Speculative
Technologies

Fellows Lookbook

Cohort 2
Spring 2025

Speculative Technologies

ABOUT BRAINS

Brains is a training program to provide the skills and opportunities to translate ambitious research visions that aren't a good fit for a company, but are too coordination- or engineering-heavy for academia alone. Over the past 15 weeks, the fellows have worked intensely to develop their ideas into impactful, shovel-ready projects.

ABOUT THE BRAINS FELLOWS

The Materials Data Factory

Jehad Abed

Keywords: materials, AI, automation, climate

Summary

Jehad is building the Materials Data Factory to create the largest open catalog of real-world materials that can fuel the AI discovery engine. While AI can now design millions of hypothetical materials, making and scaling them in the lab remains a major bottleneck. By experimentally generating over 100,000 synthesis recipes — 3,000× faster and 200× cheaper than traditional methods — we will provide the critical data to train AI models that can instruct how to make materials step-by-step. This breakthrough will democratize technologies from carbon capture to water harvesting and drug delivery — accelerating solutions to the world's most urgent challenges.

About Jehad

Jehad Abed is a materials scientist pushing the frontiers of AI-driven materials discovery. As program director for the Alliance for AI-Accelerated Materials Discovery (A3MD) consortium at the University of Toronto, he built robotic labs from the ground up to accelerate the experimental discovery and testing of high-performance energy materials. Then, as a researcher on Meta's Fundamental AI Research (FAIR) team, he leveraged these labs to experimentally validate AI predictions from Meta's Open Catalyst project. Jehad's research extends beyond the lab: as a finalist of the Carbon XPRIZE, he scaled carbon conversion technologies to pilot demonstrations, gaining firsthand experience in translating discovery into deployment. He holds a Ph.D. in Materials Science and has over a decade of experience in materials research. His work has been recognized with honors including the Emerging Hydrogen Leader award from the Canadian Hydrogen Convention.

Email: jehadh@gmail.com

SIN: The Seed of Industrial Nanomechanics
Jeremy Barton

Keywords: nanotechnology, materials

Summary
Jeremy is building molecular robot arms with electronic 'nerves' and AI control, creating a new paradigm for nanoscale manufacturing that finally overcomes the precision vs. speed limitation. This breakthrough technology will enable revolutionary applications like ultra-energy-efficient computers, sensors detecting disease biomarkers at 1,000x lower concentrations, and adaptive materials that change properties on command. Drawing on 15 years pioneering atomically precise manufacturing, Dr. Jeremy Barton now leads this open-science initiative to scale nanomanufacturing and make it available to the labs and startups of the world.

About Jeremy
Dr. Jeremy Barton is the founder and Science Director of the NanoDynamics Institute, where he is establishing the Seed of Industrial Nanomechanics (SIN) program. With a PhD in Physical Chemistry from Northwestern University and 15 years dedicated to developing precisely controlled nanotechnology, Dr. Barton is a recognized expert in bridging the gap between biological precision and electronic control. His technical leadership includes serving as Chief Technology Officer at Nanofactory Inc. and Chief Science Officer at Canadian Bank Note Nanotechnologies. In these roles, he built and scaled a pioneering mechanosynthesis program from 4 to 100 people, successfully demonstrating 'kinematic chemistry'—controlling carbon radical reactions with pure mechanics and chemistry. Dr. Barton secured significant support for this previous program, including grant funding from the DOE and a $40 million fund from the Canadian Strategic Innovation Fund.

Email: jeremy.barton@gmail.com

NeuroDyM: Re-drawing the boundaries of neuro conditions through high-resolution biological datasets
Hourinaz Behesti

Keywords: neuroscience, health, precision medicine

Summary
If we could change the way we diagnose and categorise neuropsychiatric and neurodevelopmental disorders, through high-resolution biologically-driven metrics instead of qualitative measures, we could create breakthrough treatments. By building a first-of-its-kind atlas of protein dynamics, which yields insights beyond the genome into what patient neurons do, linked to a catalogue of symptoms, we could eliminate misdiagnosis and develop cures just like how precision has transformed the cancer field.

About Hourinaz
Hourinaz is a neuroscientist and a stem cell biologist. Born in Iran, raised in Sweden, and educated in the UK, she holds a PhD in Developmental Biology from UCL-Institute of Child Health (London). She came to the US for a postdoc at the Rockefeller University in NYC to study autism. There, she discovered a novel cell biological pathway in autism and developed some of the first methodologies to engineer specific subclasses of neurons from patient induced pluripotent stem cells. She advises rare neurodevelopmental disease patient organizations in translational research and drug development and recently founded Hebbian Bio to develop a precision technology platform that reduces biological complexity to accelerate drug development for neuro patients.

Email: hourinaz@gmail.com

The Icarus Atlas
Alina Chan

Keywords: biosecurity

Summary
Alina is building an atlas of research that can cause pandemics, with the goal of enabling governments, research funders, and biosecurity organizations to track and regulate such research more effectively. With greater visibility into risky pathogen research, research funders will be able to intervene earlier to prevent catastrophic accidents and pandemic preparedness offices will be able to devise strategies for laboratory-based pandemic scenarios. This will reduce the likelihood and harms of future laboratory-based pandemics.

About Alina

Alina Chan, PhD, is a technology expert with research experience in medical genetics, synthetic biology, and genetic engineering. Dr. Chan was a scientific advisor in the Broad Institute's vector engineering group. Dr. Chan is a mission-driven and resilient scientist who cares deeply about averting biological catastrophe. During the pandemic, Dr. Chan was an early and persistent advocate for an investigation into both natural and laboratory Covid-19 origin hypotheses. She published her work in a book, VIRAL: The Search for the Origin of Covid-19, and in the New York Times. In 2022, Dr. Chan co-founded the Bulletin of the Atomic Scientists' taskforce to generate cross-disciplinary recommendations to regulate risky pathogen research. U.S. government and research funding leaders crafting legislation and policies on risky pathogen research seek Dr. Chan's advice.

Email: alinac@broadinstitute.org

Abundant Domestic Copper
David Cohen-Tanugi

Keywords: energy, materials, recycling

Summary
David Cohen-Tanugi is developing a research program to develop solutions for domestic production of copper from end-of-life electronic products. The program aims to demonstrate new technological pathways that can drive down the cost of copper produced from e-scrap to under $3 per pound. David has been developing this program concept within MIT's venture studio for the past year, in partnership with faculty members in materials science & engineering. The research program will focus on drastically advancing the field of component and material characterization in mixed material streams, enabling intelligent processing decisions in real-time. Within five years, the program will demonstrate new technical pathways for circuit board extraction and metal production that require no hazardous ingredients or toxic byproducts and can economically be scaled in the USA.

About David
David leads the Clean Energy & Fusion program at MIT Proto Ventures, the venture studio of the Massachusetts Institute of Technology. David has a decade of startup experience and holds a Ph.D. in Materials Science & Engineering from MIT.

Email: davidctanugi@gmail.com

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Omega: Modern Geometry for AI in Engineering
Blake Courter

Keywords: engineering, computer science

Summary
Engineering innovation has become stifled by fragmentation across design, simulation, and manufacturing, whose siloed, proprietary databases fail to model or include customer need and design intent. Gradient Control Laboratories is building open source engineering tools that compile to existing technology while leveraging modern data science. If we can make engineering knowledge universally computable, we remove the bottleneck between engineering and AI, unlocking generative mechanical engineering. Our team has delivered some of the most innovative engineering software of the past two decades, including Autodesk Dynamo, SpaceClaim (ANSYS Discovery), the Dart programming language, GrabCAD, and nTopology.

About Blake
Blake Courter has led innovation in engineering software for three decades. As CTO and Head of Product at nTop, he established the category of field-driven, generative design. As founder of SpaceClaim (now ANSYS Discovery), he created the first interactive direct editing CAD system, an approach later adopted across the industry. At GrabCAD, he developed the first cloud-based collaborative PDM system, growing the user community to eight million users. Currently, through Gradient Control Laboratories, he continues advancing implicit modeling technology while advising numerous engineering software startups.

Email: blake@gradientcontrol.com

Global clean energy distribution via ammonia
Garth Edwards

Keywords: energy, climate

Summary
The growing problem of clean energy waste (from curtailment or overloaded transmission lines) threatens our ability to reach net zero, but can be solved by converting energy, air and water at source to ammonia, a high value market commodity that is easily stored and transported. Unlike battery packs and other forms of stationary storage, which are expensive and depend on transmission lines, ammonia can be transported offsite using safe, cheap, existing infrastructure for use as low emissions fertilizer, power generation and shipping fuel. This program is developing small-scale, modular ammonia production technology that supports intermittent onsite operation from variable renewable energy.

About Garth
Garth Edwards is a builder of complex systems across the energy and technology industries. He was a lead chemical (process) engineer on multi-billion-dollar energy projects characterized by high technical risk and critical safety standards. From a strong foundation in industrial hardware design, he expanded into big tech as a Google Product Lead for data, security and APIs. Today, Garth is using his dual expertise to drive transformative change in the energy and chemical industries and accelerate the global energy transition.

Email: garth@17.eco

A Platform for Enabling the Prevention of Age-Related Cognitive Decline

Ravi Jain

Keywords: neuroscience, longevity

Summary

Ravi's program aims to identify proteins responsible for age-related cognitive decline. Cognition depends on the ability to send signals between regions of the brain through connections made by neurons. The connections comprise the brain's neural network and the integrity of that network is governed by proteins. Pinpointing proteins involved in maintaining a healthy brain network has been stymied by (1) the inability to replicate brain networks that could be scaled to 10,000s of samples, while maintaining aging characteristics; and (2) the lack of technological development for examining the proteome at scale. We combine the state-of-the-art in growing brain networks in a dish, microscopy, image analysis, and proteomics to find proteins that directly impact the ability to make neural connections. Identifying early markers of age-related cognitive decline provides a window of opportunity for enabling proactive intervention to prevent or reverse cognitive decline and extend brain health.

About Ravi

Ravi Jain is a strategic executive leader and published scientist with over 20 years of experience in the life sciences and technology sectors. He specializes in commercializing innovative solutions and leading high-impact projects. Ravi has a proven track record in R&D, data science, and machine learning applications for therapeutic discovery. He has successfully built and managed cross-functional teams, secured significant funding, and developed strategic partnerships. With a PhD in Bioinformatics & Molecular Evolution from UCLA and 23 issued patents, Ravi is dedicated to advancing science and technology to improve human health.

Email: mr.ravi.jain@pm.me

Frontier AI Tamperproofing (FAIT)

Taylor Kulp-McDowall

Keywords: AI, security

Summary

Taylor is building safeguards that make it substantially harder to misuse open-source AI models. It is currently trivial to circumvent the safety protections of open-source AI models, meaning anyone can repurpose them to enable dangerous national security threats such as advanced malware or bioweapons development. By layering new capabilities enabled by recent advancements in adversarial model security—including safety capability entanglement, hidden safeguards monitoring, and dangerous capability removal—novel safeguards could 'tamperproof' open-source models and provide robust, scalable protections against highly-resourced adversaries. These safeguards would serve as a foundational layer of defense to prevent the proliferation of AI-enabled national security threats.

About Taylor

Taylor Kulp-McDowall is a machine learning engineer and research manager specializing in AI security and safety. Taylor brings extensive experience advising AI security initiatives across the ARPAs, where he has a history of designing and overseeing AI security research programs. As a lead technologist at Booz Allen Hamilton, he directs research on mitigating AI vulnerabilities and enhancing security evaluation frameworks. His background spans developing AI models biosecurity for Harvard research groups and building data infrastructure solutions at Keystone Strategy. A Princeton physics graduate, Taylor has expertise in adversarial machine learning, AI security, and driving research at the intersection of academia, national security, and private industry.

Email: taylorkmc@gmail.com

CausalEarth Initiative
Christina Last

Keywords: climate, AI

Summary
Christina is building CausalEarth: a framework to assess when and where we could safely pursue aerosol-based geoengineering. Aerosols form the largest source of uncertainty in our climate system, thus, a major component of this initiative is to connect real-time observations of aerosols to Physics-AI climate models to evaluate their influence on short-term weather and distant climate states. As the world enters a period of accelerated climate change, CausalEarth will function as an interpretable evaluation toolkit for geoengineering, helping governments and public stakeholders collaborate to safely avert disastrous climate tipping points.

About Christina
Christina Last is a Machine Learning Scientist at Mila, the Quebec AI Institute, where she builds climate models using causal AI. She serves as Co-Director of TipplyAI, a GenAI startup forecasting critical climate thresholds, part of ARIA's Forecasting Tipping Points Programme. She is also a fellow within Renaissance Philanthropy's ARC Institute, where she investigates the impact of sulfur on climate change. She is a US-UK Fulbright Alumna, who supported her Postgraduate degree at MIT, where she estimated carbon emissions using AI. She founded and scaled the UN's open source air pollution AI early warning system, featured at the 78th UN General Assembly and NASA. She has supported investigations into illegal activity and environmental pollution featured in the Guardian and the BBC.

Email: lastc@mit.edu

Arcadia: Autonomous Engineering Systems
Eder Medina

Keywords: manufacturing, AI, automation

Summary
Eder is building autonomous engineering systems that integrate AI, simulation, real-world data, and expert knowledge into unified, verifiable frameworks. By connecting design, analysis, and manufacturing through dynamic, physics-aware models, Eder's work will enable more adaptive, efficient, and innovative development processes — expanding the possibilities of engineering while remaining anchored to real-world constraints.

About Eder
Eder Medina is dedicated to advancing innovation at the intersection of machine learning and artificial intelligence in engineering and manufacturing. With a doctoral degree in engineering science and postdoctoral research in machine learning for autonomous manufacturing, he specializes in creating adaptive engineering solutions. His goal is to design complex systems capable of evolution and adaptation, contributing to more efficient and sustainable systems without sacrificing durability or repairability. His work bridges theoretical AI advancements with practical applications, creating technologies that benefit both industry and society.

Email: e_medina@g.harvard.edu

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Reimagining Global Biosurveillance
Rik Obiso

Keywords: global health, biosurveillance, diagnostics, AI

Summary
Rik is developing a next-generation global biosurveillance and diagnostics system to detect emerging infectious diseases and biological anomalies before they become crises. Today's health security infrastructure is fragmented, reactive, and too slow to respond to fast-moving biological threats. Rik's approach combines AI-driven early warning systems with portable diagnostics to create a seamless, real-time network for early detection and intervention. By decentralizing biosurveillance and making it accessible in resource-limited settings, his work is transforming how the world prepares for pandemics and biological risks—turning delay into foresight, and chaos into coordination. Transforming global health intelligence and disease detection to prevent tomorrow's outbreaks and build a safer, more resilient world.

About Rik
Dr. Richard Obiso is a founder and Executive Director of Exiome Biosciences Foundation, a nonprofit Focused Research Organization (currently in stealth) advancing global biosurveillance and diagnostics. Rik also serves as a research area lead in Global Health at the Johns Hopkins University Applied Physics Laboratory, where he supports and funds projects aimed at strengthening health security and improving how we detect and respond to infectious disease threats. With 20+ years of experience in biotechnology, public health, and infectious disease, Rik co-develops biosurveillance platforms and systems that combine artificial intelligence with field-ready tools to catch outbreaks early and prevent their spread. He has built and mentored international teams, launched multiple small businesses, advised U.S. government agencies, and helped bring new products, tools, and technologies into real-world use. His work connects science with practical solutions to build a future where disease detection is faster, more reliable, and accessible to all.

Email: innovatebio@richardobiso.com

Forecasting where animals move with foundation AI models
Kasim Rafiq

Keywords: conservation, global health, climate, AI

Summary
Kasim aims to develop models that forecast where animals move, for any species, anywhere. By leveraging billions of GPS points on animal movements, integrating environmental sensing, and applying advances in foundation models, Kasim believes we could generate forecasts across species and environments based on projected conditions, like a weather forecasting system for wildlife movements. Current forecasting approaches require data that takes decades to collect and costs hundreds of thousands of dollars for just one species, and most regions lack the data needed for actionable forecasts. Generalisable models could forecast animal-human contacts at scale and unlock early warning systems to prevent zoonotic spillovers, reduce human-wildlife conflicts, and protect ecosystems, even in data-poor regions and for critical species where forecasting was previously impossible.

About Kasim
Kasim is a wildlife scientist at the University of Washington who uses emerging technologies, collaborative science, and on-the-ground fieldwork to study the drivers and impacts of animal movement. With over a decade of experience, he has led the development of wildlife monitoring methods using tourist photographs that cut costs by up to 97% of previous tools, tracked large predators on foot through the African savannah to deploy animal-worn GPS tags, and used AI to create fitness trackers for wildlife. Kasim is a National Geographic Explorer, Fulbright Alumnus, and Washington Research Foundation Fellow.

Email: kasim.rafiq@hotmail.co.uk

Terra Watts Labs: Underground wireless power transmission
Kaitlyn Suarez

Keywords: energy

Summary
Kaitlyn pioneers the future of wireless power transfer by using the subsurface as a propagation medium. This innovative technology transforms power deployment to create the world's first underground wireless grid. Early applications could bring transformative power solutions to remote and disaster-prone regions, including rural communities, forward military operations, to future extraterrestrial settlements. With a working prototype complete, she is ready to scale and plans to see this work completed via a focused research organization led by compassionate thinkers and visionaries.

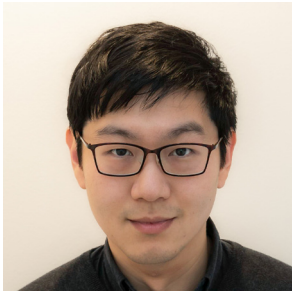
About Kaitlyn
Kaitlyn Suarez earned her Ph.D. and M.S. in geosciences as a National Science Foundation Graduate Research fellow at the University of Massachusetts Amherst. Suarez is supported by the National Science Foundation, Activate, and Rose Rock Bridge. She is based in Brooklyn, NY.

Email: kaitlyn@terra-watts.com

Synthetic Conductors to Surpass Mined Metals
Mervin Zhao

Keywords: energy, materials, manufacturing

Summary
Mervin is developing approaches to scale and process synthetic conductors, like carbon nanotubes, into wires to replace copper. Electrification is key to the energy transition, but copper will soon become the largest barrier to electrification, with supply only meeting 80% of demand in 2030. This program will focus on the industrial scalability of high quality carbon nanomaterials, as well as the processing of these materials into industrial forms to meet and possibly exceed the performance of conventional metals.



About Mervin
Dr. Mervin Zhao is a materials scientist who has worked on nanotechnology for electronics, energy, and health. He is currently a technical advisor for the Advanced Research Projects Agency – Energy (ARPA-E) where he supports materials science related new program development and active project management. Previously, he led the research and development team at a startup working on scaling nanofibers for filtration applications. He received his M.S. and Ph.D. in materials science from UC Berkeley working on synthesis of two-dimensional nanomaterials.

Email: zhaoink@gmail.com