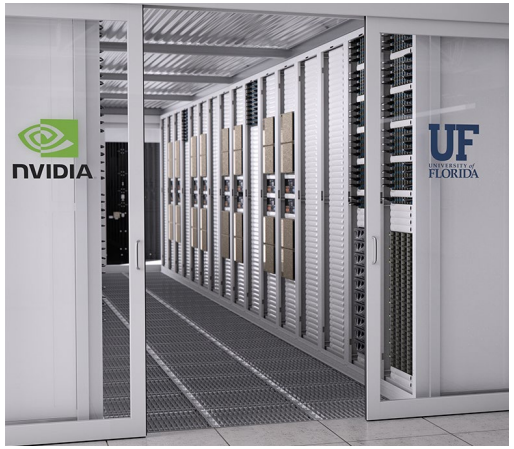
Access to publicly funded supercomputers has enabled Nobel Prize-winning research, driven economic growth, and supported the attraction and retention of AI talent.



Supercomputer simulations using TACC's Frontera helped Prof. David Baker win the Nobel Prize. Baker's research lab used Frontera for deep learning to augment existing physical models to design proteins from scratch, resulting in a 10-fold increase in success rates.



According to Hyperion Research, **Fugaku is projected to yield an economic value of 68 to 90 times of its costs**, amounting to more than **$102B to $135B** in value from an initial $1.5B investment in Fugaku.



The University of Florida aims to produce 30,000 AI-enabled graduates by 2030 and has committed to **hiring 100 new faculty members in AI** and related disciplines, with the goal of positioning itself as a national leader in AI education and research.

According to UK government estimates, high-performance computing powered by **Archer2 is expected to generate between $4B and $12B in total economic impact** over its operational lifetime, compared to $110M in investment—a return of up to $110 for every $1 invested.

Sources: TACC, "Frontera-supported Protein Design Nets Chemistry Nobel Prize,"; Hyperion Research, "Analysis of the Total Potential Ripple Effects of the Fugaku Computer,"; NVIDIA, "University of Florida, NVIDIA to Build Fastest AI Supercomputer in Academia,"; and EPSRC, "The impact of EPSCR's investments in High Performance Computing infrastructure" (link).

INCREASING COMPETITIVENESS

Empire AI allows researchers in New York to do things that were previously impossible for them, to vastly expand the scope of their analyses, and to conduct research more rapidly.

CAPABILITY

Capability is a system's ability to conduct a certain type of analysis or computation. Empire AI allows researchers to do what they previously could not, or would have taken too long to be practical.

CAPACITY

Capacity is the volume of any given type of analysis that a system can support. Empire AI allows researchers to process more, higher-quality data in their models.

INCREASING COMPETITIVENESS

Empire AI gives researchers the resources to make discoveries faster and strategically invest their funding to meet ambitious goals.

TIME SAVINGS

Alpha has **dramatically accelerated the research process**, allowing research teams to reach results more quickly and dedicate more time to solving innovative problems.

COST SAVINGS

By obtaining free access to a supercomputer—typically, an expensive resource—researchers can **reallocate their budgets to other priorities**, such as hiring more research assistants.

INCREASING COMPETITIVENESS

Investing in computing resources is becoming critical to recruiting and retaining top-tier AI talent to New York State, from professors to students.

Leading academic and research institutions consistently find that providing access to supercomputers has a significant positive effect on recruiting and retaining premier talent, including professors, postdoctoral researchers, and students.

"Empire AI's initiative is basically trying to put our researchers at the forefront of AI research and, in doing so, really put New York at the forefront of AI revolution. We are already seeing the return on investment in faculty recruitment, talented people choosing to come to New York."

- Robert Harrison, Interim Executive Director of Empire AI

"Having Empire AI will allow institutions like Columbia to train the workforce to be ready for the increasing prevalence of tech industry in New York."

- Prof. Tian Zheng, Columbia University

"[The HiPerGator supercomputer] helps us to recruit top talent and faculty from around the globe. Almost all of them said they'd never seen anything like it."

- Elias Eldayrie, Chief Information Officer, University of Florida

"Marlowe [supercomputer] will also help attract and retain world-class faculty, postdocs, and students hoping to work on the data-intensive models."

- Emmanuel Candès, Faculty Director, Stanford University Data Science

Sources: Robert Harrison in RPA event, "Harnessing the AI Revolution,"; HR&A Interview with Prof. Tian Zheng; University of Florida, "Building an AI University"; and Stanford University, "Stanford welcomes first GPU-based supercomputer."

INCREASING COMPETITIVENESS

Though high-performance computing is energy-intensive, New York State is investing in Empire AI without compromising environmental goals.

Empire AI is designed to be an energy-efficient compute center. Its design reduces energy consumption and allows it to recirculate heat generated from the facility to heat dorms on campus.

Additionally, using clean energy sources is essential since compute centers require immense amounts of electricity. The New York Power Authority (NYPA) recently announced a plan to supply clean renewable hydropower to Empire AI in Buffalo.

*"When construction is complete, **Empire AI will be one of the most sustainable and energy efficient data centers in the world**, showing how New York is leading the nation in the development of AI research for the public good. That would not be possible without Governor Hochul's vision for this project and our collaboration with the New York Power Authority."*

- Robert Harrison, Empire AI Interim Executive Director

Sources: Empire AI.

Benefiting New Yorkers and the Economy

BENEFITING NEW YORKERS AND THE ECONOMY

Since the launch of Alpha in 2024 through November 2025, Empire AI supported at least 139 academic research projects among its consortium institutions. More are being launched.

Industry Clusters
Empire AI **supported 139 projects** spanning three research categories through mid-2025:

40	47	52
Advanced Manufacturing & Cleantech	Biotech & Life Sciences	Technology & Digital Media

Projects by Academic Intuition
Empire AI connects **500+ researchers** (principal researchers and their teams) at major institutions:

34	27	22	16
Columbia University	Cornell University	State University of New York (SUNY)	New York University (NYU)
14	**11**	**9**	**6**
Rensselaer Polytechnic Institute (RPI)	City University of New York (CUNY)	University of Rochester	Icahn School of Medicine at Mount Sinai

Note: Empire AI is adding new projects and partners, so the number of projects will grow from the latest set HR&A received in November 2025.

BENEFITING NEW YORKERS AND THE ECONOMY

Research being conducted with Empire AI's resources has real-world goals and potential.

HR&A prepared 10 case studies to show the work that is being done with Empire AI. These represent just a small slice of the 130+ projects ongoing on the Alpha.

Even though these projects are in their early stages, researchers already describe the impact Empire AI has had on their work.

In the medium to long term, these projects stand to benefit New York State's critical industries and the lives of New Yorkers and people around the world.

Note: Empire AI is adding new projects and partners, so the number of projects will grow from the latest set HR&A received in November 2025.

Case Study Selection Criteria

- **Potential Economic Impacts:** Projects with potential impacts for New York State's most important industries, from advanced manufacturing to biotech to digital media.
- **Societal Impacts:** Projects with challenges that can show the societal benefits of Empire AI.
- **Representation:** Projects that showcase research at every university among the consortium's 6 founding academic institutions. (Researchers at the 3 new consortium members have only just begun to use the Alpha and will be included in future reports.)

BENEFITING NEW YORKERS AND THE ECONOMY

Artificial intelligence, machine learning, and compute enable New York's priority industries to deliver new and different kinds of products and services.

Economic Benefits	Direct	Indirect
Advanced Manufacturing & Cleantech Manufacturing for semiconductors, clean energy, and similar products; new materials development.	• Accelerate the innovation cycle • Patents and spinoffs could lead to creating new products, services, companies, and jobs • Attract top AI talent—professors and students—to NY universities, especially strengthening smaller and public institutions' competitiveness • Improve AI education and knowledge • Solidify New York as a leader in the global AI landscape	• Open-source knowledge forms basis for future advancements • Building a culture of public-benefit AI applications • Knowledge spillovers to other sectors • New York's AI brand helps retain or attract businesses and workers • Greater competitiveness for NYS-based firms and organizations
Biotech & Life Sciences R&D and production of drugs and health equipment; improvements to patient care and health services.		
Technology & Digital Media Software development, data processing, and information services, including to support movie, TV, and creative production.		

Source: Empire State Development, "A Strategic Approach to Workforce Development," (link).

BENEFITING NEW YORKERS AND THE ECONOMY

Research conducted with Empire AI also produces shorter- and longer-term societal benefits for New York, the country, and the world.

Societal Benefits	Short-Term	Longer-Term
Prevent & Treat Disease Develop new ways to identify illnesses and create effective treatments that improve human quality of life and expectancy.	• Improve disease detection and diagnosis	• Advance treatments for rare and complex diseases • Enable new paradigms in biomedical research and health care
Strengthen Climate Resilience Create new materials and solutions that reduce energy use and waste and models that better forecast climate hazards.	• Generate more accurate and local climate forecasts	• Improve planning for infrastructure and disaster response • Develop cleaner, safer materials and energy systems
Accelerate Scientific & Tech Discovery Enable computationally intensive research projects that were previously impossible, enhancing scientific research.	• Provide AI tools to simulate, analyze, and visualize complex phenomena	• Drive new approaches for scientific modeling, experimentation, and foundational AI research
Expand Human Potential Broaden who can create, access, and benefit from AI and research tools.	• Empower creators, students, and researchers with new AI capabilities	• Improve tools in education, music, communication, and public services • Expand access to cutting-edge tech and foster inclusive innovation

BENEFITING NEW YORKERS AND THE ECONOMY

HR&A conducted a deep dive into the work of 10 researchers who are using Alpha to enhance their research and solve a range of challenges.

Biotech, Life Sciences, and Health Care

Thomas D. Grant, *University at Buffalo*
Protein Structure Prediction for Drug Design

Ekta Khurana, *Weill Cornell Medicine*
AI Detection of Prostate Cancer Subtypes

Rabindra K. Mandal, *CUNY*
Role of Gut Microbiome in Malaria Infections

Sozanne Solmaz, *SUNY Binghamton*
Infant Brain Development Disorder From BicD2 Mutations

Pingkun Yan, *Rensselaer Polytechnic Institute*
Medical Image Analysis for Diagnosis

Advanced Manufacturing & Cleantech

Mark Tuckerman, *NYU*
Molecular Simulations for Next Generation-Battery Applications

Tian Zheng, *Columbia University*
Climate Modeling with Generative AI

Technology & Digital Media

Kilian Weinberger, *Cornell University*
Diffusion Language Generation

Christine Constantinople, *NYU*
Studying How Brain Makes Decisions

John Thickstun, *Cornell University*
Building Generative Models of Musical Scores

BENEFITING NEW YORKERS AND THE ECONOMY

Empire AI supports researchers in biotechnology and life sciences to improve the drug design and production and/or diagnosis processes, which ultimately enhance patient care.

Researcher	Challenge	Potential Benefits
Thomas D. Grant, *University at Buffalo* Protein Structure Prediction for Drug Design	Drug development process from concept to approval typically takes **12-15 years**.	SWAXSFold's dynamic protein predictions could **cut a year or more from** the 12-15 year, $2.6B drug pipeline by enabling more precise, effective treatments.
Ekta Khurana, *Weill Cornell Medicine* AI Detection of Prostate Cancer Subtypes	Among the **15,500 patients diagnosed with prostate cancer annually**, almost all patients develop castration-resistant prostate cancer (CRPC).	Early identification of aggressive, resistant subtypes of metastatic CRPC could save New York State an estimated **$1.2B annually in medical expenses** since late-stage treatment can cost over $12,000 per patient per month.
Rabindra K. Mandal, *CUNY* Role of Gut Microbiome in Malaria Infections	**263 million** malaria cases worldwide in 2023—approximately 11 million more than in 2022.	Innovation in malaria treatment could save the **600,000+ malaria deaths worldwide** (within the 263 million cases).

Sources: Thomas Lane, "Protein structure prediction has reached the single-structure frontier," (link); N-side, "What's the average time to bring a drug to market in 2022"; Quoc-Dien Trinh et al., "The cost of disease progression to metastatic castration-sensitive prostate cancer," (link); World Health Organization, "World malaria report 2024," (link); Yahoo Finance, "Global Human Microbiome Market Report to 2029: Rising Awareness About Importance of Human Microbiome Drives Growth"; and New York State Dept of Health, "About prostate cancer."

BENEFITING NEW YORKERS AND THE ECONOMY

Empire AI supports researchers in biotechnology and life sciences to improve drug design and production and diagnostics, which ultimately enhances patient care.

Researcher	Challenge	Potential Benefits
Sozanne Solmaz, *SUNY Binghamton* Infant Brain Development Disorder From BicD2 Mutations	Mutations of BicD2 protein, while extremely rare (1 in 6,000 babies), cause **brain development defects** among infants.	New therapies for neurodegenerative diseases, such as Alzheimer's, can be developed by studying how infant brains develop. Better understanding of brain defects could help reduce New York's **$18.9 billion annual cost of caring** for individuals with Alzheimer's and other dementias.
Pingkun Yan, *RPI* Medical Image Analysis for Diagnosis	**54,000** deaths due to cardiovascular diseases (CVD) in NYS in 2022.	AI-powered medical diagnostics have the potential to **reduce the $19 billion** spent on treating cardiovascular diseases in 2019 in NYS. Improving accuracy and efficiency of medical diagnosis can lead to early detection of diseases, improve outcomes, and reduce costs.

Sources: HR&A interview with Sozanne Solmaz; New York State Office for the Aging; Yahoo Finance, "Neurodegenerative Diseases Market to reach USD 53 Billion by 2030 and grow steadily at a CAGR of 3.2%: Straits Research"; and Dhruv S. Kazi et al., "Forecasting the Economic Burden of Cardiovascular Disease and Stroke in the United States Through 2050: A Presidential Advisory From the American Heart Association," (link).

BENEFITING NEW YORKERS AND THE ECONOMY

Empire AI provides computing resources to advance innovation in advanced manufacturing, such as next-generation batteries, and in applications like climate modeling.

Researcher	Challenge	Potential Benefits
Mark Tuckerman, *NYU* Molecular Simulations for Next Generation-Battery Applications	Lithium mining, essential for creating batteries, is estimated to emit about **1.3M tonnes of carbon annually**.	Reducing emissions from lithium mining could avoid **approximately $247 million each year** in health, agricultural, and climate-related damages.
Tian Zheng, *Columbia University* Climate Modeling with Generative AI	**$10 billion** in projected annual economic losses from climate events in NYS by 2050 and **1,300+** heat-related deaths that occur annually in the state.	Targeted interventions informed by advanced climate modeling could **mitigate billions in economic damages** and **reduce the number of lives lost each year**.

Sources: New York City Mayor's Office of Climate & Environmental Justice; NYSERDA, "Climate Change,"; NYSTIA, "Governor Hochul Announces Record level of Clean Energy Jobs Reached in New York State,"; and Earth.Org, "The Environmental Impacts of Lithium and Cobalt Mining."

BENEFITING NEW YORKERS AND THE ECONOMY

Empire AI's computing resources enable researchers to create specialized AI models, helping them advance ethical AI research that benefits a wide range of industries.

Researcher	Challenge	Potential Benefits
Kilian Weinberger, *Cornell University* Diffusion Language Generation	Commercial large language models (LLMs) like ChatGPT are **difficult to control**, limiting their safe and reliable use.	Developing controllable LLMs can enable **safer, more reliable** AI tools for use in healthcare, education, and public services.
Christine Constantinople, *NYU* Studying How Brain Makes Decisions	Many aspects of human decision-making and neuropsychiatric disorders, including schizophrenia and depression, are still unexplained due to our **limited knowledge of the brain's underlying mechanisms**.	A deeper understanding of the brain could lead to new therapeutic targets for many mental and cognitive disorders, which could **benefit up to 4 million New York residents** who experience symptoms of mental disorders every year.
John Thickstun, *Cornell University* Building Generative Models of Musical Scores	Commercial AI music generation models **undermine artistic ownership and threaten jobs** across the music industry.	Developing a generative AI tool to aid music composition can support the creative process for New York's thriving music industry, which employs **3,600+ music directors and composers**.

Sources: New York State Dept of Health; Jonathan Sperling, "Mental Health and the Economy -- It's Costing Us Billions,"; and US Dept of Labor.

BENEFITING NEW YORKERS AND THE ECONOMY

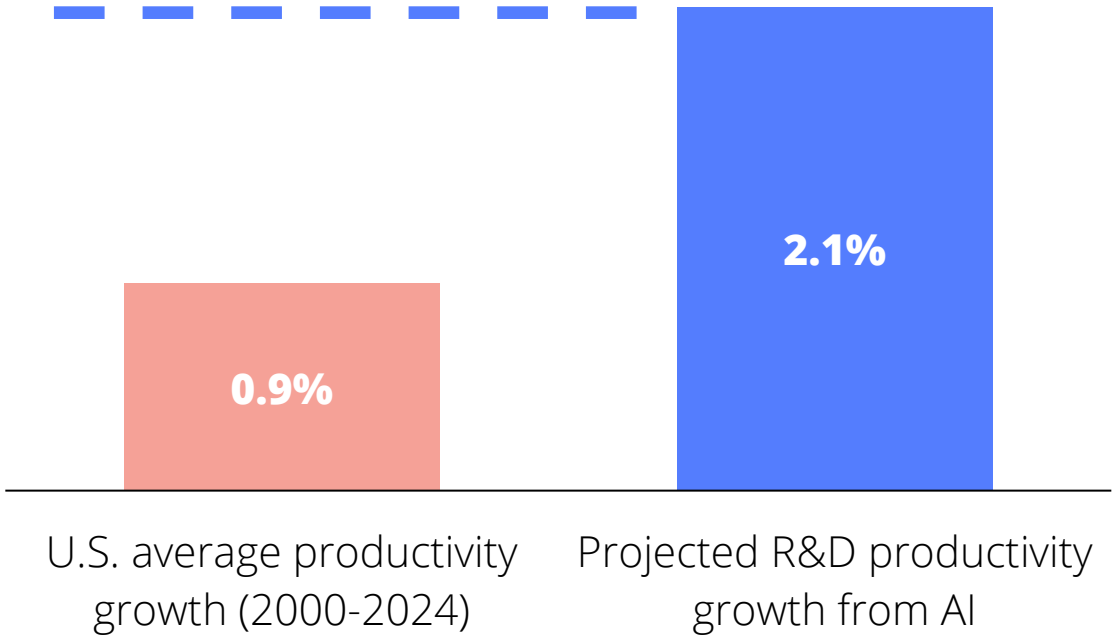
Case studies and independent research show that AI models and powerful compute infrastructure can increase R&D productivity by speeding results and scaling analyses.

AI models and capital investments could increase productivity growth for R&D by 2.3x over the average from the last 25 years. MIT FutureTech and UCLA Department of Economics researchers Tamay Besiroglu, Nicholas Emery-Xu, and Neil Thompson found in 2022 that advances in machine learning techniques and technologies could increase R&D productivity to 2.1% from the recent average of 0.9%.

If Empire AI can facilitate adoption of these resources, it can significantly increase R&D value in New York State.

Doubling U.S. R&D Productivity Growth

+1.2 percentage points (2.3x)
projected productivity increase



Note: R&D productivity represents how effectively research efforts accelerate knowledge creation and economic growth. Increasing productivity growth means that R&D can happen faster and more reliably. Investments that increase productivity growth, like Empire AI, expand existing researchers' output and capabilities, allowing them to accomplish more than they could without them.

Sources: National Center for Science and Engineering Statistics (NCSES), "Business R&D Performance in the United States Tops $600 Billion in 2021," (link); and Tamay Besiroglu, Nicholas Emery-Xu, and Neil Thompson, "Economic impacts of AI-augmented R&D," (link); Bureau of Labor Statistics, "Total factor productivity by major sectors: private business and private nonfarm business" (link).

BENEFITING NEW YORKERS AND THE ECONOMY

The three industry clusters supported by Empire AI's research contribute about $257B in Gross Regional Product (GRP) to New York State—about 11% of the state's total GRP.

Industry Cluster	Gross Regional Product (NYS, 2024)
Advanced Manufacturing & Cleantech Manufacturing for semiconductors, clean energy, and similar products; new materials development.	**$73.4B** *Number of jobs: 193,800*
Biotech & Life Sciences R&D and production of drugs and health equipment; improvements to patient care and health services.	**$40.7B** *Number of jobs: 115,400*
Technology & Digital Media Software development, data processing, and information services, including to support movie, TV, and creative production.	**$143.1B** *Number of jobs: 193,800*

$257.2B

Total value of industries in New York State that could benefit from Empire AI's research.

Sources: New York State Empire State Development, "A Strategic Approach to Workforce Development," (link) and HR&A analysis of Lightcast data.

BENEFITING NEW YORKERS AND THE ECONOMY

If tools and models from Empire AI became standard in key industries, they could generate $266M in additional annual R&D value creating in New York State.

Industry Cluster	Gross Regional Product (NYS, 2024)	Estimated R&D Spending (NYS)	Estimated Value of Productivity Growth impacted by Empire AI
Advanced Manufacturing & Cleantech	$73,401M	$2,936M 4% of GRP	**$35M** +1.2pp productivity
Biotech & Life Sciences	$40,721M	$4,886M 12% of GRP	**$59M** +1.2pp productivity
Technology & Digital Media	$143,111M	$14,311M 10% of GRP	**$172M** +1.2pp productivity

$266M
Estimated annual impact of Empire AI on NYS R&D

Note: Detailed methodology in the appendix.
Sources: New York State Empire State Development, "A Strategic Approach to Workforce Development," (link); HR&A analysis of Lightcast data; OECD, "Main Science & Technology Indicators"; National Center for Science and Engineering Statistics (NCSES), "Business R&D Performance in the United States Tops $600 Billion in 2021," (link); Tamay Besiroglu, Nicholas Emery-Xu, and Neil Thompson, "Economic impacts of AI-augmented R&D," (link).

Investing in Leading Facilities & Equipment

INVESTING IN LEADING FACILITIES & EQUIPMENT

Empire AI's initial one-time investments into construction and equipment generate economic benefits in New York State.

Empire AI's initial investments in Buffalo across the Alpha, Beta, and Gamma phases are estimated to total $196 million. These investments will occur between 2024 and 2027, with other major equipment purchases and initiatives to happen beyond 2027.

This analysis describes the economic impacts of Empire AI's investments to establish and upgrade the three compute cluster facilities for New York State.

Overall Impacts

$196M
Total investment

...of which...

$90M
Spent in-state

...will produce:

$155M
Economic output

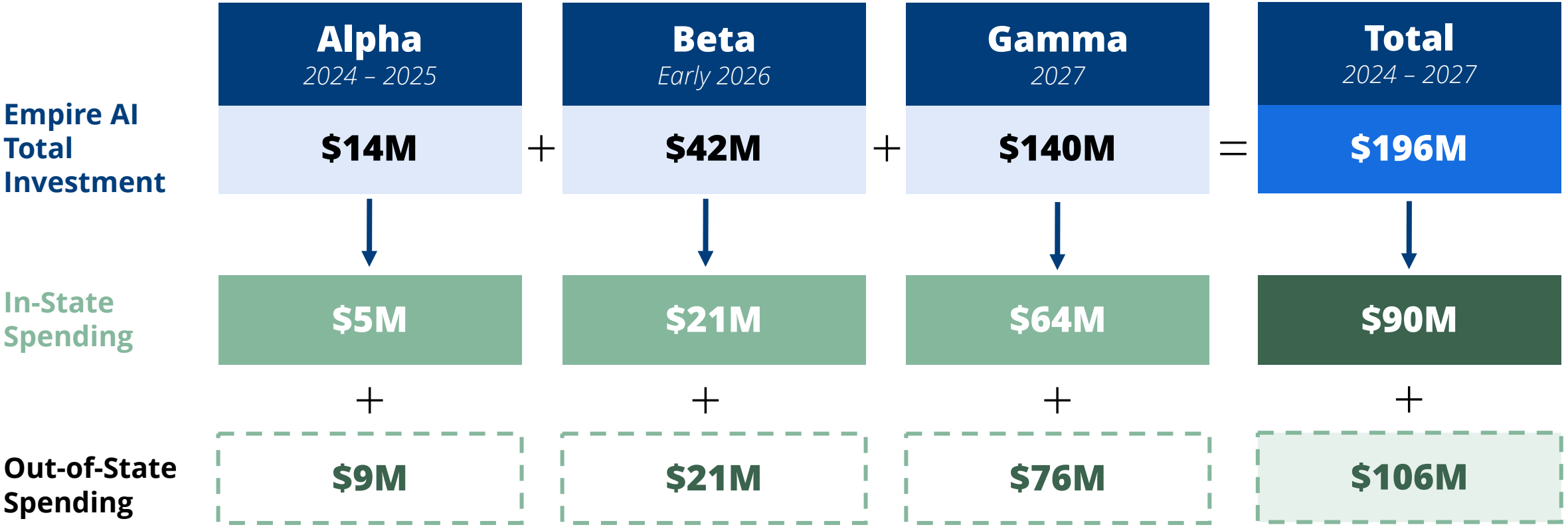
750
Full-Time Equivalent Jobs

$67.1M
Labor income
($89,200 per worker)

INVESTING IN LEADING FACILITIES & EQUIPMENT

Empire AI is investing in advanced equipment, services like data storage and processing, and construction to develop its facilities.

Empire AI's In-State spending includes New York State-based suppliers across these categories. Out-of-state spending is high at this stage as most computing equipment is manufactured outside of New York State.



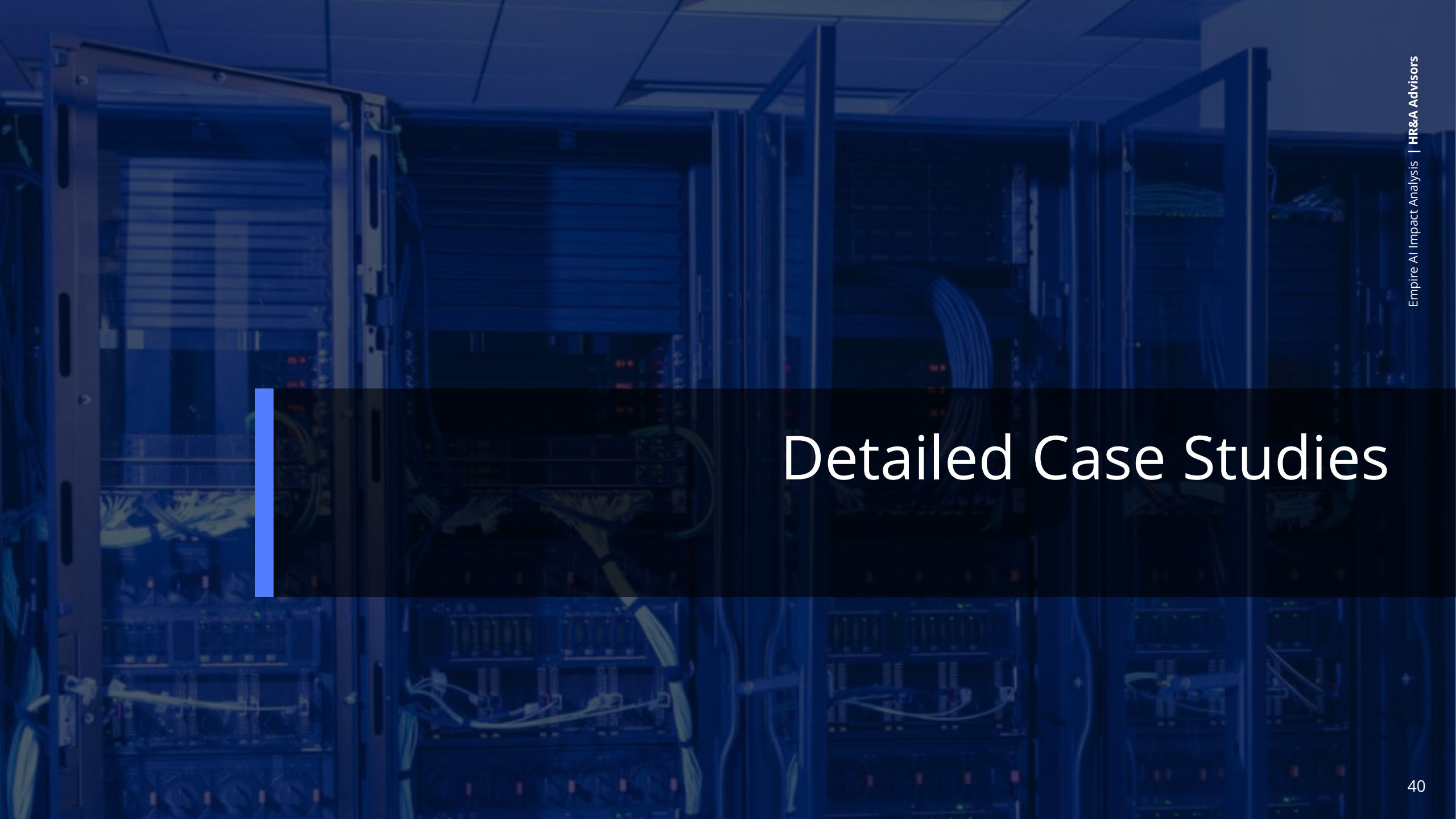
Source: HR&A analysis of Empire AI and IMPLAN data.

INVESTING IN LEADING FACILITIES & EQUIPMENT

This investment will generate jobs, labor income, and economic output in New York State between 2024 and 2027.

	Alpha *2024 – 2025*		Beta *Early 2026*		Gamma *2027*		Total *2024 – 2027*
Empire AI Investment	**$14M**	+	**$42M**	+	**$140M**	=	**$196M**
Economic Impacts Generated in New York State Includes direct and multiplier impacts	**$9M** **ECONOMIC OUTPUT**	+	**$36.5M** **ECONOMIC OUTPUT**	+	**$109.5M** **ECONOMIC OUTPUT**	=	**$155M** **ECONOMIC OUTPUT**
	50 **JOB-YEARS**	+	**170** **JOB-YEARS**	+	**530** **JOB-YEARS**	=	**750** **JOB-YEARS**
	$4.1M **COMPENSATION** ($82,000 per worker)	+	**$16M** **COMPENSATION** ($94,100 per worker)	+	**$47M** **COMPENSATION** ($88,100 per worker)	=	**$67M** **COMPENSATION** ($89,200 per worker)

Source: HR&A analysis of Empire AI and IMPLAN data.



Detailed Case Studies

Biotech, Life Sciences, and Health Care

SWAXSFold: Experiment-guided Structure Prediction for Drug Design

Prof. Grant, is developing an AI model (SWAXSFold) to predict protein structure, potentially accelerating drug development and diseases treatment.

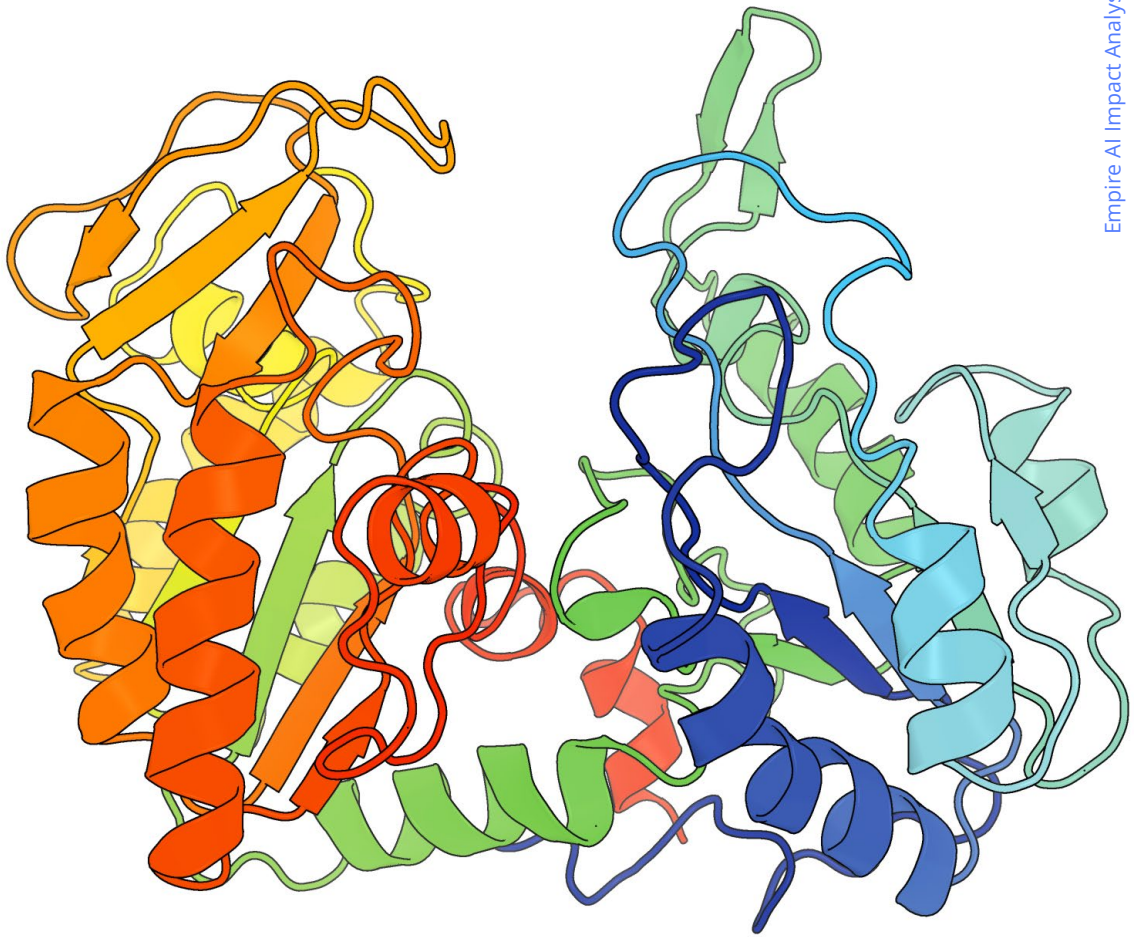
Prof. Thomas D. Grant

Assistant Professor,
Jacobs School of Medicine & Biomedical Sciences

University at Buffalo

Image source: University at Buffalo.

Image source: Prof. Thomas D. Grant.



SUNY: SWAXSFold: Experiment-guided Structure Prediction for Drug Design

SWAXSFold aims to improve upon AlphaFold, an AI-model developed by Alphabet's DeepMind that predicts protein structure, to integrate changes to environments and stimuli.

Challenge

In protein dynamics, determining protein structures was historically a slow and expensive process of trial and error.

While DeepMind's AlphaFold was a major leap in AI-driven protein prediction, it struggles to account for how proteins change shape in response to environmental factors like pH and temperature.

Approach

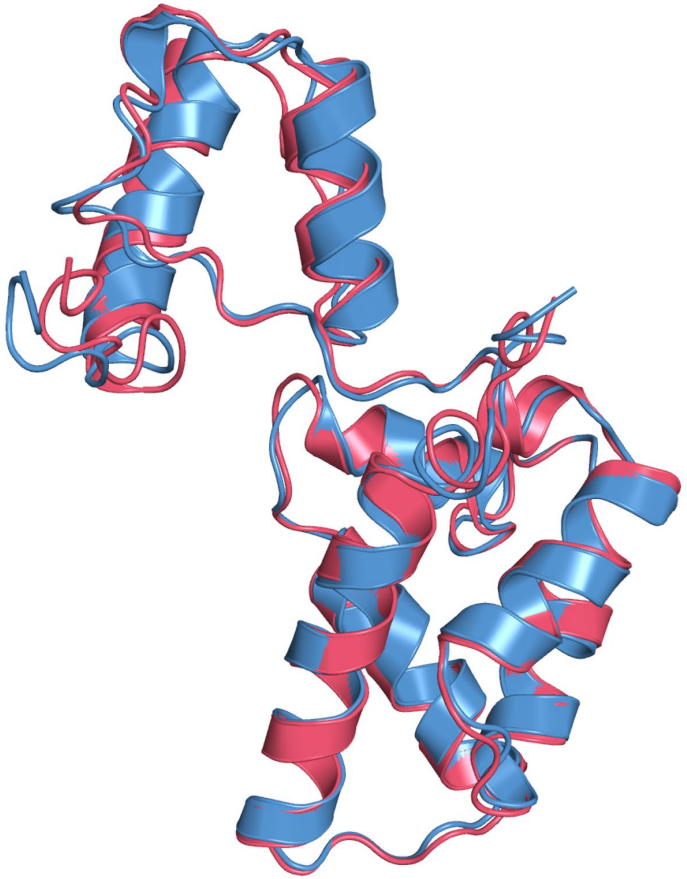
Prof. Grant is developing SWAXSFold to improve upon AlphaFold's predictions by using experimental data from small and wide-angle X-ray scattering (SWAXS).

SWAXSFold aims to predict how **protein structure could change shape in response to environmental factors**.

Source: HR&A Interview with Prof. Thomas D. Grant.

SUNY: SWAXSFold: Experiment-guided Structure Prediction for Drug Design

With Alpha, SUNY researchers are able to train large-scale AI models like SWAXSFold that innovate at the level of well-funded, large-scale projects like AlphaFold.



Training and developing SWAXSFold requires **thousands of GPU hours** until seeing initial results.

Previously, Professor Grant's team, which had access to only a few GPUs, **would have spent 3 months on a single training round. With Alpha, that same process now takes 1 or 2 days.**

Source: Thomas Grant et al., "High-Resolution Structure Determination of Protein-Ligand Complexes with Solution Scattering," (link).

SUNY: SWAXSFold: Experiment-guided Structure Prediction for Drug Design

Improved AI-driven protein predictions that consider environmental changes can speed up drug development. This enables more effective treatments for a wide range of diseases.

"Without Empire AI, we would have relied on commercial cloud services like Amazon EC2 or Google Cloud. However, gaining access to the large-scale GPU resources needed for our work is both difficult and expensive."

- Prof. Thomas D. Grant

Potential Impact

Accelerating drug discovery: Providing accurate protein structure predictions through SWAXSFold could shave years and billions of dollars off the drug discovery process, which usually takes decades and lots of failures.

Improving the design of new treatments: Detailed understanding of protein dynamics will allow researchers to create more specific and powerful drugs and vaccines.

Source: HR&A Interview with Prof. Thomas D. Grant.

AI Detection of Prostate Cancer Subtypes

Professor Ekta Khurana is applying AI-powered image analysis to identify aggressive, treatment-resistant subtypes of prostate cancer, aiding early diagnosis and personalized care

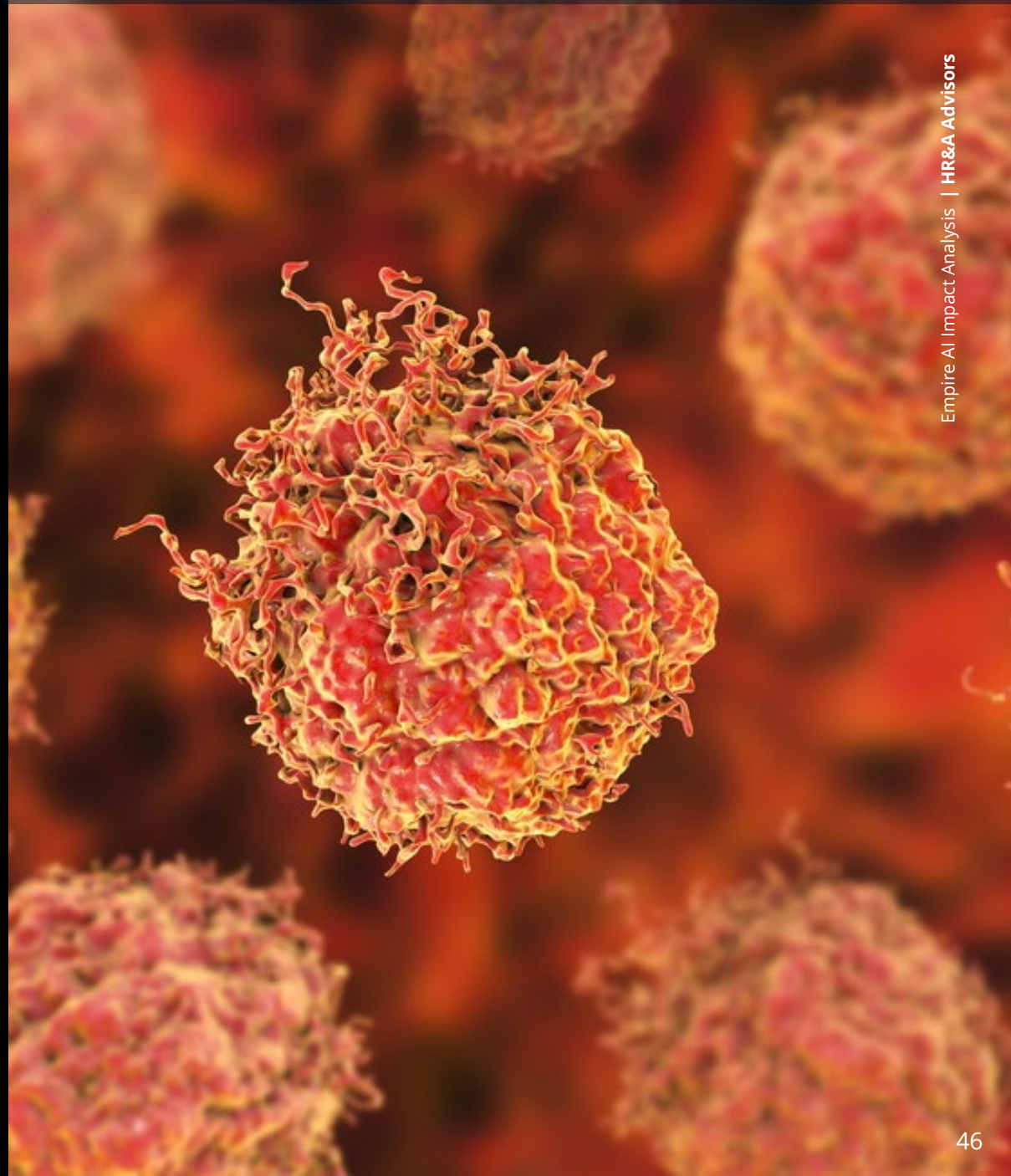
Prof. Ekta Khurana

Associate Professor of Systems and Computational Biomedicine

Weill Cornell Medicine

Image source: Weill Cornell Medicine.

Image source: Shutterstock.



Weill Cornell Medicine: AI Detection of Prostate Cancer Subtypes

With Alpha's compute power, Prof. Khurana's team can train large-scale AI models on prostate cancer images, boosting the detection of high-risk subtypes.

Challenge

Castration-resistant prostate cancer (CRPC), particularly aggressive subtypes, are **difficult to detect and respond poorly to hormonal therapies.**

15,550 patients

Diagnosed with prostate cancer annually, with almost all patients developing CRPC

30%

Of CRPC patients develop the specific subtype that Professor Khurana is studying

Approach

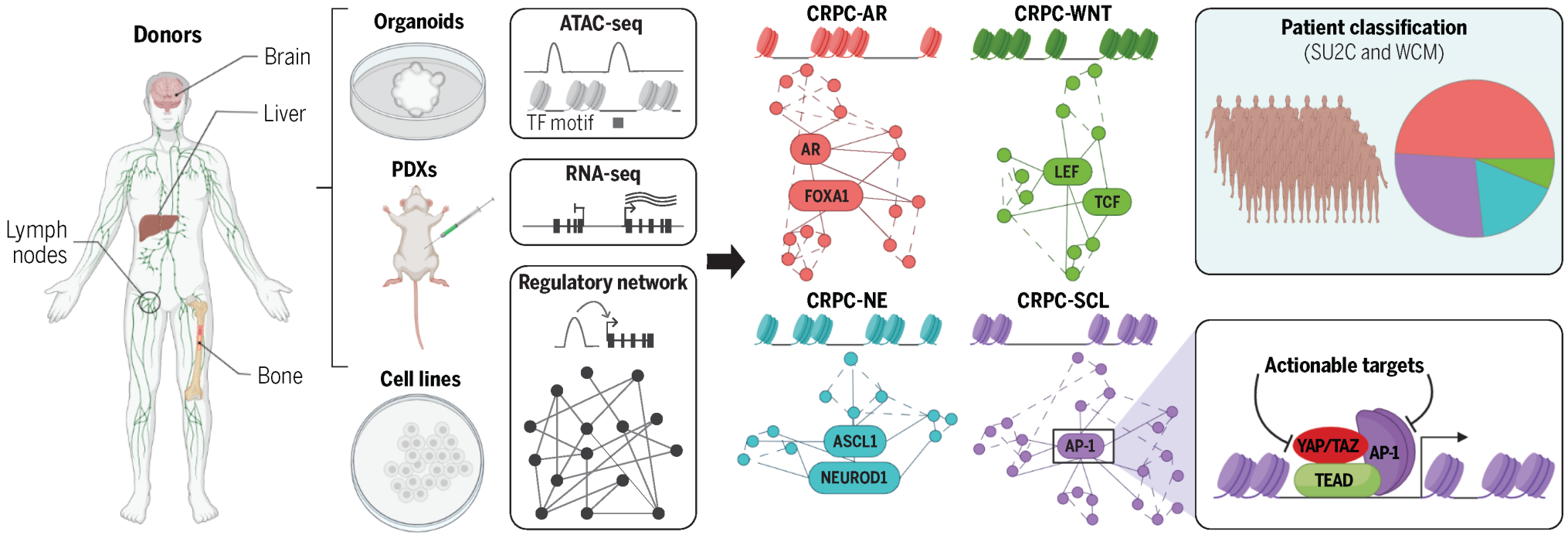
Professor Khurana's team uses AI and foundation models to **analyze thousands of de-identified prostate cancer tissue images, aiming to identify an aggressive CRPC subtype that resists hormone therapy.**

These subtypes are difficult to detect with standard methods, but **the model trained on Alpha can spot subtle patterns without invasive molecular tests**. Oncologists and pathologists then validate the findings.

Sources: HR&A Interview with Prof. Ekta Khurana; Philip A. Watson et al., "Emerging mechanisms of resistance to androgen receptor inhibitors in prostate cancer," (link); and Fanying Tang et al., "Chromatin profiles classify castration-resistant prostate cancers suggesting therapeutic targets," (link).

Weill Cornell Medicine: AI Detection of Prostate Cancer Subtypes

Prof. Khurana is using Alpha to train AI models on tens of thousands of de-identified, high-resolution images of prostate cancer tissue paired with molecular and clinical data.



Identification of four subtypes of CRPC using omics data by the Khurana lab. The team is now using EmpireAI to identify these subtypes using histopathology images and AI

Source: Fanying Tang et al., "Chromatin profiles classify castration-resistant prostate cancers suggesting therapeutic targets," (link).

Weill Cornell Medicine: AI Detection of Prostate Cancer Subtypes

Prof. Khurana is using Alpha to detect aggressive, treatment-resistant prostate cancer from standard tissue images, aiming to improve diagnoses and guide personalized care.

Potential Impact

Improved Outcomes: AI models trained on large, diverse image datasets can spot subtle patterns to help identify aggressive, treatment-resistance prostate cancer earlier, improving patient outcomes.

Personalized Treatment Planning: Detecting molecular-level differences from standard tissue images can help oncologists tailor therapies, reducing trial-and-error and unnecessary side effects.

Lower Healthcare Costs: More accurate early detection and targeted treatment can reduce the need for expensive, late-stage interventions, lowering overall care costs.

Source: HR&A Interview with Prof. Ekta Khurana.

Role of Gut Microbiome in Malaria

The researchers are using Alpha to analyze genomic data and reveal how gut bacteria affect malaria severity, guiding potential new treatment strategies.

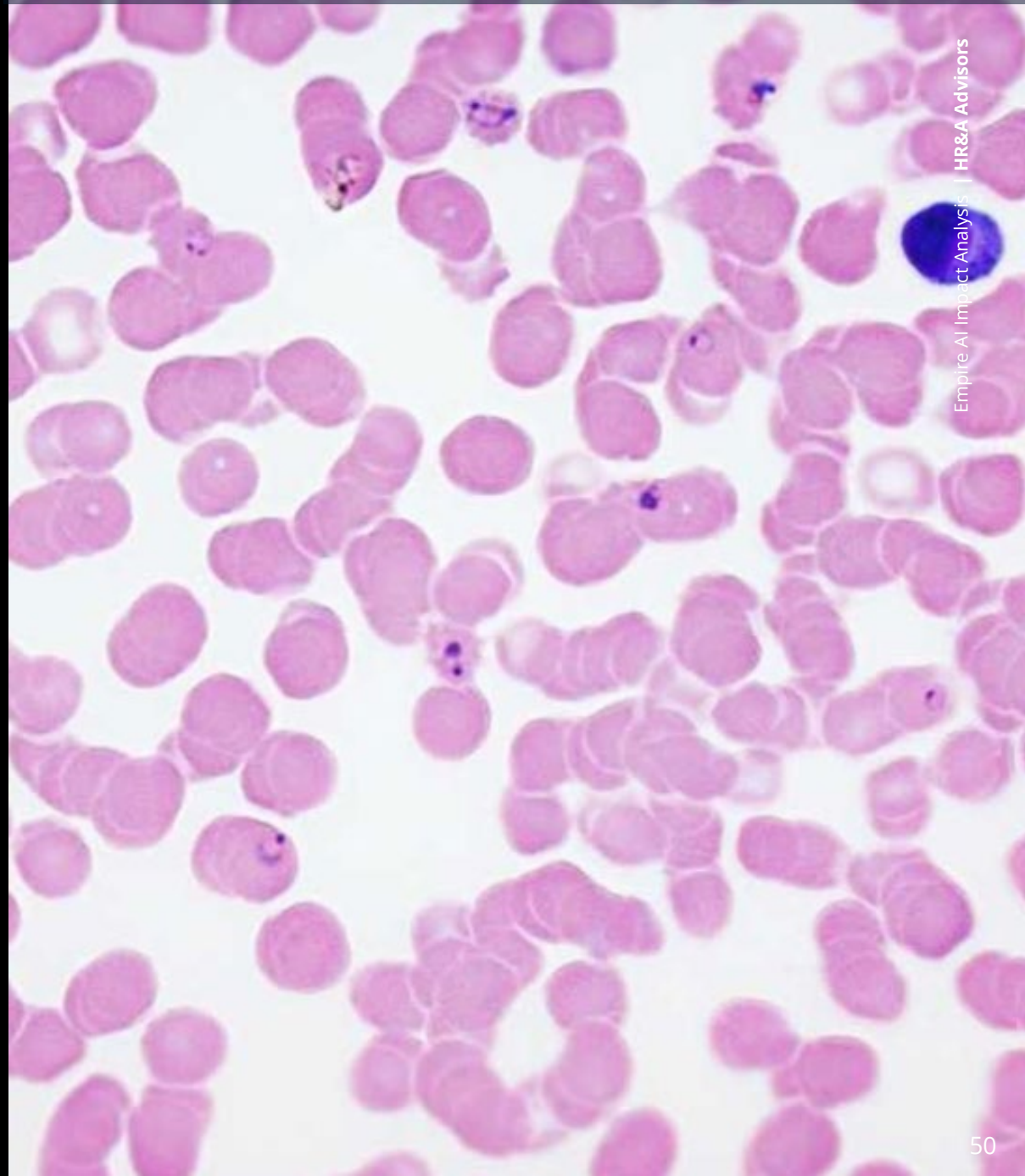
Prof. Rabindra Kumar Mandal

Assistant Professor, Biology & Biochemistry

City University of New York (CUNY)

Image source: CUNY.

Image source: MIT News, "Red blood cells from a patient infected with *Plasmodium falciparum*, the parasite that causes malaria."



CUNY: Role of Gut Microbiome in Malaria

Alpha is accelerating large-scale genomic analysis to uncover how gut bacteria influence malaria severity and immune response.

Challenge

It is not yet fully understood how **gut bacteria regulate the immune response to malaria,** and learning more about relationship could inform the **development of new treatments.**

263 million

Annual global malaria cases

600,000+

Estimated global deaths from malaria, 80% of which are children under 5 years old

Approach

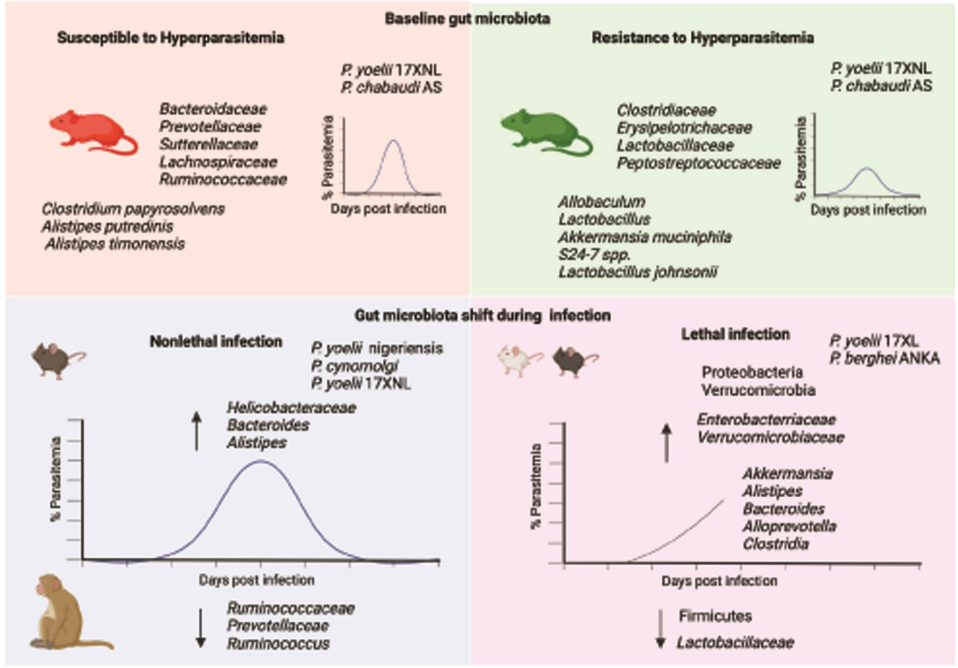
Prof. Rabindra Kumar Mandal is studying **how the gut microbiome influences the severity of malaria,** with a focus on uncovering how certain gut bacteria affect the body's immune response.

His team analyzes **large-scale genomic data to identify patterns in the bacteria** linked to different outcomes in malaria, requiring high-performance computing resources to process nearly half a terabyte of data.

Source: HR&A Interview with Prof. Rabindra Kumar Mandal and WHO, "World Malaria Report 2024."

CUNY: Role of Gut Microbiome in Malaria

Professor Mandal is using Alpha to **process massive genomic datasets** from gut and blood samples to uncover how bacteria influence malaria severity.



Mechanistic insights into the interaction between the host gut microbiome and malaria

Alpha has analyzed:

Hundreds

of gut bacterial interaction, pathways, metabolites, and immune patterns

500+ GB

of genomic, transcriptomic, and metabolomic data from gut and blood samples of malaria models

Source: Rabrinda K. Mandal and Nathan W. Schmidt, "Mechanistic insights into the interaction between the host gut microbiome and malaria," (link).

CUNY: Role of Gut Microbiome in Malaria

Empire AI's Alpha supercomputer provides the speed, memory, and affordability needed to advance life-saving infectious disease research.

"Without Empire AI, we wouldn't be able to run our models. AWS costs ~$300/month even for small projects. Alpha lets us train complex models quickly—something we simply couldn't afford otherwise."

- Prof. Rabindra Kumar Mandal

Potential Impact

Global Health Equity: Alpha enables low-cost, high-performance analysis of malaria-related microbiome data, supporting the development of treatments for a disease that disproportionately affects children and people in low-income regions.

Advancing Microbiome Science: By helping identify how gut bacteria influence the immune system, Alpha supports groundbreaking research that could extend beyond malaria to other immune-related diseases.

Source: HR&A Interview with Prof. Rabindra Kumar Mandal.

Structural Studies of BicD2-related Cellular Transport Pathways that are Essential for Brain and Muscle Development

Prof. Solmaz studies mutations of BicD2 protein, which causes severe brain and muscle developmental defects in infants.

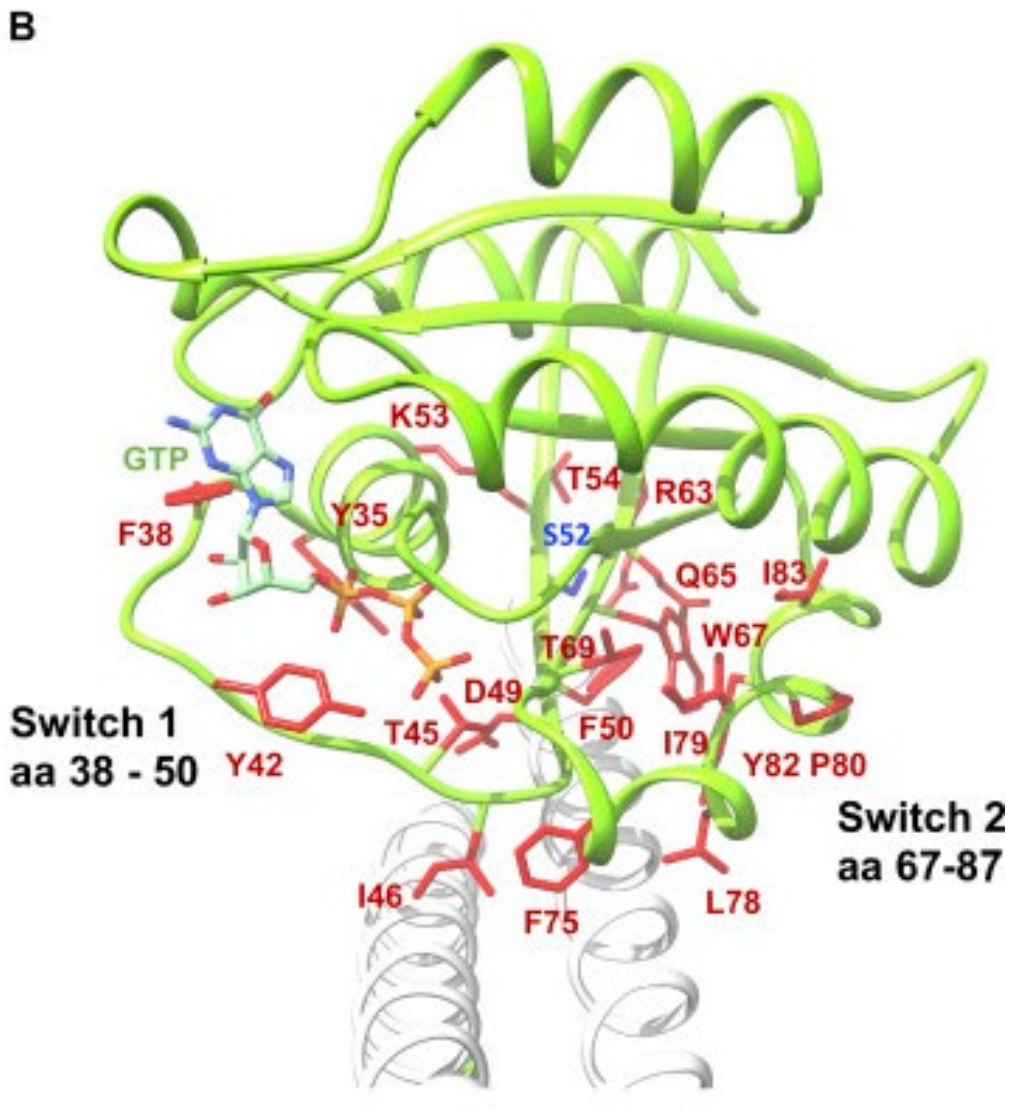
Prof. Sozanne Solmaz

Associate Professor, Chemistry

Binghamton University, State University of New York (SUNY)

Image source: Binghamton University.

Image source: National Institutes of Health.



SUNY: Structural Studies of BicD2-related Cellular Transport Pathways

Prof. Solmaz is researching how mutations in the BicD2 protein disrupt cellular transport pathways, with the goal of developing therapies for brain and muscle development diseases.

Challenge

Mutations in BicD2 gene have been found to cause **brain developmental defects**, particularly among infants. Despite its impact on human disorders, the underlying cause of BicD2 associated diseases remains incompletely understood.

1 in 6,000 babies

are born with Spinal Muscular Atrophy (SMA), which is the most common genetic cause of deaths in infants

Spinal Muscular Atrophy (SMA) is a genetic neuromuscular disorder that cause certain muscles to become weak and waste away (atrophy). Mutations of BicD2 protein have found to cause SMA. In the worst case, it can cause deaths.

Approach

Developing protein mutations models is crucial to investigating brain development disorders.

Professor Solmaz's team is using Alpha to design these protein structures, focusing on how mutations of BicD2 protein disrupt cellular transport pathways.

Sources: HR&A Interview with Prof. Sozanne Solmaz; Julie Yi et al., "Role of Nesprin-2 and RanBP2 in BICD2-associated brain developmental disorders," (link); and Munkhtuya Tumurkhuu et al., "A novel BICD2 mutation of a patient with Spinal Muscular Atrophy Lower Extremity Predominant 2," (link).

SUNY: Structural Studies of BicD2-related Cellular Transport Pathways

Alpha allows Prof. Solmaz's research team to predict protein structure and quickly formulate hypotheses and perform experiments.

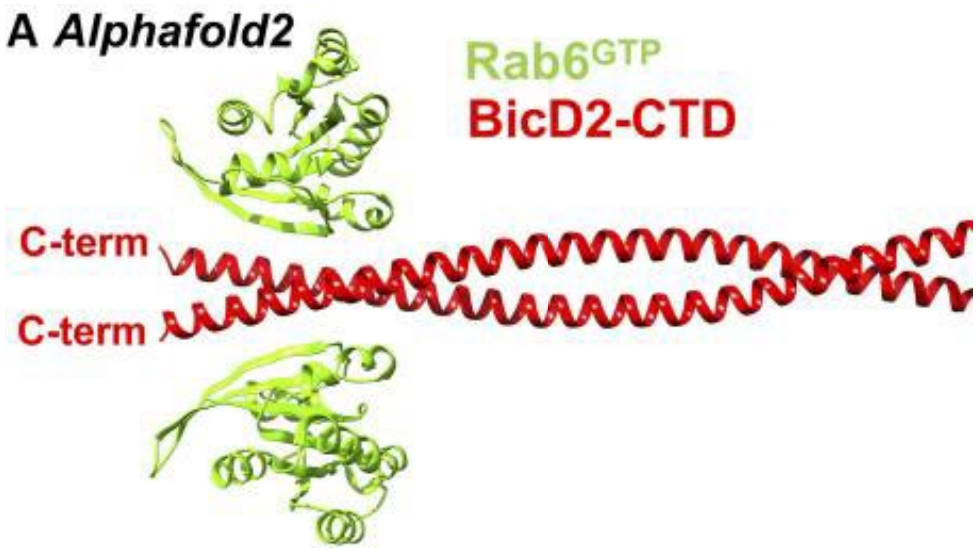


Illustration of the highest ranked structural model of Rab6 / BicD2-CTD complex, generated by AlphaFold—an AI model developed by DeepMind, a subsidiary of Alphabet, that predicts protein structures.

Determining protein structures through experimental biochemistry was historically a time-intensive process.

Prof. Solmaz's team uses Alpha to run AlphaFold—an AI model developed by DeepMind—to **rapidly predict protein structures, enabling them to concentrate on hypothesis generation and experimentation** based on protein structure.

Source: Xiaoxin Zhao et al., "Molecular mechanism for recognition of the cargo adapter Rab6GTP by the dynein adapter BicD2," (link).

SUNY: Structural Studies of BicD2-related Cellular Transport Pathways

Enhancing our understanding of infant brain development has the potential to develop of therapies for rare diseases and offer insights for other neurodegenerative conditions.

Potential Impact

Infant brain development: Studying how BicD2 mutations affect infant brain development provides insights into the vital mechanisms underlying a healthy neural development and lead to the development of targeted therapies for BicD2-related diseases.

Applicability to Other Neurodegenerative Diseases: The discoveries made in Prof. Solmaz's research are also relevant beyond infancy to neurodegenerative disorders among adults such as Alzheimer's, which could pave the way for novel therapeutic cures for a range of brain diseases.

Source: HR&A Interview with Prof. Sozanne Solmaz.

Medical Image Analysis for Diagnosis

Prof. Pingkun Yan of RPI is using Alpha to develop an AI foundational model for medical image analysis for cardiovascular diseases, the leading cause of death in New York State.

Prof. Pingkun Yan

P.K. Lashmet Chair Professor and Department Head of Biomedical Engineering

Rensselaer Polytechnic Institute

Image source: RPI.

Image source: Shutterstock.

RPI: Medical Image Analysis for Diagnosis

Alpha is advancing medical image analysis by enhancing the efficiency and accuracy of key clinical tasks, including diagnosis, surgical and treatment planning, and prognosis.

Challenge

Cardiovascular diseases (CVD) are the leading cause of death in New York State.

54,000

Deaths due to CVD in New York State in 2022.

31%

Of all deaths statewide caused by CVD in 2022.

Approach

Doctors typically spend 20–30 minutes analyzing a CT scan and reviewing patient data to prepare a diagnosis.

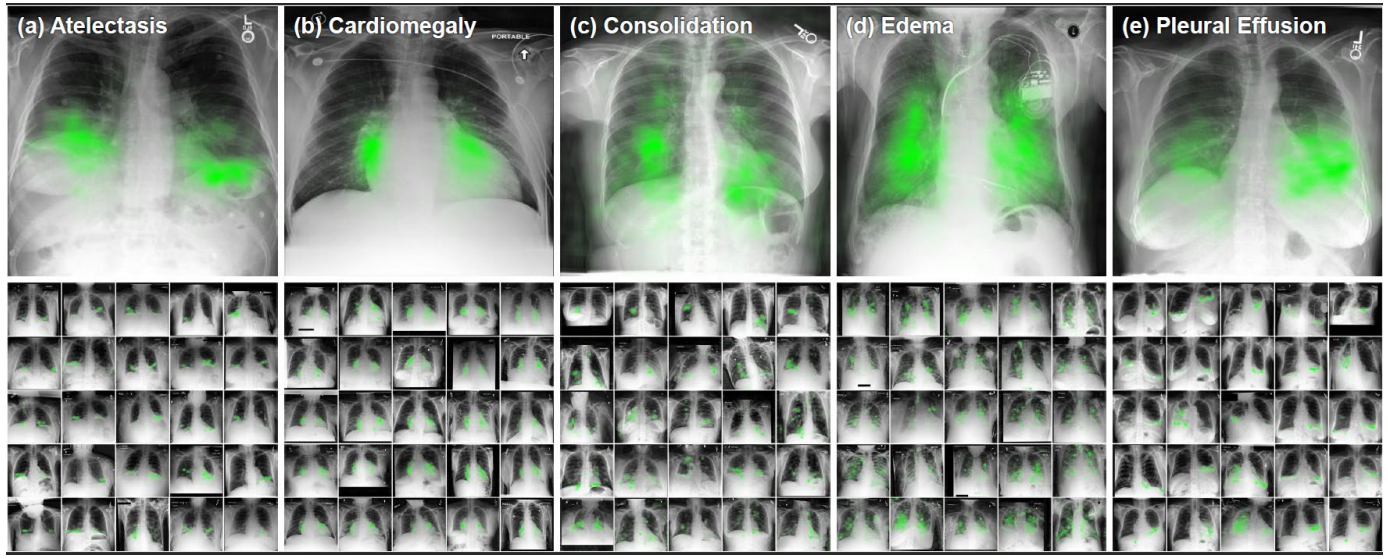
Prof. Yan aims to develop an AI model that can integrate medical imaging with patient data to **deliver faster and more accurate diagnoses**.

The research team uses thousands of chest X-rays and CT scans to develop an AI model that predicts and detects cardiovascular diseases.

Sources: HR&A Interview with Prof. Pingkun Yan and New York State Dept of Health, "Deaths and Death Rates by Selected Causes and Race, New York State – 2022."

RPI: Foundation Model for Medical Image Analysis

Without Alpha, Prof. Yan's team could not have conducted their research involving the training of an AI model on thousands of medical images and patient data.



Examples of attention maps that show abnormalities in chest X-rays for five different pathologies by highlighting the regions where they most frequently occur. Each anchor image (above) represents the average of 25 attention maps (below) for a given pathology.

Alpha has analyzed:

987,000

Chest X-rays

128,000

CT scans

33,000

Anonymized patient data

Source: Zefan Yang et al., "Chest X-ray Foundation Model with Global and Local Representations Integration," (link).

RPI: Foundation Model for Medical Image Analysis

Developing an AI model using Alpha can improve the accuracy and efficiency of medical image diagnostics and lead to early disease detection, which can reduce healthcare costs.

Potential Impact

Enhance Diagnostic Accuracy and Efficiency: A trained AI model delivers fast, consistent, and detailed analysis of medical images, exceeding human limitations in time and precision.

Reduce Healthcare Costs: Early detection of cardiovascular diseases through more accurate diagnoses can reduce the severity of the disease and improve patient health while lowering healthcare costs.

Advancing AI Innovation: Alpha enables researchers like Prof. Yan to develop leading AI models that contribute significantly to AI advancement and position New York State as a leader in AI development.

Source: HR&A Interview with Prof. Pingkun Yan.

Advanced Manufacturing & Cleantech

Molecular Simulation for Next-Generation Battery Applications

Prof. Tuckerman and his collaborators aim to revolutionize battery electrolytes by replacing crucial metals with organic molecules that are cleaner for the environment.

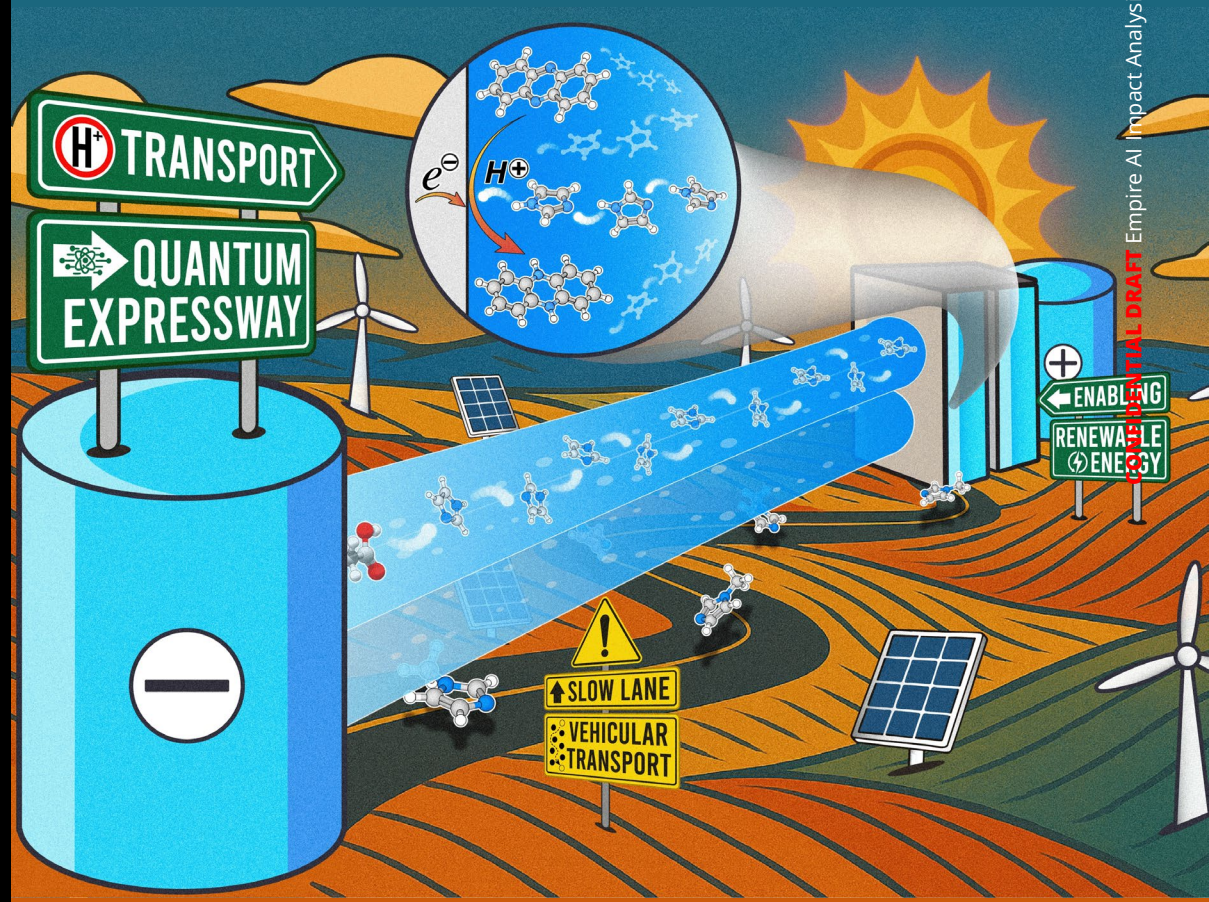
Prof. Mark Tuckerman

Professor of Chemistry & Mathematics

New York University

Image source: Mark Tuckerman.

Image source: Miguel Muñoz, (link).



NYU: Molecular Simulation for Next-Generation Battery Applications

Prof. Tuckerman aims to create green battery technologies using stable, easily synthesizable organic molecules through a combination of AI-driven modeling and targeted experimental investigations.

Challenge

Manufacturing conventional batteries based on critical minerals, such as lithium or vanadium, is harmful to the environment.

1.3M tonnes

Global annual carbon emissions from lithium mining

Approach

Concentrated hydrogen-bonded electrolytes, which move protons quickly via a series of concerted chemical reactions, are promising for clean energy.

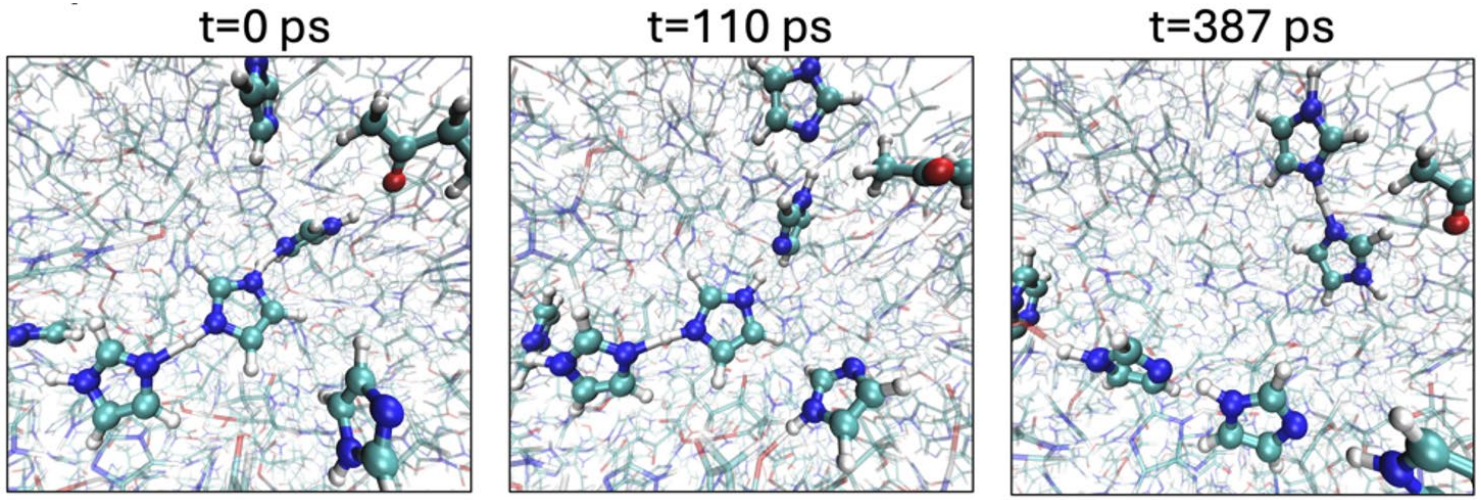
Prof. Tuckerman and his collaborators use AI-driven quantum simulations to explore how this proton transport works at the molecular level to guide the design of advanced electrolytes for next-generation batteries.

Sources: HR&A Interview with Prof. Mark Tuckerman and Earth.Org, "The Environmental Impacts of Lithium and Cobalt Mining."

NYU: Molecular Simulation for Next-Generation Battery Applications

Alpha is helping Prof. Tuckerman and his collaborators develop and deploy machine learning models for performing complex and lengthy quantum simulations.

Prof. Tuckerman and his collaborators use Alpha to model electrolyte performance via conductivity/viscosity relations that assess the rate of proton transport under different temperatures and chemical compositions.



In just under half a nanosecond, a chain of imidazole molecules shuttles a proton in a series of chemical reactions until the chain breaks and reforms with different molecules, leaving the proton on a new chain with no path back to its original state, leading to net proton transport.

Source: Mark Tuckerman, Paper under Review.

NYU: Molecular Simulation for Next-Generation Battery Applications

Availability of green batteries using stable, easily synthesized molecules can deliver significant environmental benefits and contribute to the clean energy transition.

Potential Impact

Environmental Sustainability: Conventional batteries rely on the mining of critical minerals like lithium and vanadium, which can cause significant ecological damage. By using cheap, stable, and naturally occurring organic molecules, Prof. Tuckerman's research could lead to innovation of next-generation batteries that are environmentally sustainable.

Facilitate the Clean Energy Transition: Prof. Tuckerman's research can accelerate the shift to renewable energy by providing more efficient, sustainable, and cheaper energy storage.

Note: Prof. Tuckerman's work was supported as part of the Breakthrough Electrolytes for Energy Storage Systems (BEES2) Center, an Energy Frontier Research Center funded by the U. S. Department of Energy, Office of Science, Basic Energy Sciences under Award No. DE-SC0019409.

Source: HR&A Interview with Prof. Mark Tuckerman.

Climate Modeling with Generative AI

Prof. Tian Zheng is using Alpha to improve climate simulations and develop models that can project future extreme weather risks for local adaptation planning.

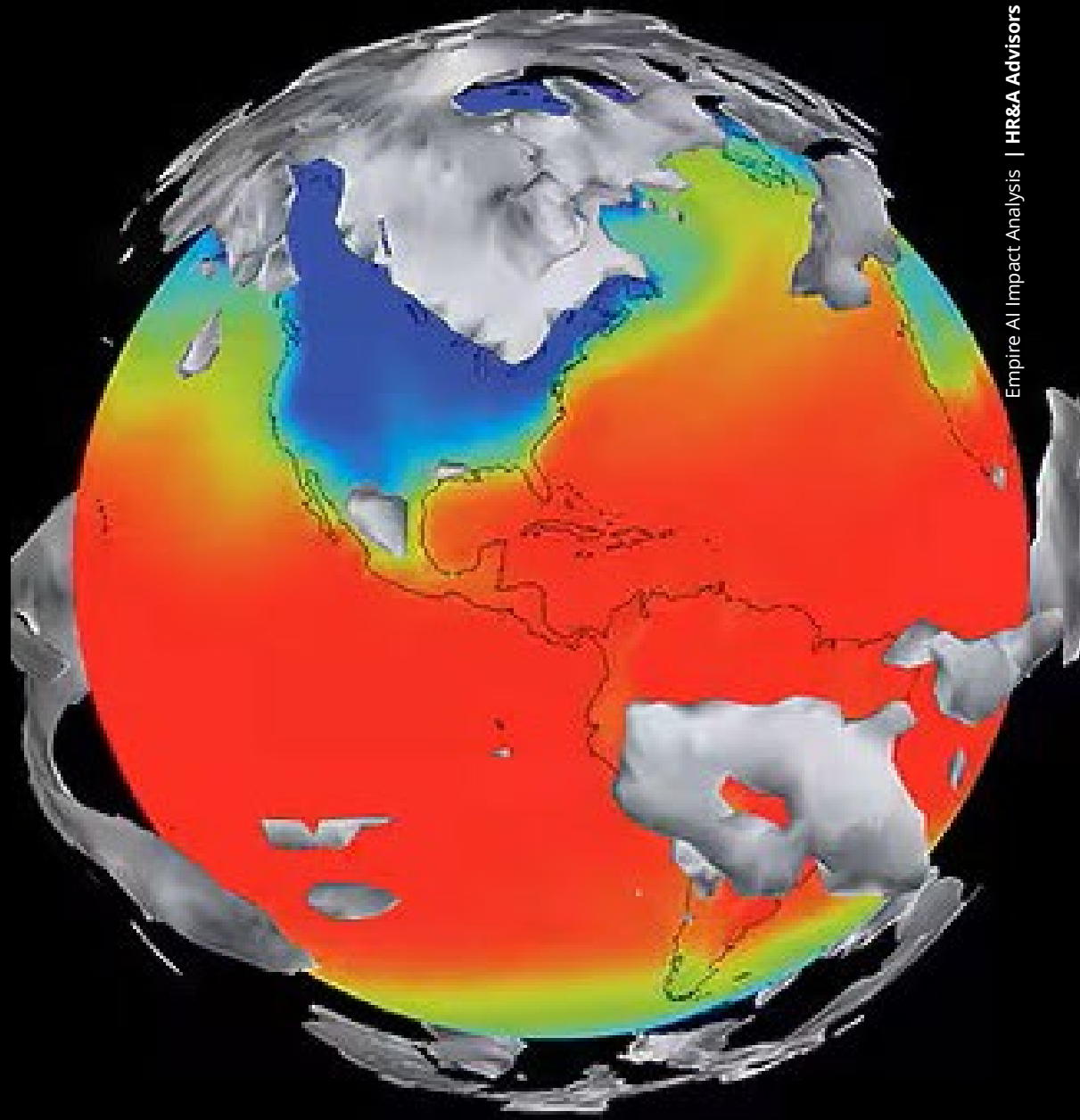
Prof. Tian Zheng

Professor of Statistics & Department Chair

Columbia University

Image source: Columbia University.

Image source: Pacific Northwest National Laboratory.



Columbia University: Climate Modeling with Generative AI

Alpha is accelerating climate research by enabling Prof. Zheng's team to run AI-enabled simulations that leverage multi-modal data for long-term extreme weather projections.

Challenge

As the climate crisis intensifies, governments must act without reliable local models to predict extreme weather and impacts.

100+

NYC emergency events tied to climate (e.g., flooding, extreme heat) since 2000

$10 billion

Estimated annual economic damages from climate-related weather events across NYS by 2050

Approach

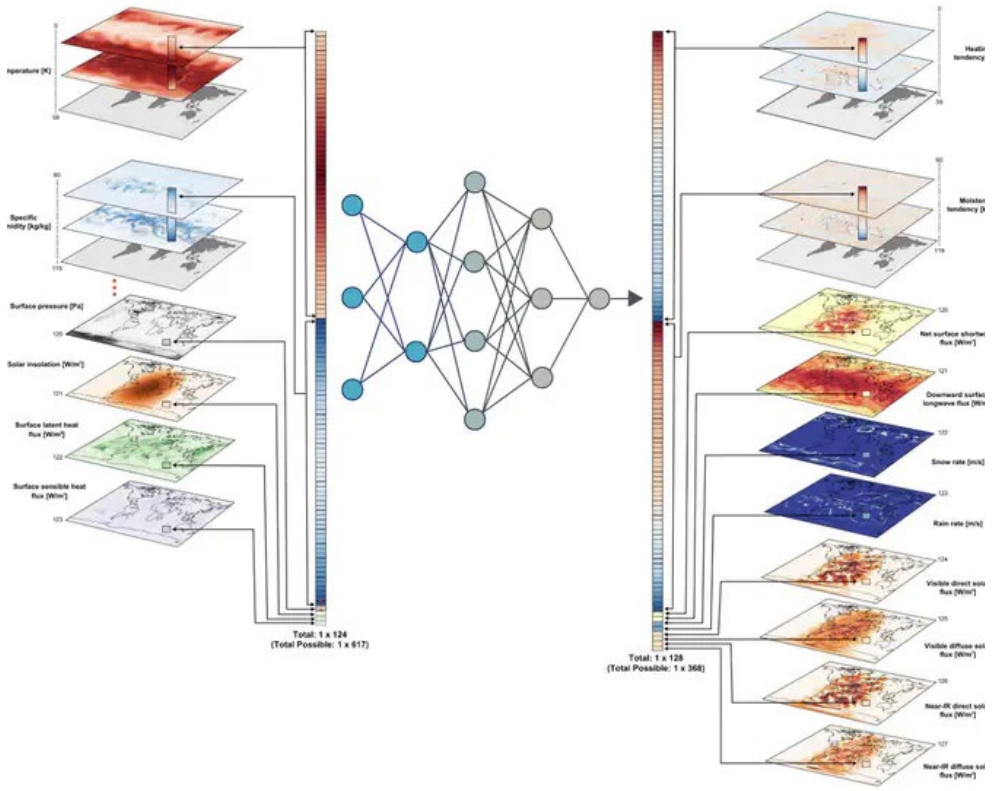
Prof. Zheng's team is using machine learning to accelerate and contextualize **long-term climate projections**, combining projections from traditional Earth Systems Models with advanced statistical latent-variable models trained using observational data like 311 flooding complaints.

The research aims to determine whether integrating climate simulations with lived experience data can yield more precise, neighborhood-level risk estimates, and produce 5-, 10-, and 20-year forecasts to guide adaptation strategies.

Sources: HR&A Interview with Prof. Tian Zheng, New York City Mayor's Office of Climate & Environmental Justice; and NYSERDA, "Climate Change."

Columbia University: Climate Modeling with Generative AI

Alpha is processing large-scale climate simulations to support AI-driven modeling.



The spatially-local version of ClimSim – a large multi-scale dataset and framework for hybrid machine learning physics climate emulation.

Alpha provides:

10x

Compute power for simulations than previous existing GPUs

Leveraging Empire AI's computational power, Prof. Zheng's team can employ state-of-the-art generative AI models, such as Stable Diffusion, to enhance the long-term stability of machine learning models that can run hundreds of climate simulations to provide neighborhood-level forecasts.

Source: Sungduk Yu et al., "ClimSim-Online: A Large Multi-scale Dataset and Framework for Hybrid ML-physics Climate Emulation," (link).

Columbia University: Climate Modeling with Generative AI

This research could help plan for flooding, heat, and infrastructure disruptions by enabling downscaling—refining global climate models to produce high-resolution local forecasts.

"We can only consider the downscaling workstream as a result of Empire AI."

- Prof. Tian Zheng

Potential Impact

Scalable Risk Modeling for NYS communities: Prof. Zheng's modeling framework, currently developed for New York City, could be extended upstate or to coastal areas in New York State, providing local governments with fine-grained forecasts to inform zoning, transportation, and emergency preparedness.

Reducing Climate-Related Harm: With extreme heat now causing more deaths annually in the United States than any other weather-related event, Professor Zheng's research could help state and local government agencies identify at-risk populations, improve early warning systems, and design life-saving interventions for high-risk populations.

Source: HR&A Interview with Prof. Tian Zheng.

Technology & Digital Media

Diffusion Language Generation

Prof. Kilian Weinberger is using Alpha to create an AI text model that uses a step-by-step generation process to give users more control over tone and rules in sensitive settings.

Prof. Kilian Weinberger

Professor of Computer Science

Cornell University

Image source: Cornell University.

Image source: Shutterstock.

Cornell University: Diffusion Language Generation

Alpha is being used to train diffusion-based large language models that improve control over text generation outputs.

Challenge

Language models like Chat GPT are difficult to control and operate largely as "black boxes", making it **challenging to guide their tone, content, or behavior.** This lack of transparency and controllability **limits their safe and reliable use in sensitive domains** such as healthcare, education, and customer service.

$22,000

Approximate industry pricing for one week of the same compute used for Prof. Weinberger's project

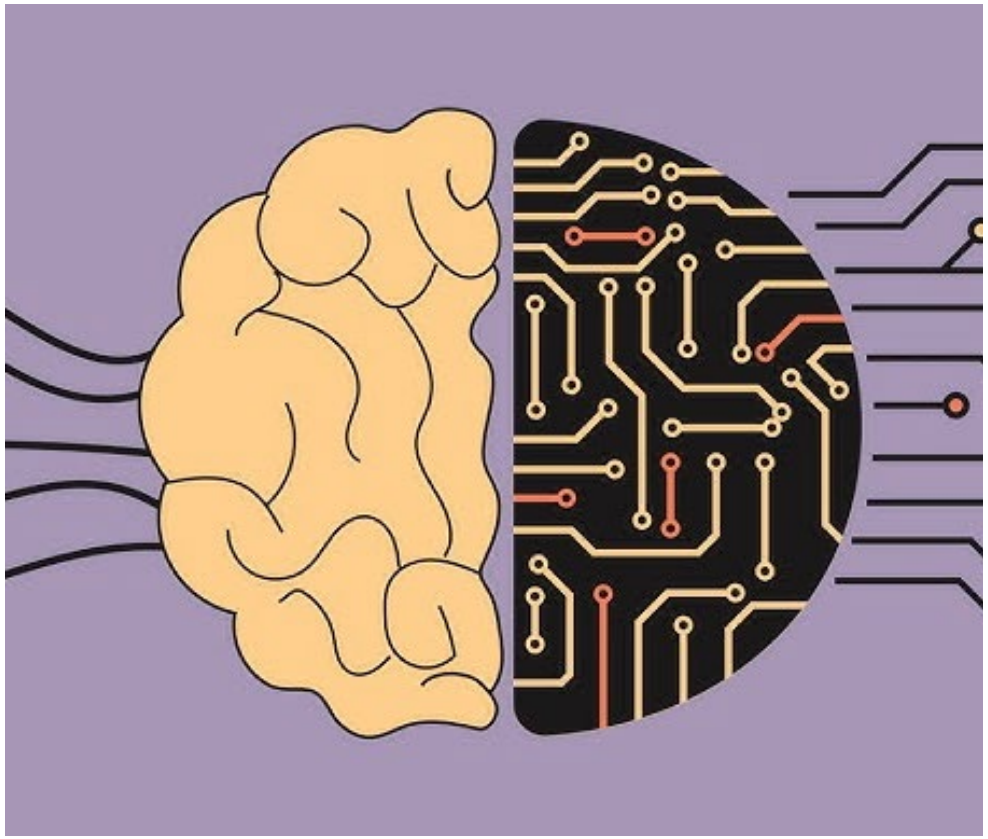
Approach

Prof. Weinberger's team is applying **diffusion models, commonly used in image generation, to language generation.** They are developing a "regulation knob" to guide responses based on positive and negative examples. Unlike other alignment methods, this preserves fluency without dulling model capabilities.

Sources: HR&A Interview with Prof. Killian Weinberger and AWS.

Cornell University: Diffusion Language Generation

Professor Weinberger is using Alpha to train diffusion-based language models on millions of text sequences from large public datasets.



Advancing Diffusion Models for Text Generation

Alpha has analyzed:

At least 4.5M

Training instances within the WMT14 De-En (English-German) dataset

537,600 GPU Core Hours

Approximate training time used over a week on Alpha

Source: Killian Weinberger, "On Knowledge Separation and Latent Diffusion for Text," (link).

Cornell University: Diffusion Language Generation

Empire AI's Alpha supercomputer allows Prof. Weinberger's team the computing power to develop controllable language models, enabling safer, more reliable AI tools for use in healthcare, education, and public services.

"Training these models takes a huge amount of computing power—days or even weeks on dozens of GPUs. Without Empire AI, we would have had to go to the private sector, and then we couldn't publish our work."

- Prof. Kilian Weinberger

Potential Impact

Safer AI in Sensitive Settings: Through advancements in diffusion-based models, AI can be tuned to follow strict rules ensuring medical chatbots, education tools, and/or government services provide tone and privacy sensitive content while preserving the accuracy and nuance of the model.

More equitable public access to AI: By keeping this research within the public domain, Empire AI enables cities, nonprofits, and smaller organizations to deploy high-quality, safe AI tools without relying solely on private tech companies.

Source: HR&A Interview with Prof. Killian Weinberger.

Scaling Music Transformers

Prof. John Thickstun of Cornell is using Alpha to build generative models of musical scores, creating controllable and editable AI tools to aid in music composition.

Prof. John Thickstun

Assistant Professor,
Computer Science

Cornell University

Image source: Cornell University.

Image source: Shutterstock.

Cornell University: Scaling Music Transformers

Alpha is being used to develop a generative AI model for music composition designed to serve as a collaborative creative tool for composers and musicians.

Challenge

Commercial music generation models (like Suno and Udio) could violate artists' copyrights and remove musicians from the music creation process.

Commercial tools like these could undermine artistic ownership and threaten jobs across the music industry.

3,640

Music Directors and Composers Jobs in New York State (2022)

Approach

Prof. John Thickstun's research explores the use of **AI to develop musical scores**, rather than generating final audio output.

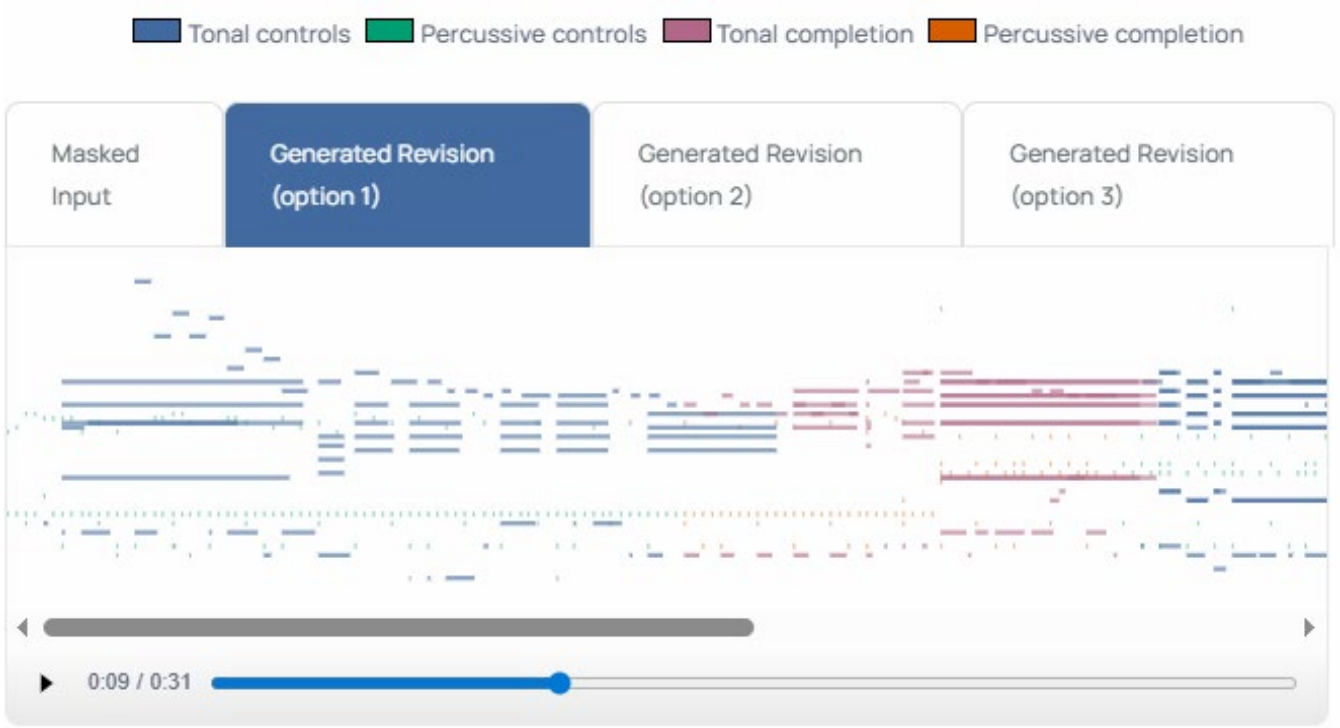
His work aims to support composers and musicians—treating AI not as a replacement but as a creative tool to support composing music.

Editing musical scores is a more flexible and collaborative medium for composers and musicians.

Sources: HR&A Interview with Prof. John Thickstun and US Bureau of Labor Statistics.

Cornell University: Scaling Music Transformers

Alpha enables Prof. Thickstun's team to build resource-intensive generative AI models by providing the multi-cluster training capabilities and multi-node computing support.



Based on a melody and vamp and percussion inputs (blue and green), the AI model has suggested musical accompaniments (purple and orange).

Alpha has analyzed:

MIDI files (Musical Instrument Digital Interface) that are in the public domain.

MIDI file is a digital file format containing instructions on how to play a music, rather than the actual sound. MIDI file is essentially a digital score, commonly used in music software.

Source: John Thickstun, "Anticipatory Music Transformer: A Controllable Infilling Model for Music," (link).

Cornell University: Scaling Music Transformers

A generative AI model for music composition can support musicians' creative processes, broaden access to music education, and support New York as a leader in ethical AI research.

"Empire AI is an important counterweight. We need more public investments like this."

- Prof. John Thickstun

Potential Impact

Empowering Musicians: A generative AI model supports the music composition process, helping musicians instead of replacing them.

Expanding Access to Music Education: AI models can act as virtual educators, like chess AI tools, that can provide feedback and suggest revisions to music composition, enabling more people to engage in music-making.

Advancing Ethical AI Research: Building AI models that align with humanistic values, unlike commercial models driven by profit motives, can more broadly benefit society.

Source: HR&A Interview with Prof. John Thickstun.

Using RNNs Trained on Cognitive Tasks to Generate Hypotheses for Neuroscience

Prof. Constantinople of NYU is using Alpha to study how brains make decisions.

Prof. Christine Constantinople

Assistant Professor,
Center for Neural Science

New York University

Image source: NYU.

Image source: Shutterstock.

NYU: Using RNNs to Generate Hypotheses for Neuroscience

Alpha is helping to train Recurrent Neural Networks (RNNs) to replicate a real brain as much as possible, so that the researchers can study how humans think and make decisions.

Challenge

Many aspects of human decision-making are still unexplained, largely due to our limited knowledge of the brain's underlying mechanisms.

An example is disordered decision-making, a feature of all neuropsychiatric disorders, including schizophrenia and depression.

1 in 5

New York residents experience symptoms of mental disorder every year

Approach

The Constantinople Lab is training RNNs to replicate the brain.

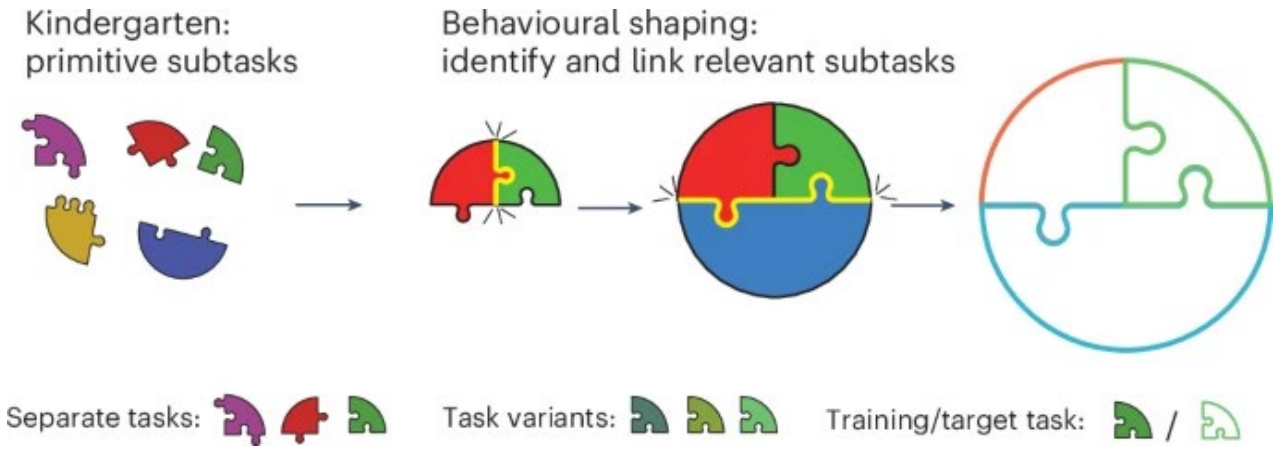
Unlike the biological brain, RNNs allow **full visibility into every neuron and all their interconnections**.

This transparent architecture enables researchers to gain valuable insights into the fundamental workings of the brain.

Sources: HR&A Interview with Prof. Christine Constantinople and New York State Comptroller, "March 2024 Report: Mental Health: Inpatient Service Capacity," (link).

NYU: Using RNNs to Generate Hypotheses for Neuroscience

With Alpha's computational power, the Constantinople Lab can quickly iterate and test a wide range of neural network setups to refine their models.



The target behavior or task (open circle) can be thought of as composed of several computational sub-elements, some of which may need to be computed in parallel. These sub-computations involve primitive skills that in animals have probably been learned through past experience. Behavioral shaping guides learning by incrementally combining basic skills into more complex functions (linked puzzle pieces).

For RNN training, the Constantinople Lab operationalizes this idea by first training a set of fundamental sub-computations in a 'kindergarten' training phase, followed by behavioral shaping that mimics animal training.

Training RNNs is computationally intensive.

According to Prof. Constantinople, a research task that **previously took about a week** to complete on NYU's compute resources **can now be finished in a single day using Alpha.**

Source: David Hocker et al., "Compositional pretraining improves computational efficiency and matches animal behaviour on complex tasks," (link).

NYU: Using RNNs to Generate Hypotheses for Neuroscience

Insights into neural decision-making may allow us to understand cognitive choices and lead to novel therapeutic solutions for complex mental health conditions.

Potential Impact

Neural Insights: A deeper understanding of the neural processes behind decision-making could lead to new therapeutic targets for many mental and cognitive disorders, including depression and schizophrenia.

Advancements in AI and Machine Learning: The Constantinople Lab introduced a novel method for developing and training neural networks. This work offers a more effective way to train AI systems and represents a significant advancement in the field.

Source: HR&A Interview with Prof. Christine Constantinople.

Appendix

APPENDIX | BENEFITING NEW YORKERS AND THE ECONOMY

Research supported by Empire AI contributes to industries in New York that employ close to 673,500 New York State residents, with an average wage of $171,500.

Industry	Number of Jobs (NYS, 2024)	Average Wage (NYS, 2024)
Advanced Manufacturing & Cleantech Manufacturing for semiconductors, clean energy, and similar products; new materials development.	**193,800**	**$141,300**
Biotech, Life Sciences, and Health Care R&D and production of drugs and health equipment; improvements to patient care and health services.	**115,400**	**$159,300**
Technology & Digital Media Software development, data processing, and information services, including to support movie, TV, and creative production.	**364,200**	**$191,400**

Note: Numbers rounded to the nearest hundred. Does not represent unique jobs as some jobs may be classified under multiple industries.
Sources: New York State Empire State Development, "A Strategic Approach to Workforce Development," (link) and HR&A analysis of Lightcast data.

APPENDIX | ECONOMIC IMPACT METHODOLOGY

HR&A quantified the potential economic impact of investing in Empire AI based on a economic modelling study on R&D productivity from MIT and UCLA researchers.

R&D productivity represents how effectively research efforts accelerate knowledge creation and economic growth. Increasing productivity growth means that R&D can happen faster and more reliably. Investments that increase productivity growth expand existing researchers' output and capabilities, allowing them to accomplish more.

1. Define Economic Base

Assumption: Empire AI Impacts three of New York State's key industry clusters: 1) Advanced Manufacturing and Cleantech; 2) Biotech, Life Sciences, and Healthcare; and 3) Technology & Digital Media

Methodology: 2024 GRP estimates for NYS's priority sectors impacted by Empire AI (Lightcast, 2024)

Total Gross Regional Product (GRP) of the 3 industries in NYS (2024):

$257,233 million

2. Estimate R&D Spending

Assumptions: We estimated the following R&D spending rates for each industry cluster:

- Advanced Manufacturing & Clean Tech R&D: **4%** of GRP
- Biotech, Life Sciences & Healthcare: **12%** of GRP
- Technology & Digital Media: **10%** of GRP

Total estimated R&D spending of the 3 industries in NYS (2024)

$22,134 million

3. Apply Empire AI Impact

Assumptions: 1.2 percentage point increase in productivity growth from investment in Empire AI and broader use of AI tools and infrastructure.

- Average annual productivity growth, 2000-2024: **0.9%** (BLS)
- Potential productivity growth from AI: **2.1%**-**2.4%** (Besiroglu et al.)

Total estimated potential annual economic impact from Empire AI

$266 million

Sources: National Center for Science and Engineering Statistics (NCSES), "Business R&D Performance in the United States Tops $600 Billion in 2021," (link); and Tamay Besiroglu, Nicholas Emery-Xu, and Neil Thompson, "Economic impacts of AI-augmented R&D," (link); Bureau of Labor Statistics, "Total factor productivity by major sectors: private business and private nonfarm business" (link).

APPENDIX | ECONOMIC IMPACT METHODOLOGY

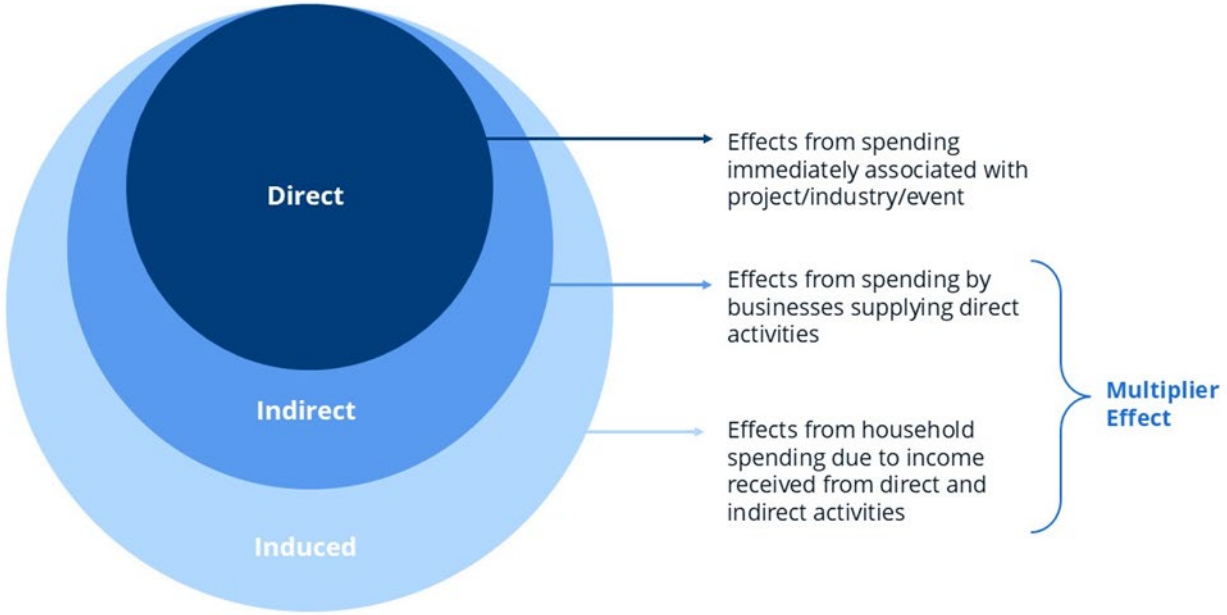
Our analysis describes the economic impacts of Empire AI's investments in the three compute facilities.

HR&A's analysis covers one-time capital investments to establish Empire AI's compute clusters. It does not include ongoing operating expenses such as staff or utilities, or the impacts from the research being conducted with the clusters. The time period covers Empire AI's initial investments from 2024 to 2027. Empire AI intends to make further investments over the coming decade, which are not included.

The total direct impact will be lower than the total investment because purchases from outside New York State mean that some spending will not benefit the state's economy. Through IMPLAN, we estimate that approximately 46% of Empire AI's initial investments will occur in New York State.

Breaking Out Economic Impacts

HR&A calculated impacts using IMPLAN's input-output model and multipliers. We report the impacts broken out into job-years and 2025 U.S. dollars.



IMPLAN is an industry standard input-output model used to conduct economic impact analyses by leading public and private sector organizations across the United States. IMPLAN traces the pattern of commodity purchases and sales between industries that are associated with each dollar's worth of a product or service sold to a customer, analyzing interactions among 528 industrial sectors within the geographies under study.

HR&A + Friends of Empire AI

Empire AI Impact Analysis

Supporting New York State's Economic Competitiveness

December 2025