The Quest for Intelligence

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MIT Quest for Intelligence

Leadership Team

Antonio Torralba
Director, Quest

Aude Oliva
Executive Director, Quest

James DiCarlo
Director, Quest Core

Nick Roy
Director, Quest Bridge

Cynthia Breazeal
Associate Director, Quest Bridge

Daniela Rus
Associate Director, Quest Core

Leslie Kaelbling
Scientific Director

Josh Tenenbaum
Scientific Director

Tomaso Poggio
Scientific Advisor

Erik Vogan
Director of Corporate Engagement

MIT Quest for Intelligence

What is the Quest?

The Quest aims to advance two fundamental intelligence challenges:

- To reverse engineer intelligence
- Deploy our current and expanding understanding of intelligence to the benefit of society

The Quest is one of the “intelligence” research arms of the MIT Stephen A. Schwarzman College of Computing

MIT Stephen A. Schwarzman College of Computing

Developing Talent

Undergraduate Students

Students fluent in computing and a second discipline will keep pace with rapid advances in AI and their chosen field

Masters Students

Software engineers trained in a specific domain will have the skills to meet industry's evolving demands

Graduate Students

A new breed of multi-disciplinary thinkers will help to advance our understanding of intelligence systems

Scientists

The AI leaders of tomorrow who will create the next generation of tools and breakthroughs

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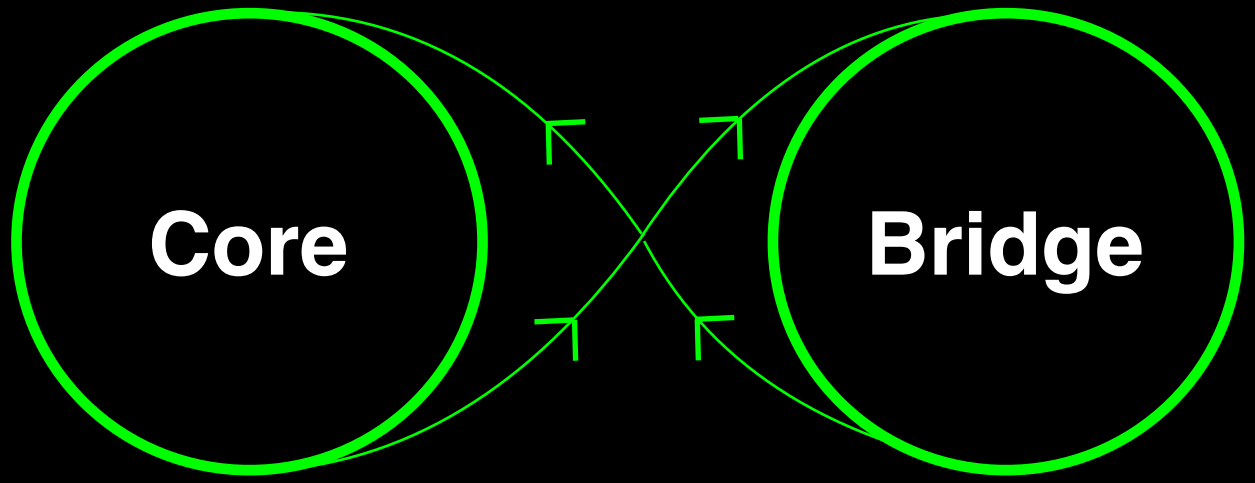
What is the Quest?



Advance the science and engineering of intelligence

Cognitive and social sciences, biology, neuroscience, chemistry, physics etc inspired machine-learning algorithms and insights

Implement the newest intelligence techniques

Intelligence technologies, tools, platforms, and infrastructure (data sets, technical support, specialized software and hardware)

The Development of AI

Narrow AI

Big data
Pattern analysis
Single task
Offline decision

Emerging AI

Multi-tasks
Online prediction
Intelligence at the edge
Reinforcement learning
Transferability
Replicability
Parallelism

Human-level AI

Cognitive Flexibility
Continuous learning
Common sense
Intuition
Ethical overlay
Adaptability
Collaboration
Theory of Mind

1980 2012

We are entering Emerging AI

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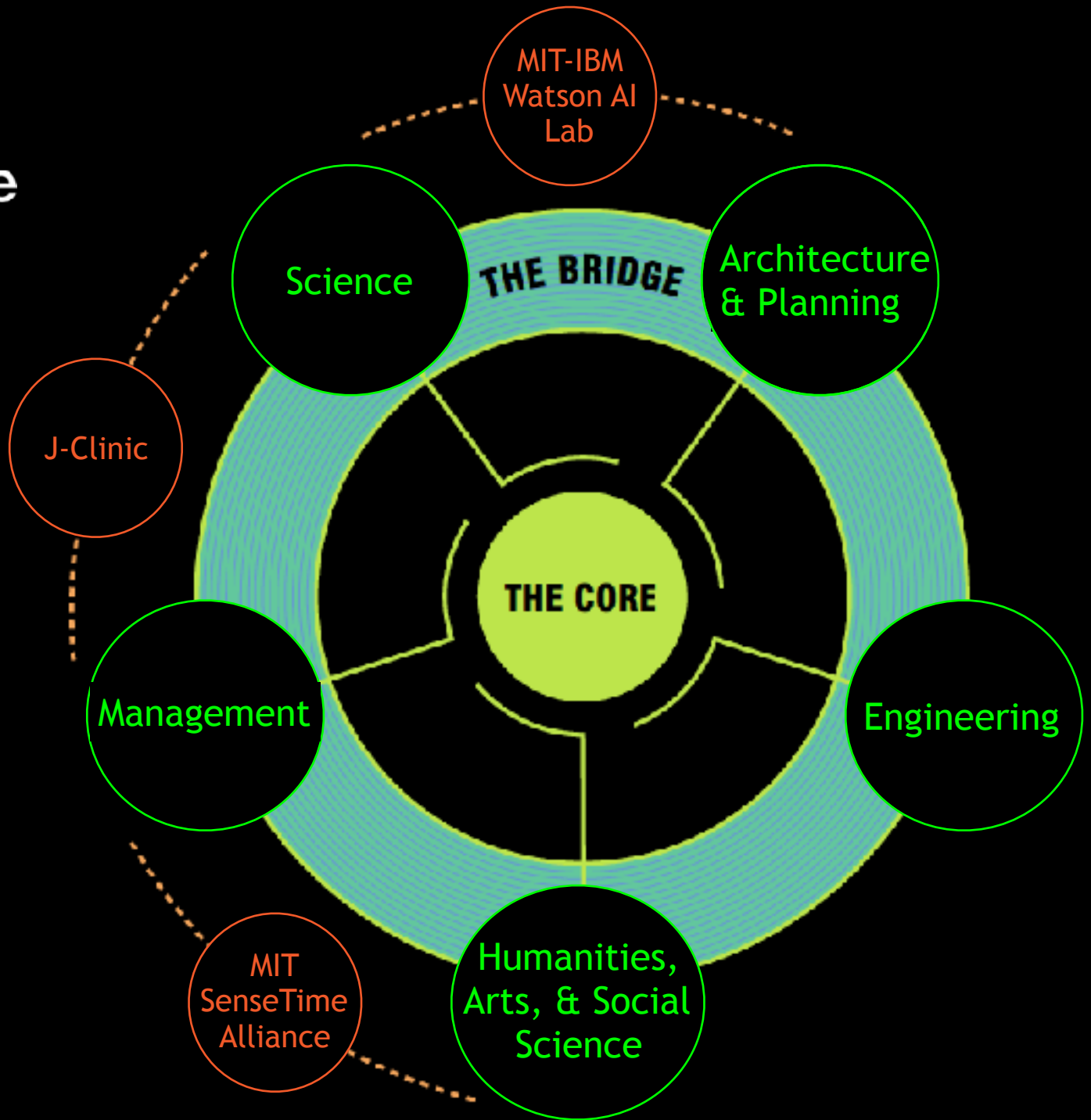


MIT-IBM Watson AI Lab

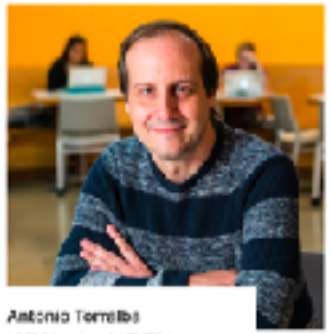
A collaborative industrial-academic laboratory focused on advancing fundamental AI research.

Explore our research [→]

- 50 Research teams funded
- 60 MIT Principal Investigators
- 23 MIT Departments/Centers

Leadership team

David Cox
IBM Director, MIT-IBM Watson AI Lab
Read biography



Antonio Torralba
MIT Director, MIT-IBM Watson AI Lab
Read biography

Aude Oliva
MIT Executive Director, MIT-IBM Watson AI Lab
Read biography

Lisa Amini
Director, IBM Research Cambridge
Read biography

[↗]

Visualizing networks can have both practical and aesthetic dimensions. The above image comes from [WonderNet], an exhibition at the intersection of art and science, created by Mauro Martino, Head of the Visual AI Group in the MI


AI Algorithms
Applications to Industries
- Healthcare, FinTech,
- Cybersecurity, Manufacturing
"Four Pillars"
Physics of AI
AI for Shared Prosperity

J-Clinic

ABDUL LATIF JAMEEL CLINIC FOR MACHINE LEARNING IN HEALTH

Massachusetts Institute of Technology

Propelling new machine learning applications from the lab to the marketplace

ABOUT NEWS RESEARCH INNOVATION AFFILIATES

The Abdul Latif Jameel Clinic for Machine Learning in Health at MIT aims to revolutionize disease prevention, detection, and treatment.

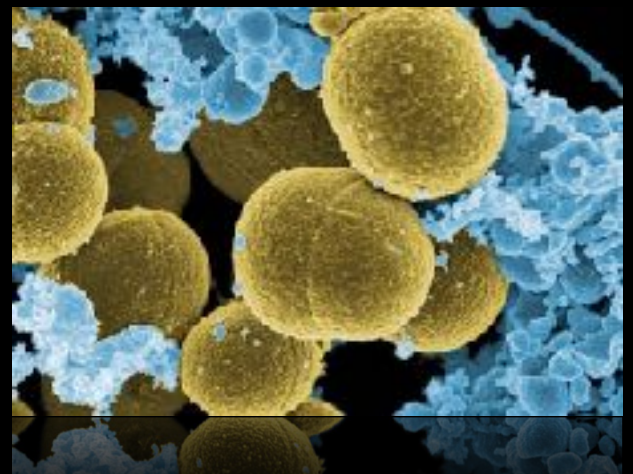
J-Clinic
ABDUL LATIF JAMEEL CLINIC FOR MACHINE LEARNING IN HEALTH

Massachusetts Institute of Technology

ABOUT NEWS RESEARCH INNOVATION AFFILIATES

Preventative Medicines

Creating preventative medicine methods and technologies that can stop non-infectious disease in its tracks



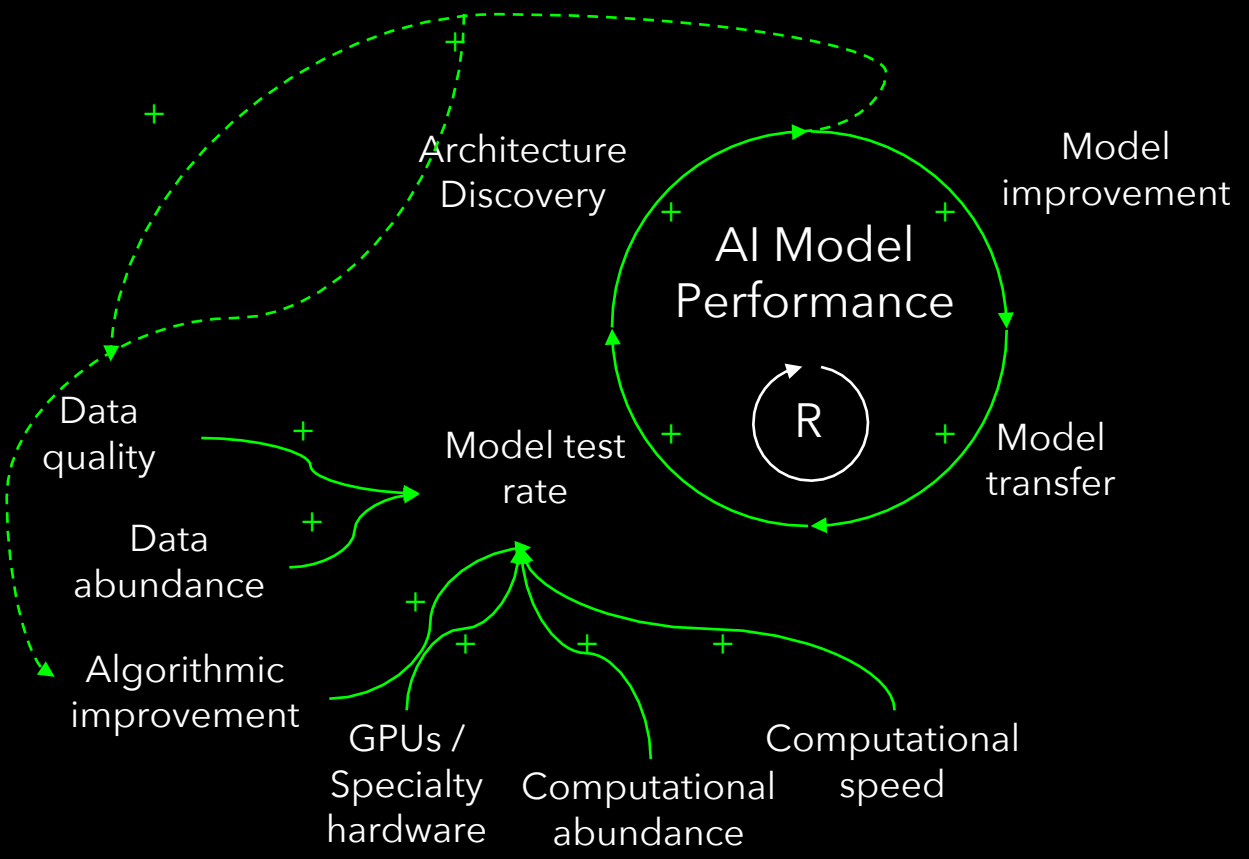
Cost-Effective Diagnostics

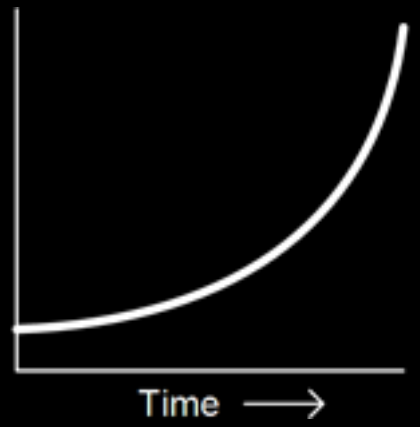
Developing cost-effective diagnostic tests using wearables and wireless biosensors to detect and alleviate health problems

Drug Discovery and Development

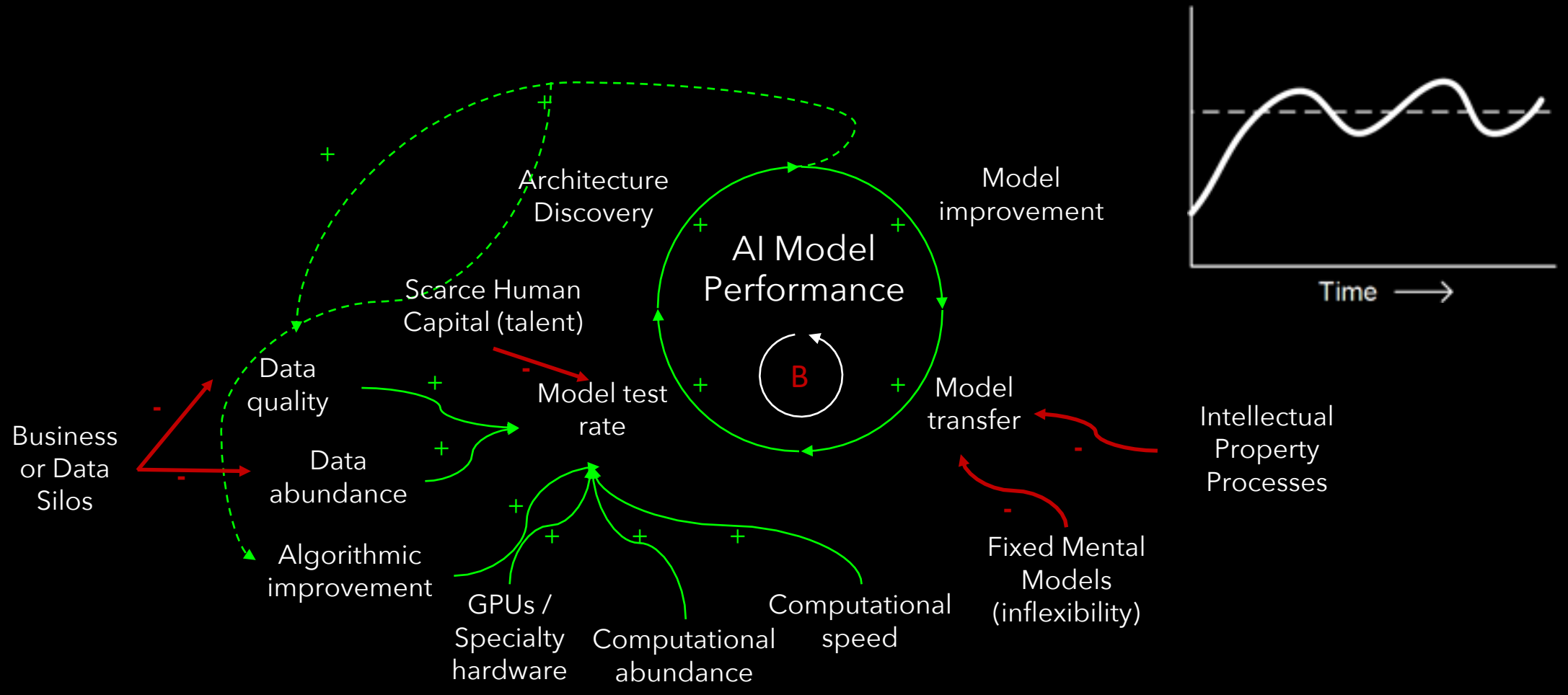
Discovering and developing new pharmaceuticals that can be tailored to the individual patient

Promoters to AI success

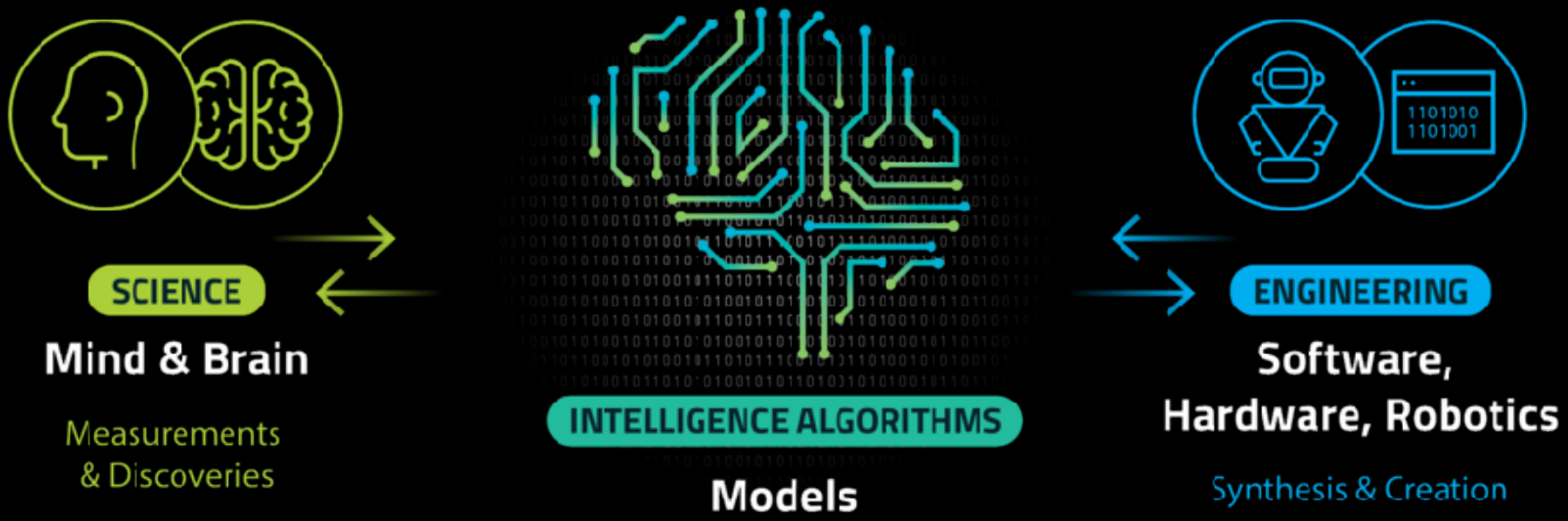




Promoters and Barriers to AI success

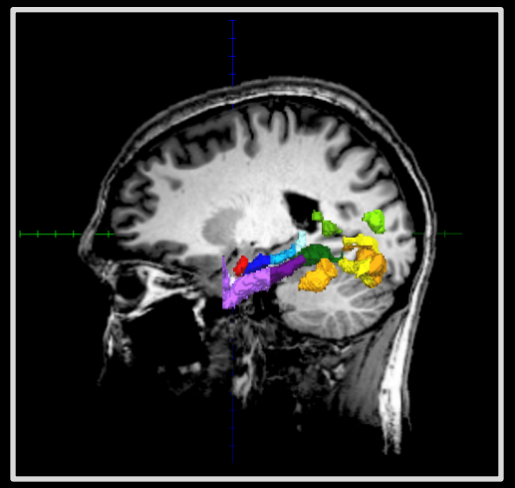


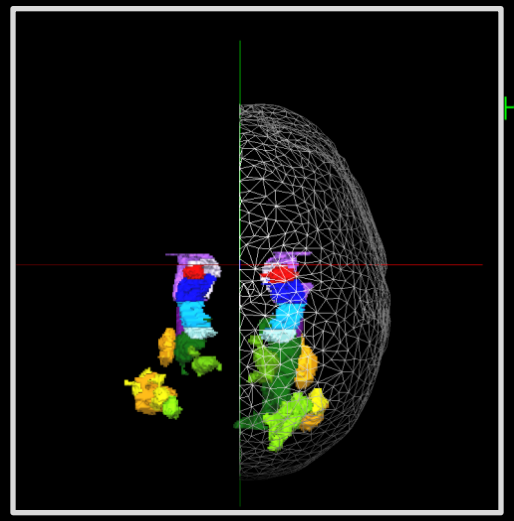
Vision for The Quest Core

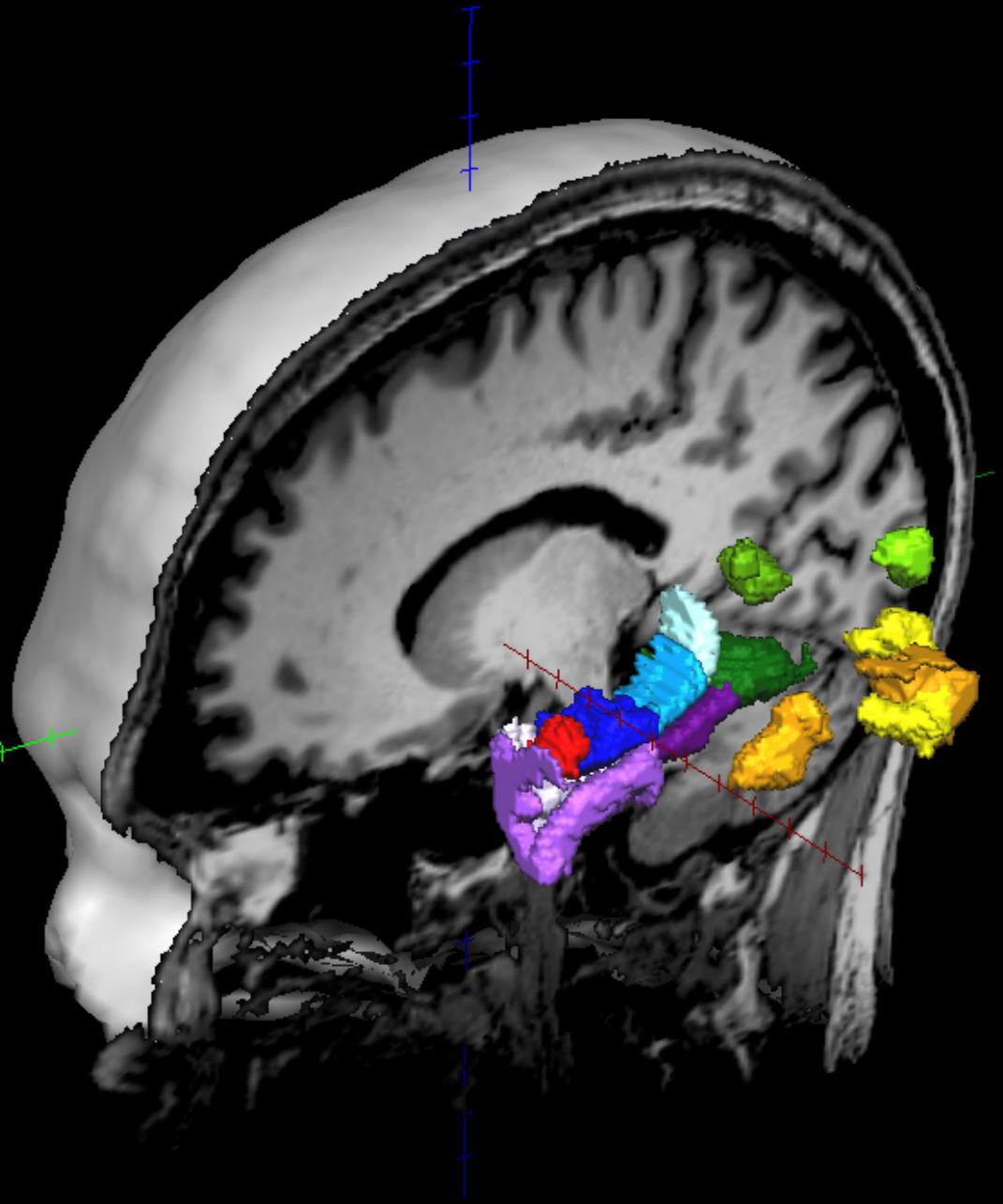


- Moonshot projects: team-driven bets on large, unsolved problems in intelligence
- Projects that MIT is well positioned to lead

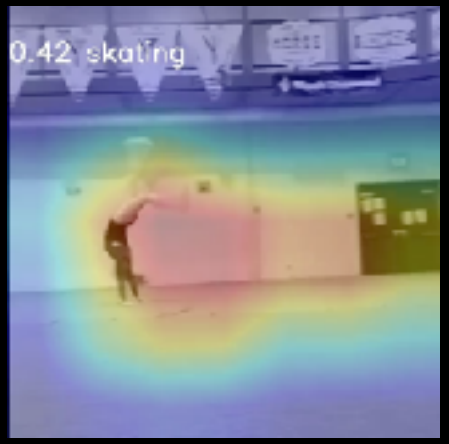
The Human Brain

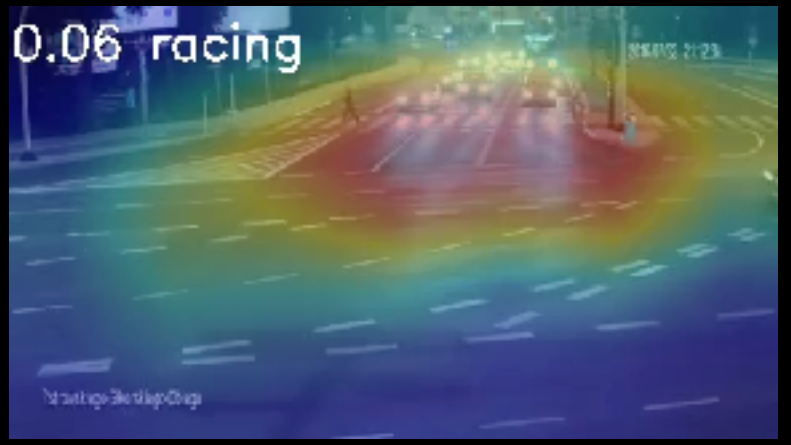


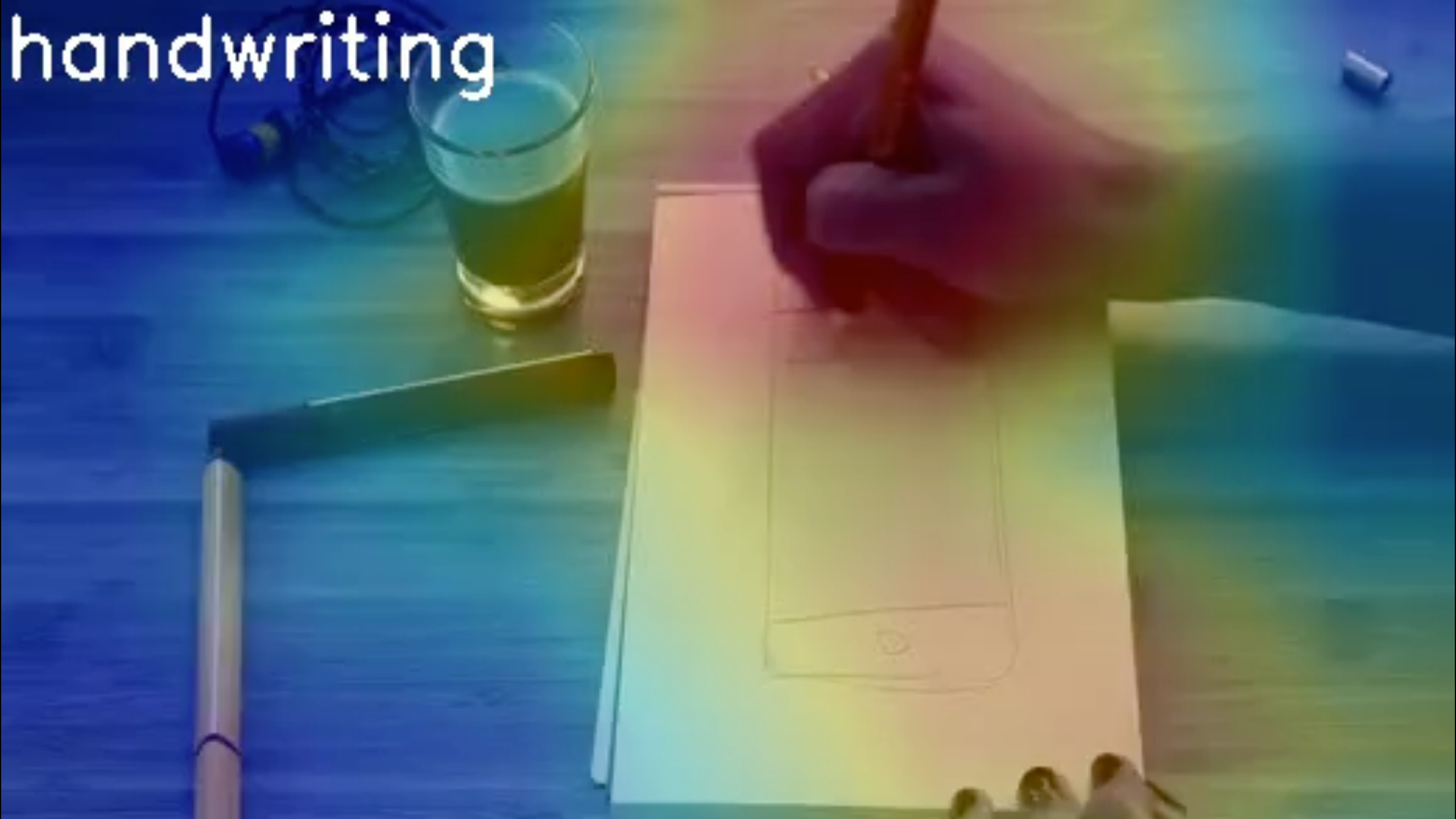




Event Understanding: 1 2 3 Seconds



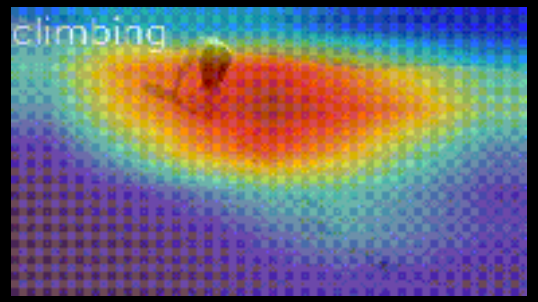



handwriting

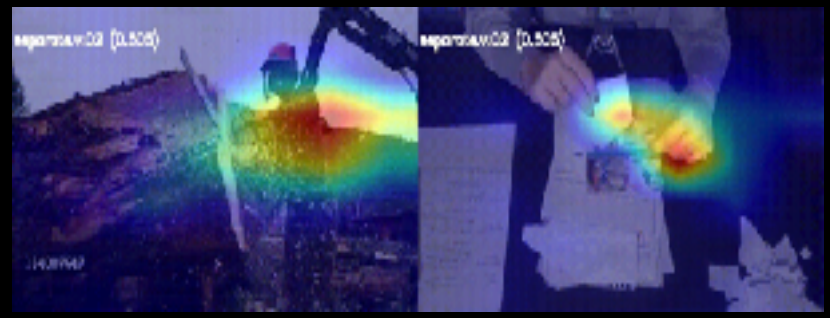
Visual Intelligence: Milestones

Visual systems with common sense-*like* reasoning

80 % Classification

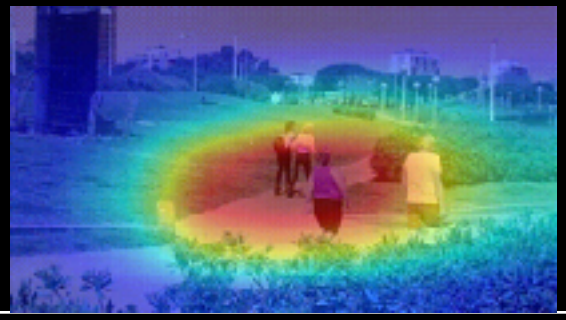


Abstraction: “separate”



Common sense-*like*

1 year → 2 years → 5 years



Recognition

Causality & Intention-like

Dissecting Artificial Networks

Selected units are shown from three state-of-the-art network architectures when trained to classify images of places (places-365). Many individual units respond to specific high-level concepts (object segmentations) that are not directly represented in the training set (scene classifications).

Interpretable AI

Systems which decisions are transparent, interpretable and explainable

Model Response: washing dishes

Correct label: brushing

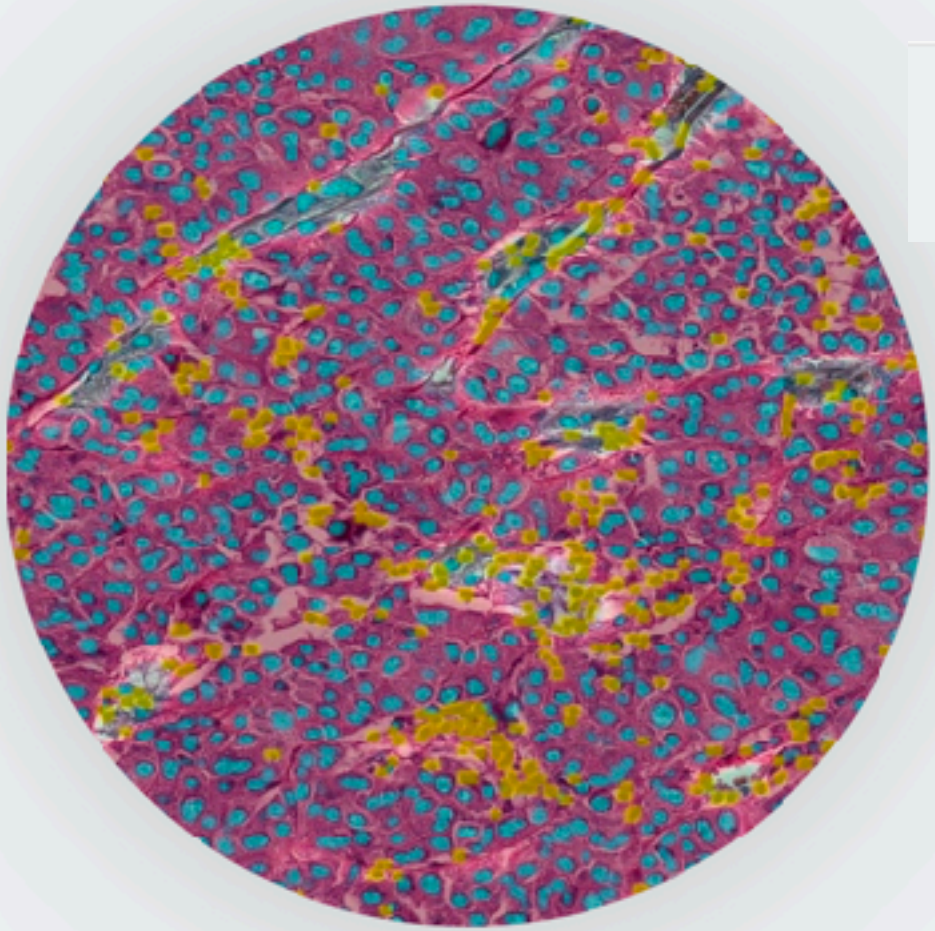
Unit 1679
Bathroom

Unit 867
Kitchen

Unit 1749
House

Unit 795
Bathroom

Unit 1978
Person



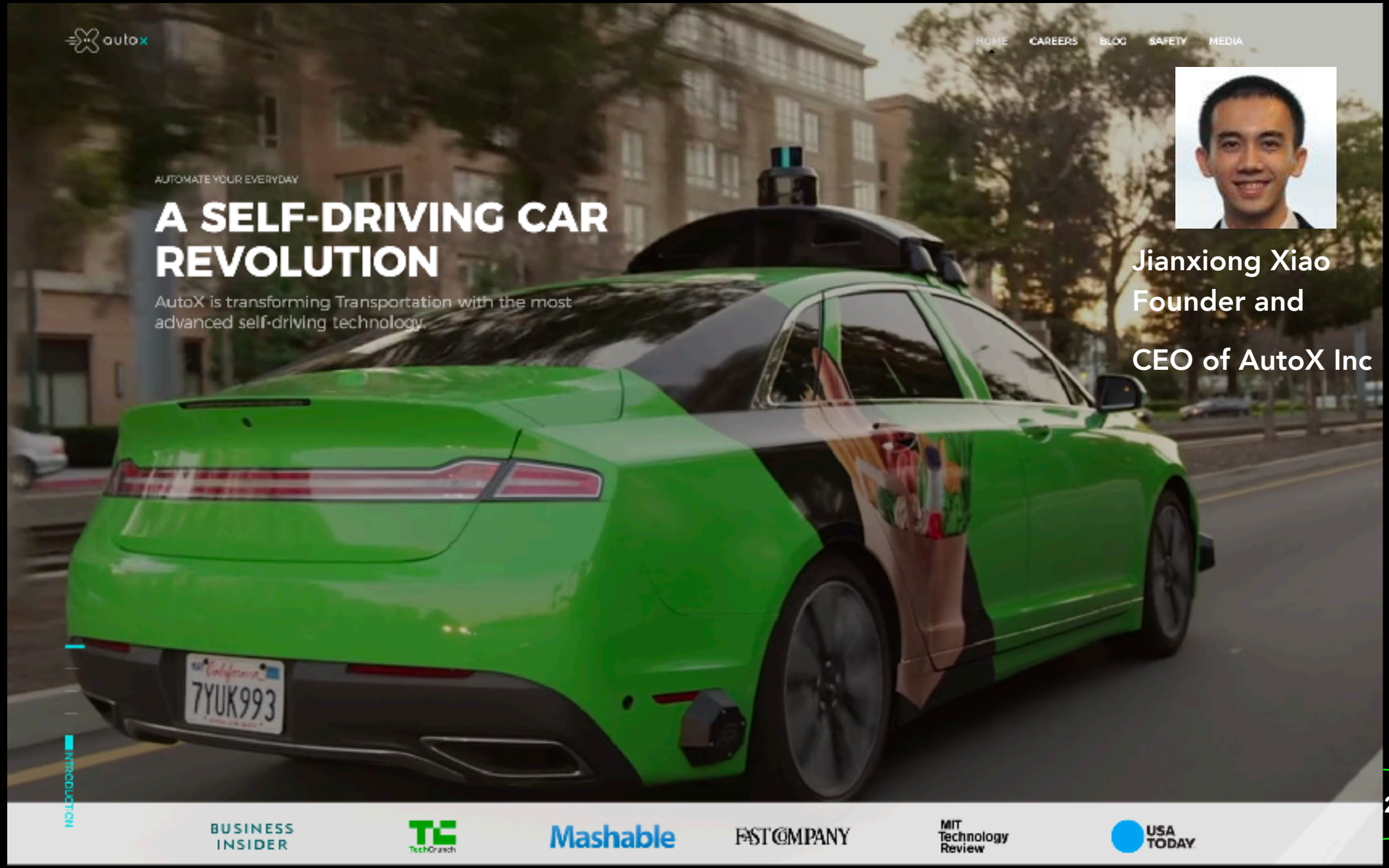
PathAI

Pathology Evolved.

Advanced learning toward faster, more accurate diagnosis of disease.

Aditya Khosla

Co-Founder & CTO



Jianxiong Xiao

Founder and

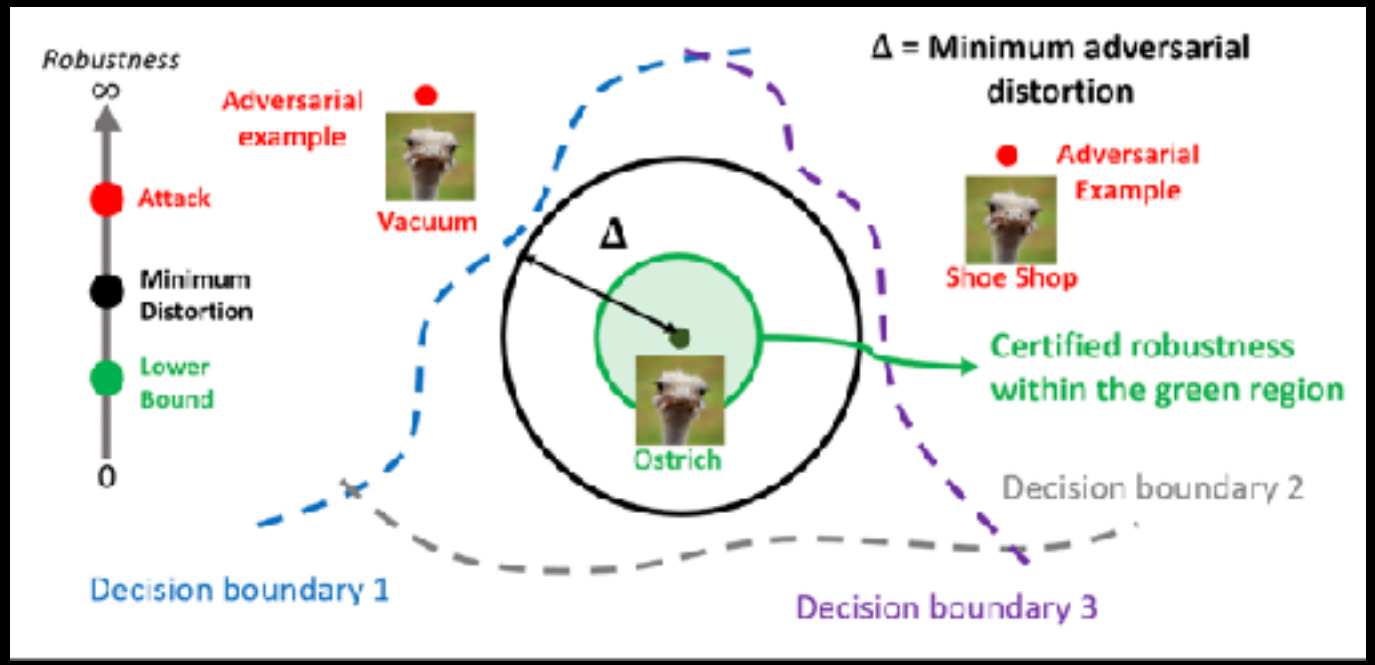
CEO of AutoX Inc

Multi-sensory AI: Seeing with Wireless Signals

D. Katabi & A. Torralba. http://rfpose.csail.mit.edu/

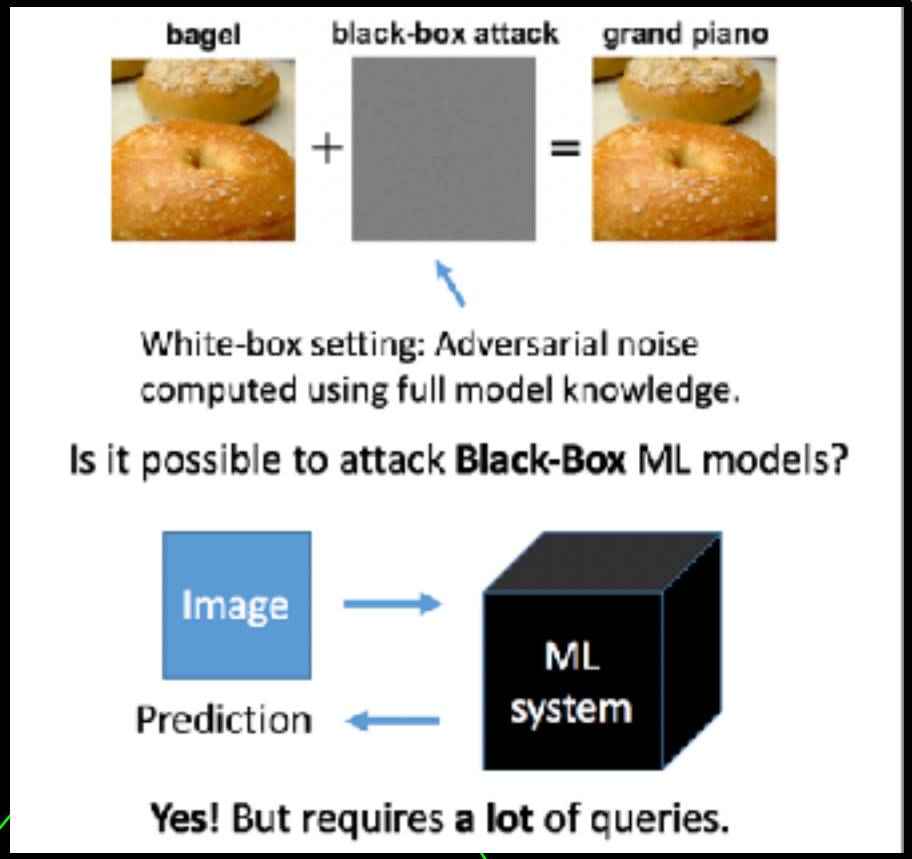
Robust AI: Safety & Security

Systems which are immune to adversarial machine learning (adversarial attacks)



Goal: Providing certified robustness evaluation to AI systems

Luca Daniel



Aleksander Madry

Moonshot: Growing Intelligence

Josh Tenenbaum lead

Moonshot: Collective Intelligence

Kinds of intelligence:

Human

Computer

Collective

Groups of individuals acting collectively in ways that seem intelligent

Collective Intelligence: 3 Moonshots

Superintelligent human-computer groups

Can we create human-computer groups that are at least 10 times as effective as typical groups today?

Faculty leads:
Thomas Malone, Daniela Rus.

Decisions with highly polarized groups

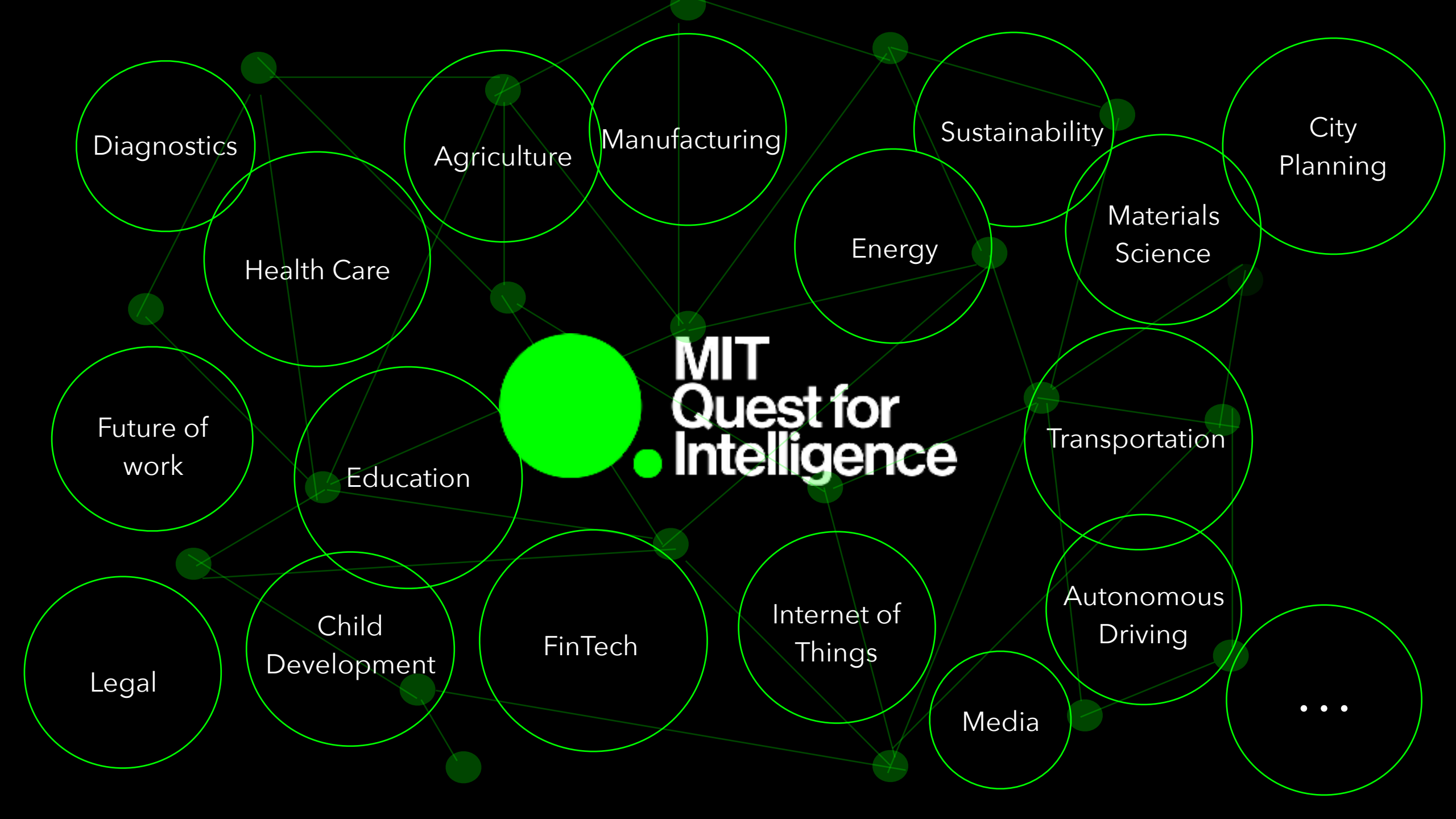
How can new computer tools or ways of dealing with human thoughts and emotions increase the acceptability of group decisions outcomes for all?

Faculty leads:
David Rand, Bengt Holmstrom

A new way of doing science

How can we accelerate scientific progress? How can we improve the peer review process?

Faculty lead:
Drazen Prelec.


Diagnostics
Agriculture
Manufacturing
Sustainability
City Planning
Health Care
Energy
Materials Science
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Future of work
Education
Transportation
Legal
Child Development
FinTech
Internet of Things
Autonomous Driving
Media
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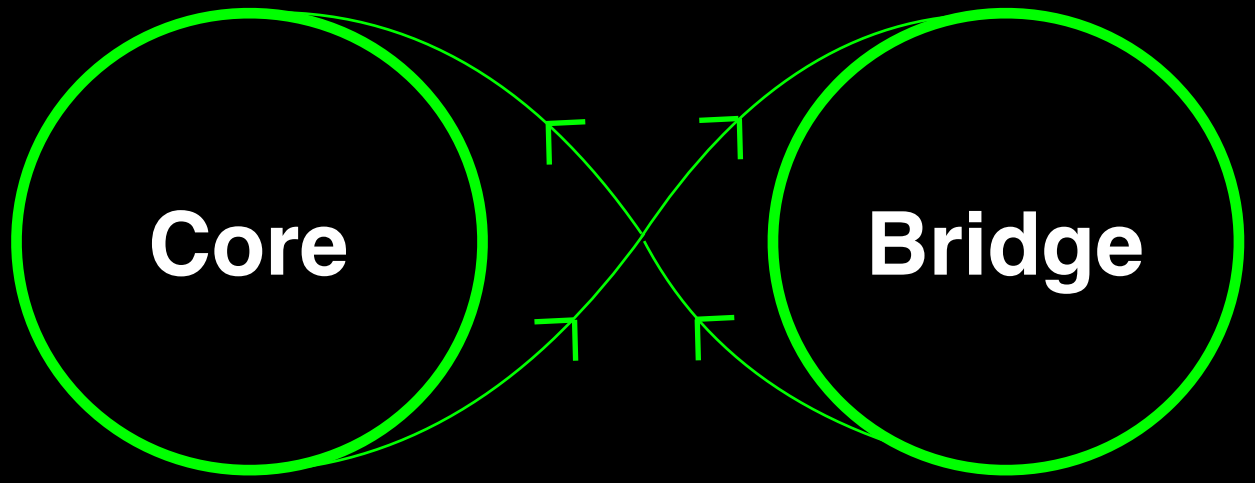
What is the Quest?



Advance the science and engineering of intelligence

Cognitive and social sciences, biology, neuroscience, chemistry, physics etc inspired machine-learning algorithms and insights

Implement the newest intelligence techniques

Intelligence technologies, tools, platforms, and infrastructure (data sets, technical support, specialized software and hardware)

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Current Issues and Challenges in AI

- Lack of accessibility
- Lack of resources
- Lack of expertise in tools
- Lack of reproducibility

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Bridge: AI Platforms - Tools - Services

Data

Develop new tools to collect and curate massive amounts of data

Hardware

Create more powerful hardware to model richer and more complex phenomena

Software

Build software that is robust, intuitive to use and will integrate seamlessly labs, classrooms, businesses and beyond

People

Consulting Team & Ethical Team
- Academic
- Industry
- Developers
- Users

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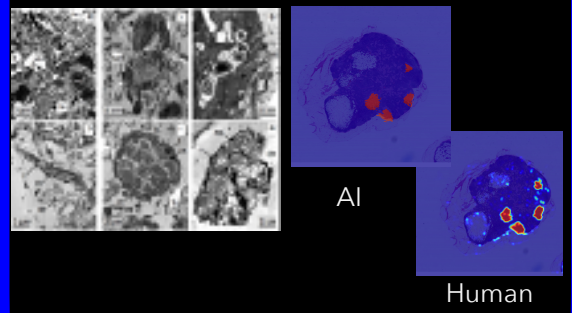
Bridge: AI Platforms - Tools - Services

Classification

Iceberg states to monitor environment, cancer types

Localization



Localization of structures
Lesions

Detection

Detection of outliers, anomalies (cyber threat detection)

Recognition

Identification of phenomenon, activity

Prediction

Predicting outcomes of a process (i.e chemical), forecasting financial risks

Ranking

Identifying disease genes from gene expression data

Recommendation

Recommendation engines

Reinforcement Learning

Control optimization, Continuous learning of of a state

The Bridge Product and Services: AI Platform

A standardized platform with new tools for researchers to use and validate the work of others; A place to store, access, and share datasets with other scientists.

AI development of organic workflows that evolve continuously and allow researchers to run their problem on a specified compute or storage platform.

AI best-practice guides which include an overview of relevant ethical issues

Implementation of Trustworthy and Robust AI

Early design phase requirements with technical and non-technical methods

- **Requirements**
  - Accountability
  - Data governance
  - Design for all, including design for vulnerable population
  - Governance of AI autonomy (human oversight)
  - Non-discrimination
  - Robustness, Safety, Transparency, Care
  - Respect for human autonomy, privacy
- **Traceability of AI**
  - Define systems capabilities
  - Define system limitations
  - Define realistic expectations of stakeholders
  - Define the scope of transparency use and misuse
  - Communicate and document trade-offs between requirements
- **Auditability of AI**
  - Define how the system explains its decision
  - Visualization of internal decisions
  - Define specific measures for critical context and situations
  - Allow tracing individual decisions to each of the various inputs-outputs

Discovery

Exposure to emerging trends, technologies and talent in intelligence

Exploratory

Multiply the impact of Discovery membership with research

Visionary

Exponentially expand Exploratory membership with a long-term research vision

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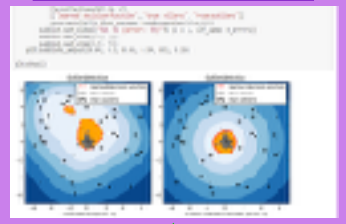
AI Workflow Steps: Visual Intelligence

DEPLOYMENT

CLASSROOM



OPEN-SOURCE

RISK PREDICTION

Multi-sensors AI

SELF-DRIVING

SPORTS/MEDIA

BRIDGE

Open-source code

Open-platform

Interactive Computing

Cloud-base

Organic AI

Life-long learning

Trustworthy

Ethical deployment

GROUND

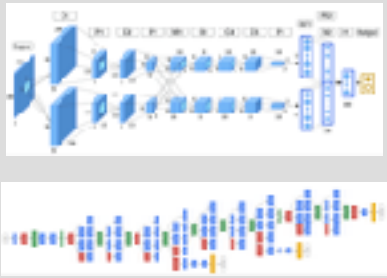
DATA

1 million labels

1 million videos

ALGORITHMS

Architectures



Optimization

INTERPRETABILITY

Visualization

Interpretability

PERFORMANCES

Recognition

75 % correct