The Need for a National Research Cloud for Human-Centered AI Research

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Human-Centered
Artificial Intelligence

Part I:
How AI can Transform Healthcare Delivery

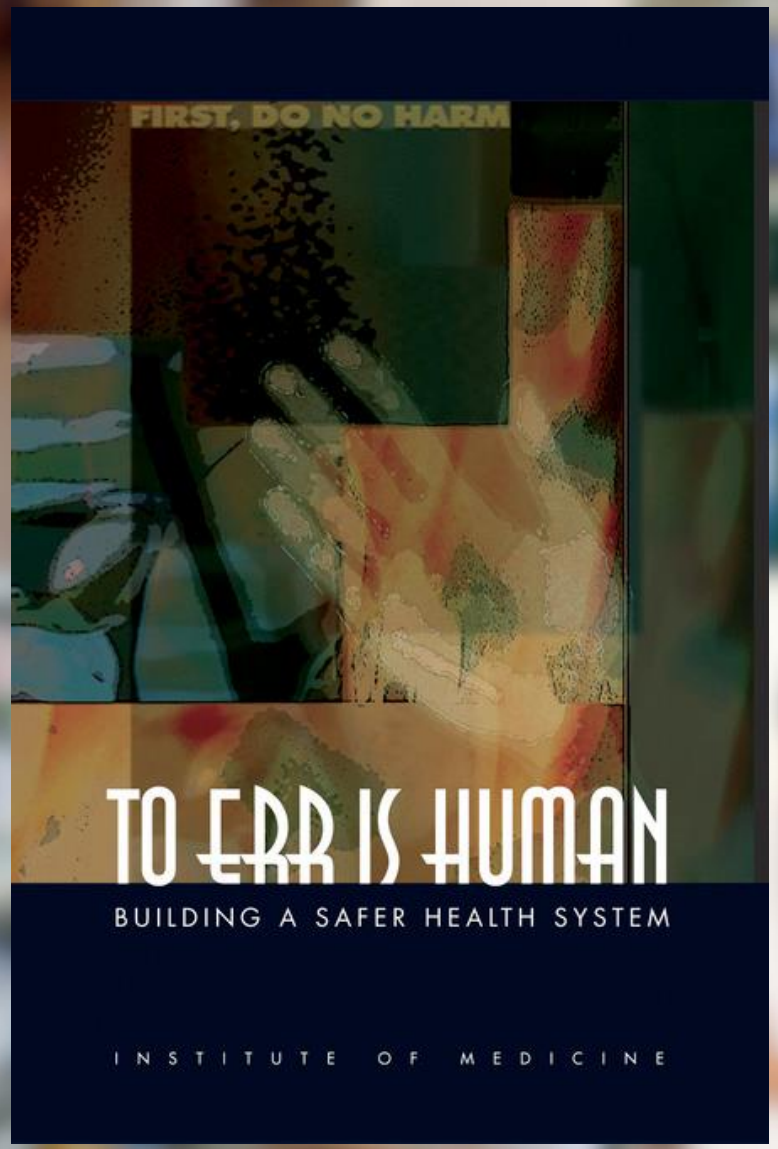
Medical data has exploded in recent decades, but the physical spaces of healthcare remain in the dark.

Yeung, Downing, Fei-Fei, Milstein, *New England Journal of Medicine* (2018)

Haque, Milstein, Fei-Fei, *Nature* (in press)

Healthcare Delivery is Highly Complex

“To Err is Human”
1999 National Institute of Medicine Report



…each year in the United States

Immobility-Induced Ulcers

60,000 deaths[1]

Patient Falls

11,000 deaths[2]

Hygiene-related infections

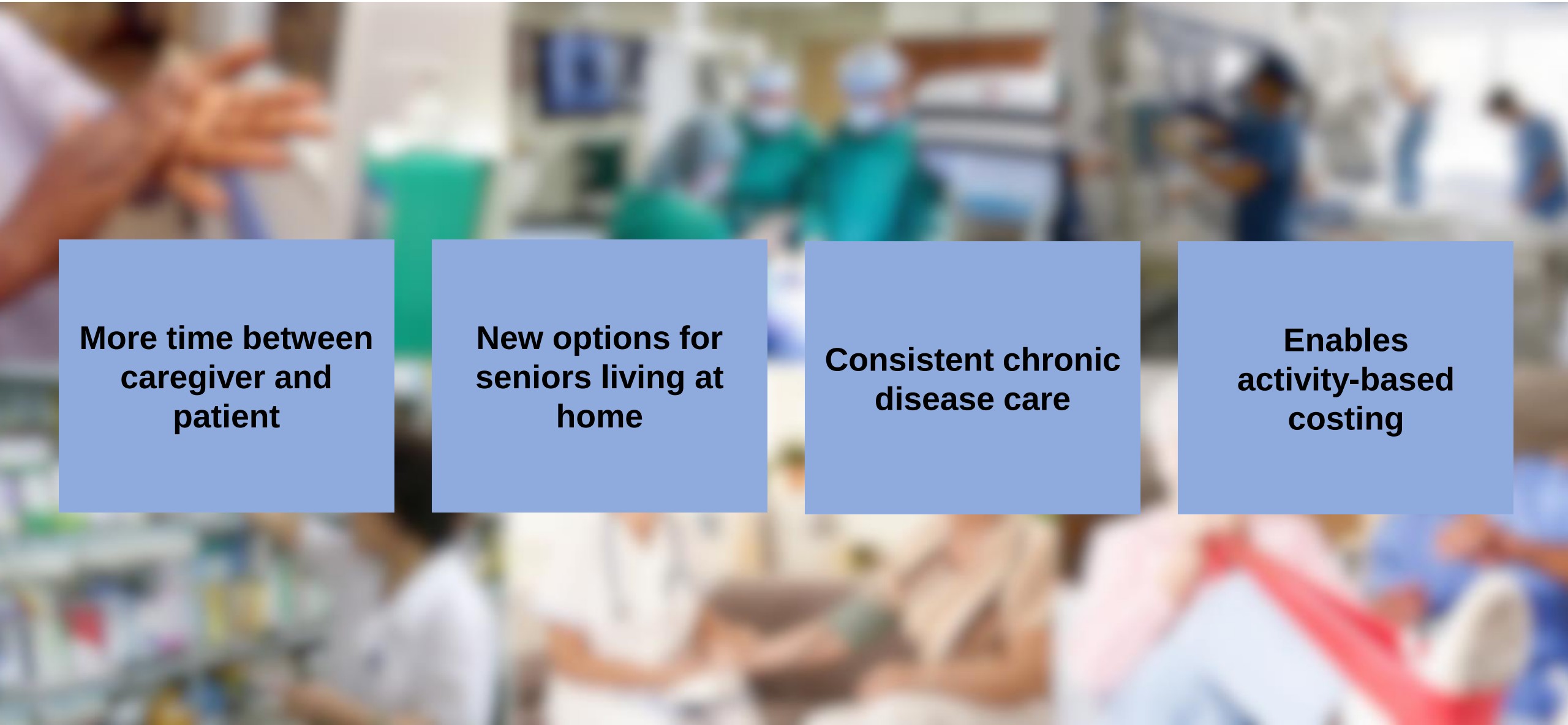
99,000 deaths[3]

CLABSI Infections

31,000 deaths[3]

[1]Barnet 2015 [2]Currie 2008 [3]Klevens 2002

New opportunities for care improvements

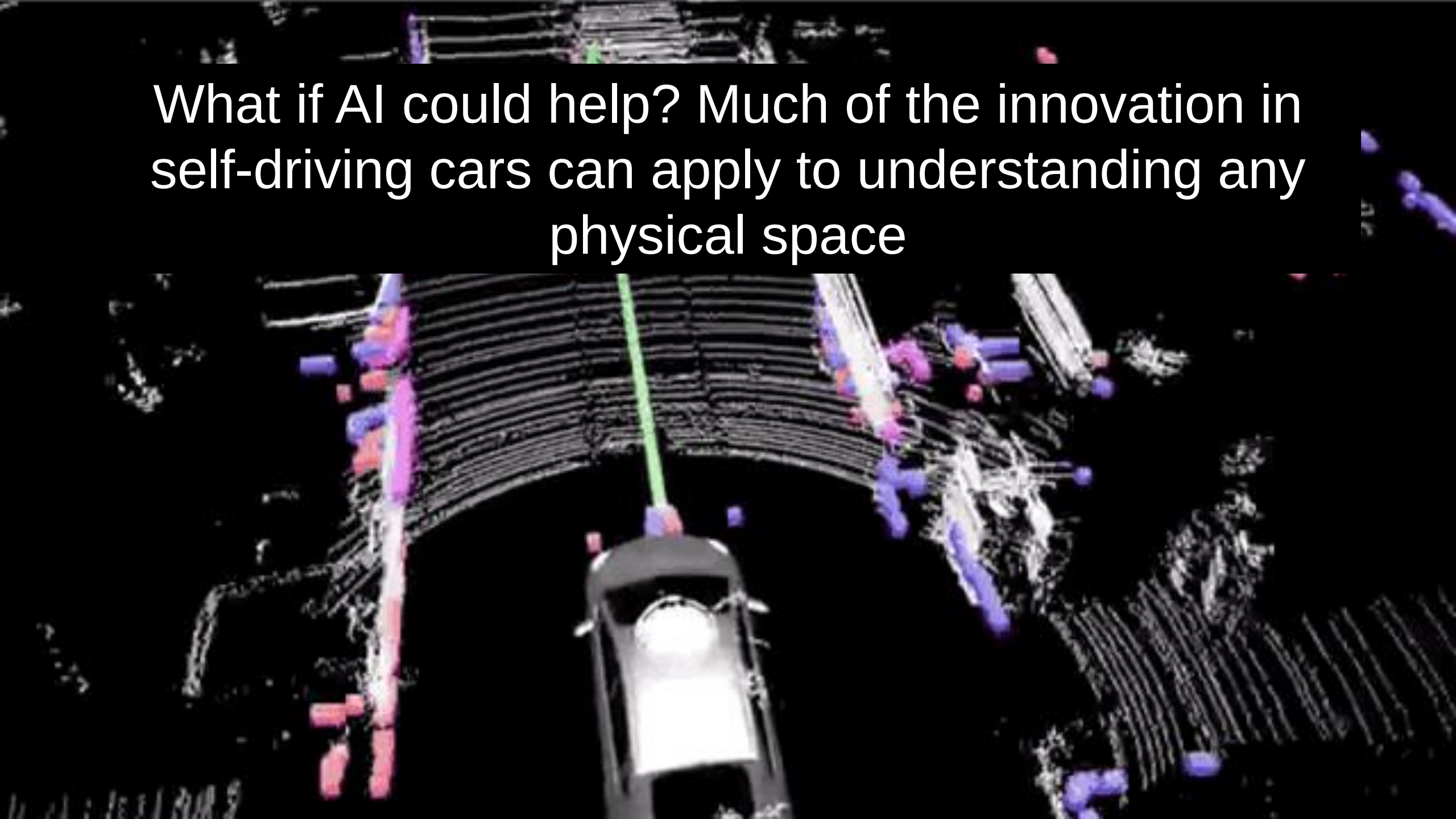


More time between caregiver and patient

New options for seniors living at home

Consistent chronic disease care

Enables activity-based costing

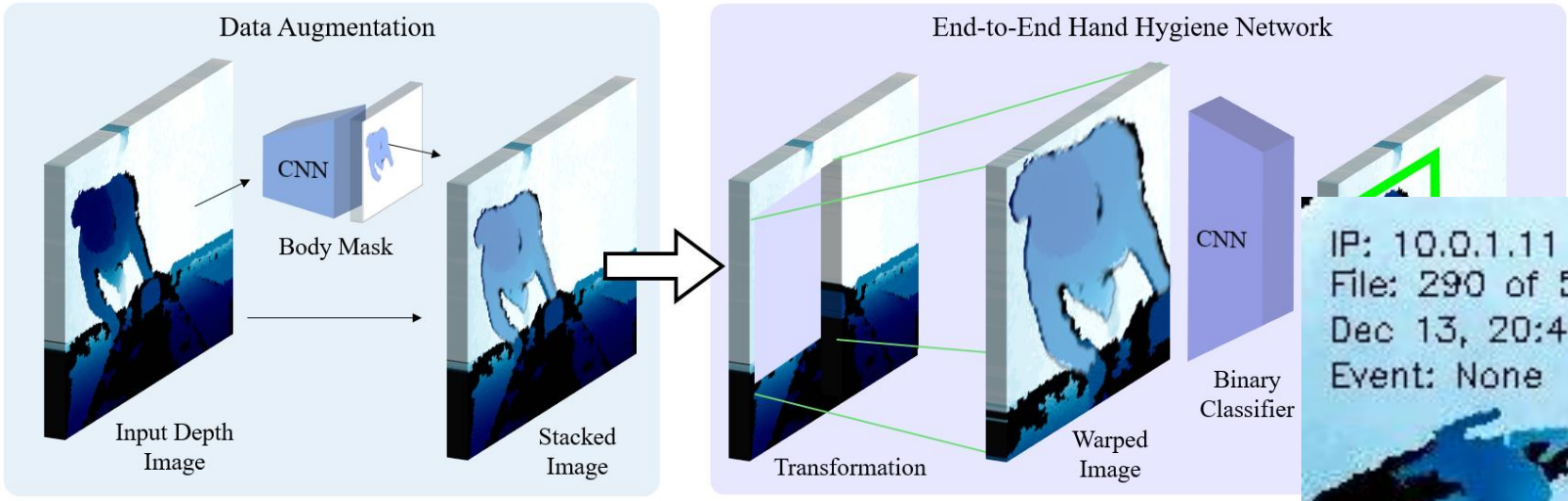

What if AI could help? Much of the innovation in self-driving cars can apply to understanding any physical space

A holistic understanding of activities in the environment

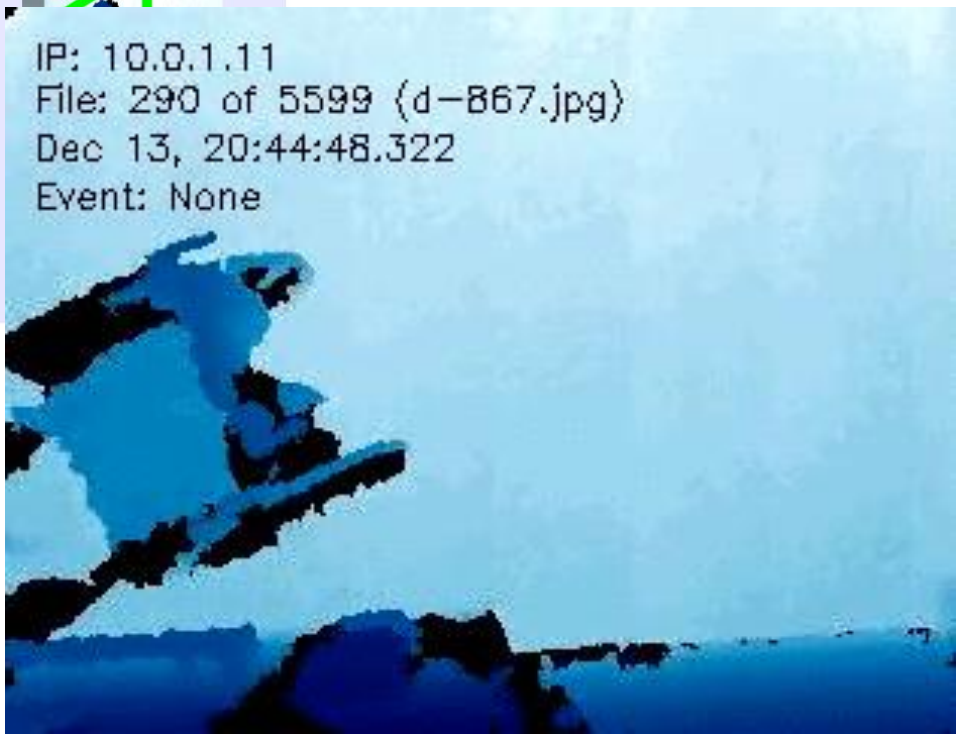
Yeung, Downing, Fei-Fei, Milstein. New England Journal of Medicine (NEJM), 2018.

Haque, Milstein, Fei-Fei, *Nature* (in press)

AI can detect human activities accurately…

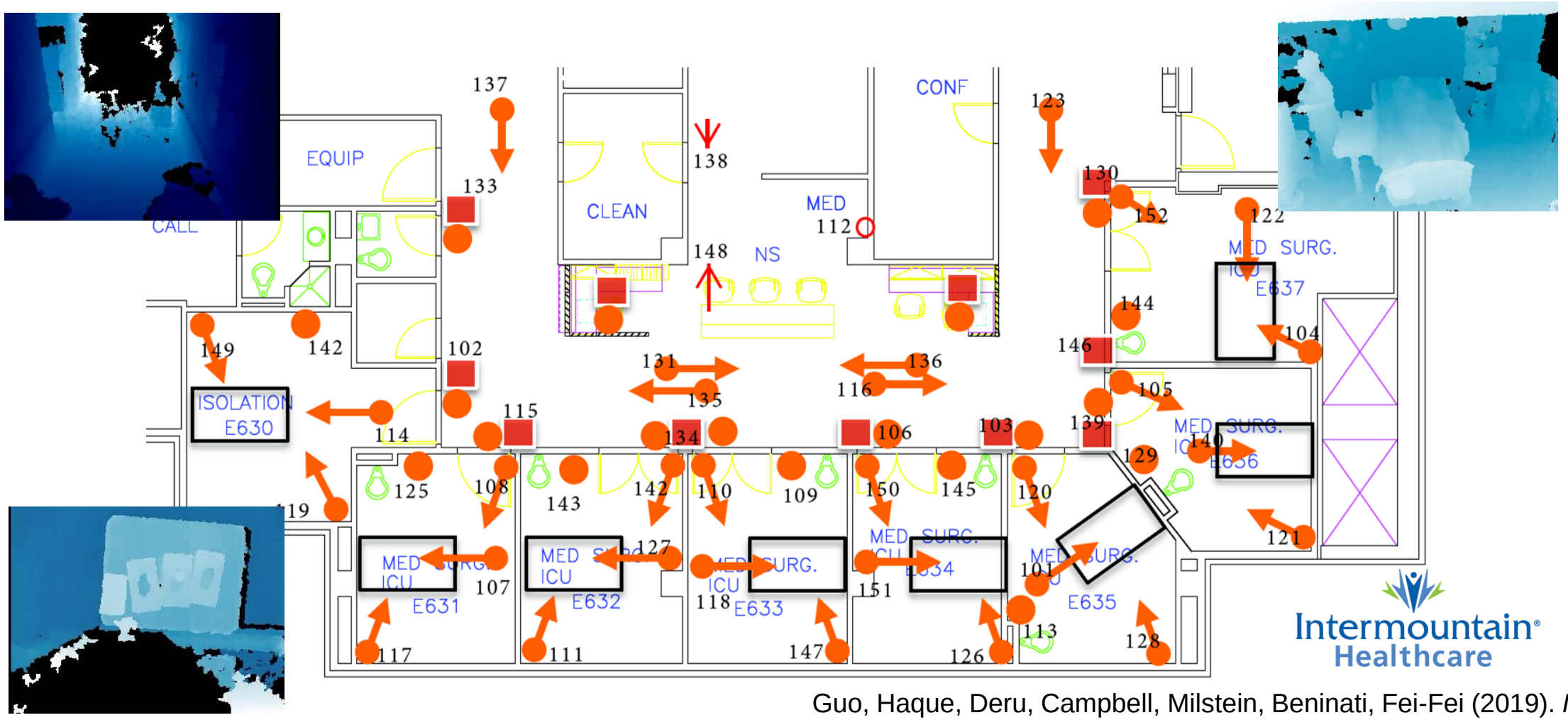


…with real-world hospital data



Singh*, Haque*, Alahi, Yeung, Guo, Glassman, Beninati, Platchek, Fei-Fei, Milstein (2020)
Haque, Guo, Alahi, Yeung, Luo, Rege, Jopling, Downing, Beninati, Singh, Platchek, Milstein, Fei-Fei (2017)

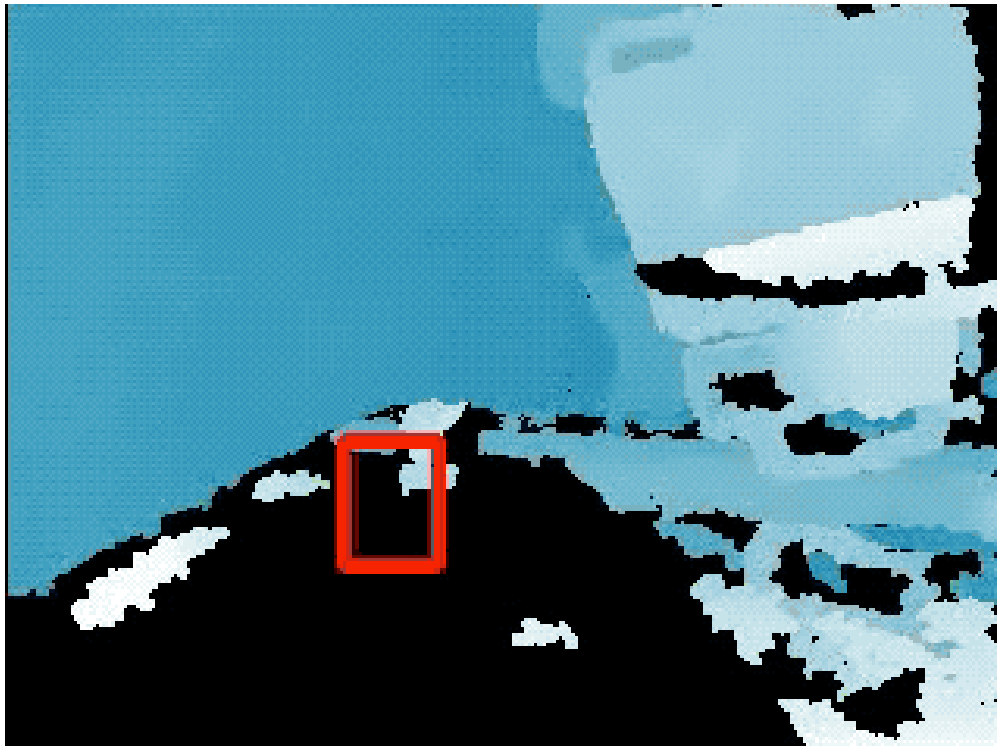
...and can be placed throughout the hospital.

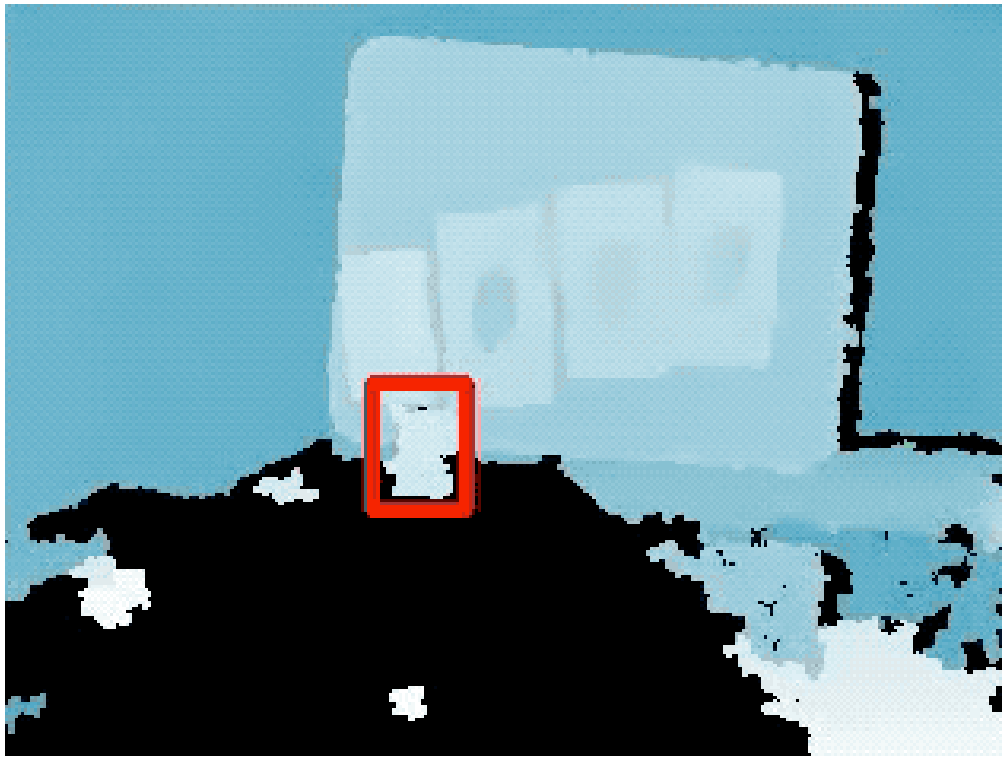


Intermountain® Healthcare

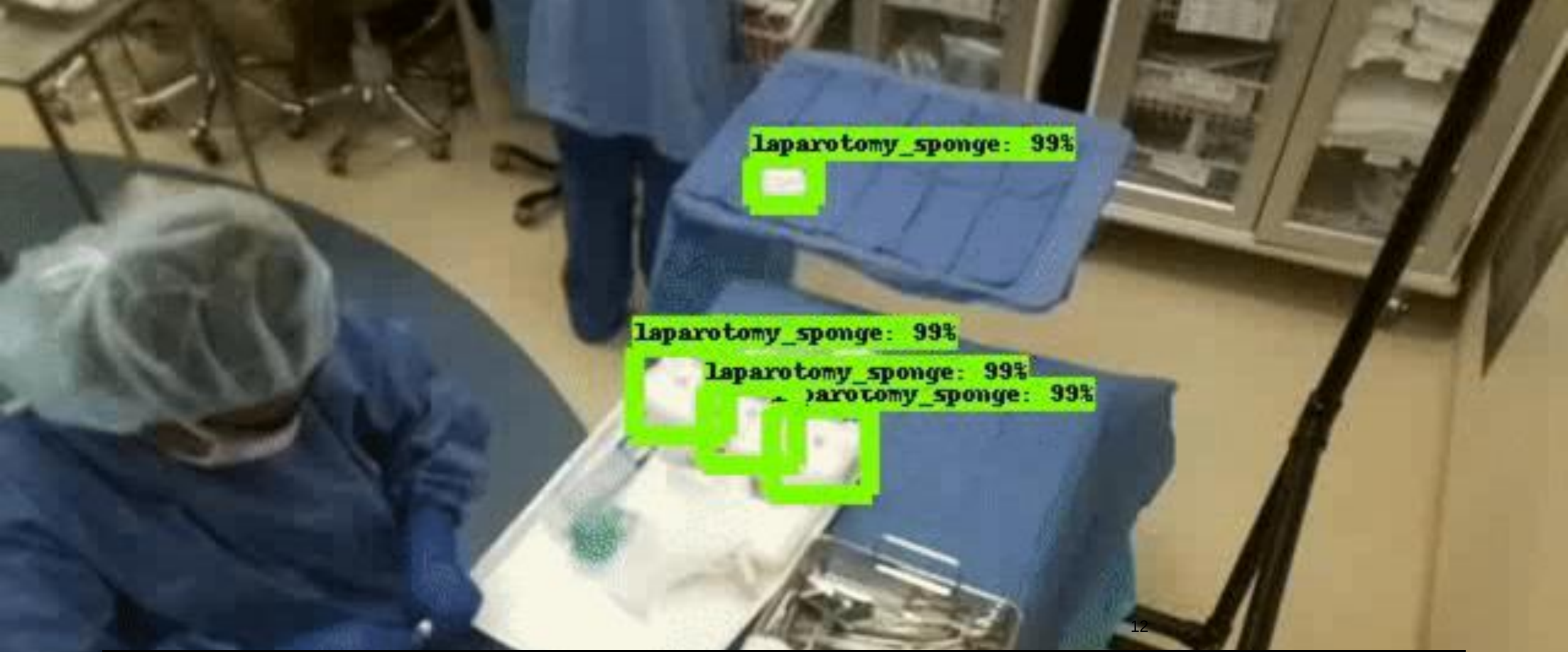
Guo, Haque, Deru, Campbell, Milstein, Beninati, Fei-Fei (2019). *In preparation*.

Seeing the difference between good hand hygiene and bad, as it happens





Guo, Haque, Deru, Campbell, Milstein, Beninati, Fei-Fei (2019). *In preparation*.



Or helping prevent surgical mistakes as an operation unfolds

Zhao et al. (2019)

A case study in now AI is helping extend the reach of senior care

7% Increase
in US residents aged 65+ by 2030

42% Decrease
in ratio of caregivers to seniors by 2030
(4:1 vs 7:1)

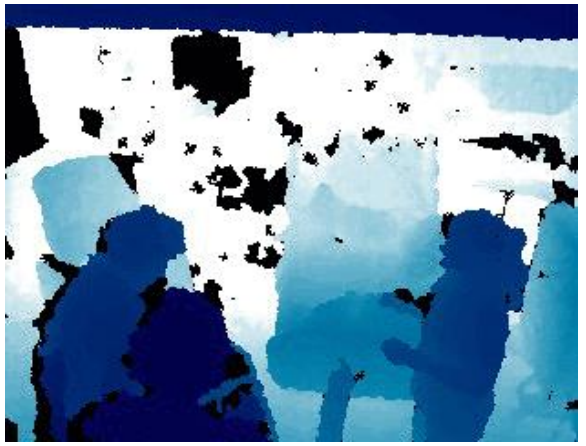
18.4 Billion
hours of assistance from unpaid caregivers

UN (2019). Alzheimer's Association (2018). Hall (2015)

AI can track senior activities accurately and non-invasively

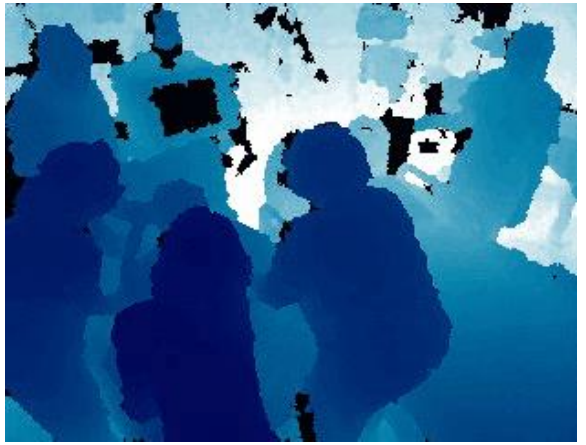
Get patient out of bed

Sit patient in chair



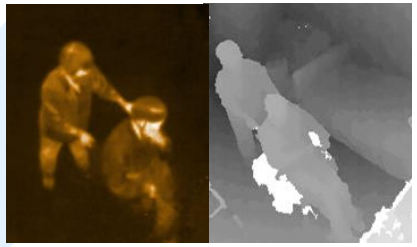
Get patient back in bed

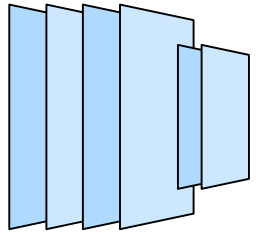
Get patient out of chair

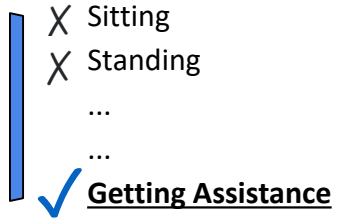


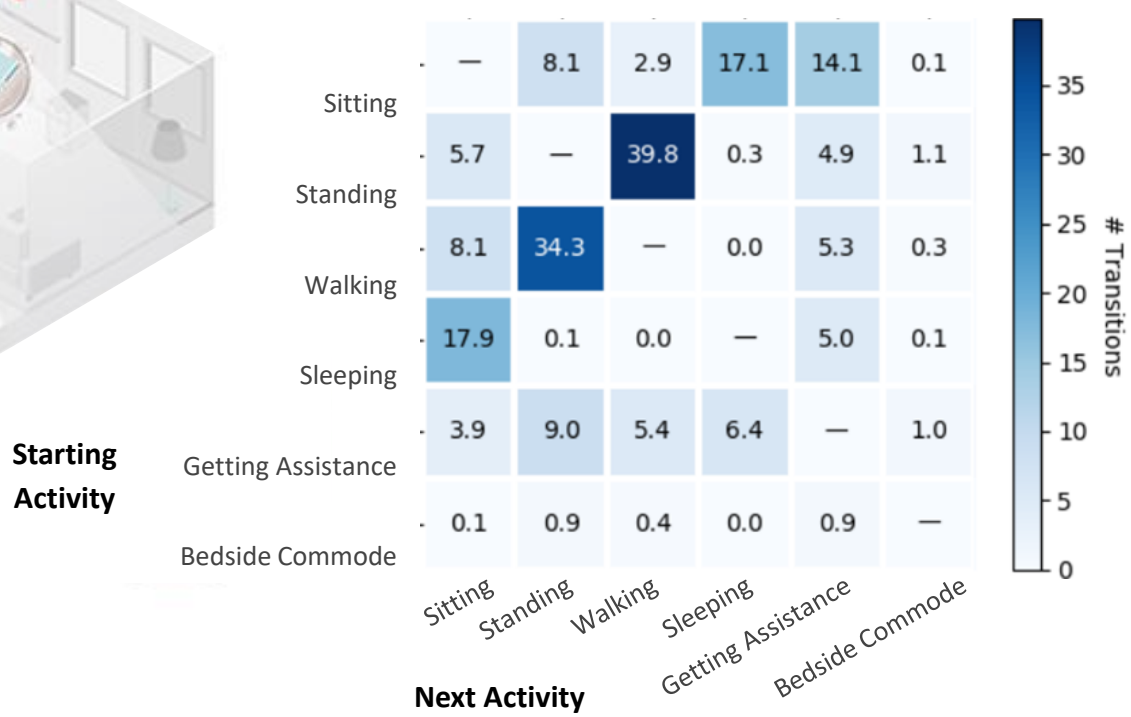
Yeung*, Rinaldo*, Jopling, Liu, Mehra, Downing, Guo, Bianconi, Alahi, Lee, Campbell, Deru, Beninati, Fei-Fei, Milstein (2019)

And turn their daily activities into a rich source of data and analytics







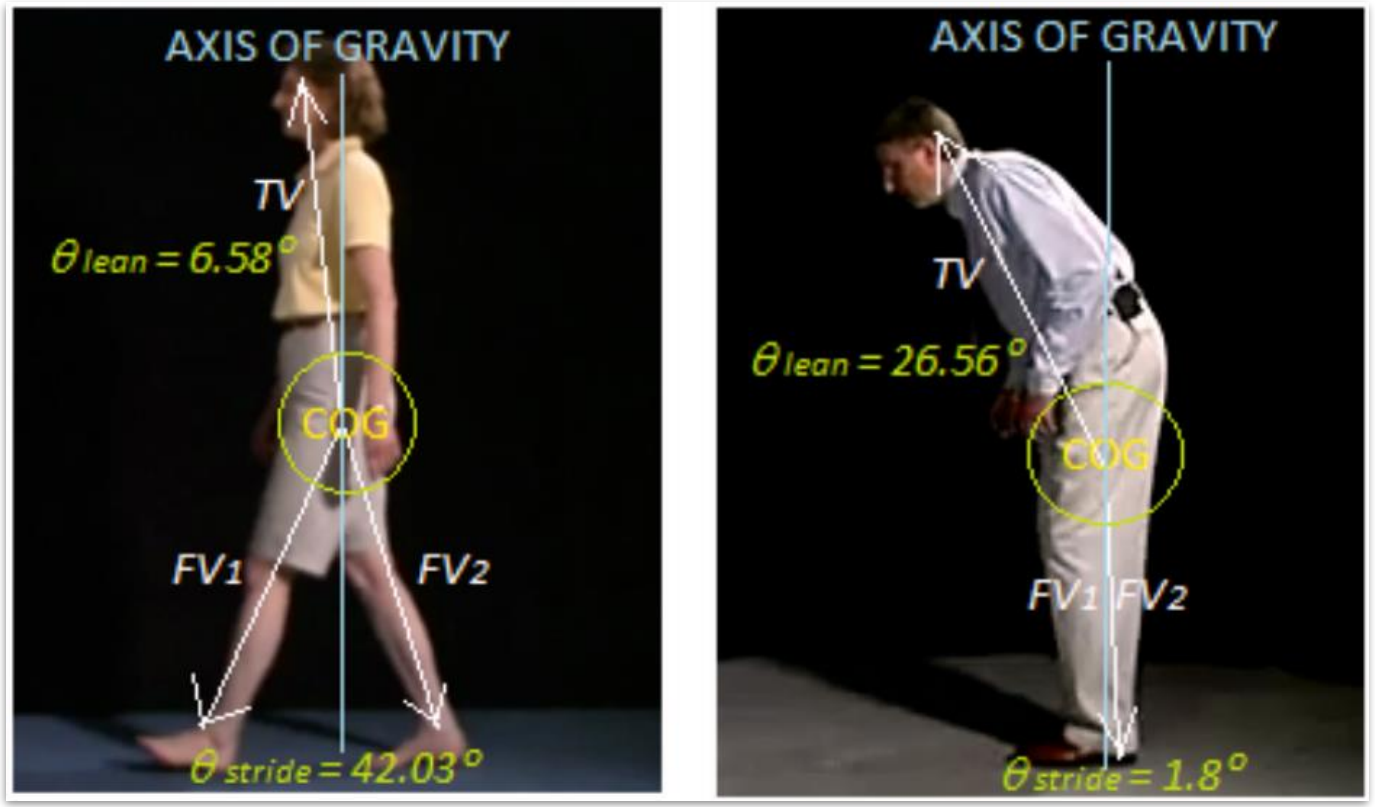


Haque, Milstein, Fei-Fei (2020)

AI for Fall Detection

Luo, Rege, Pusiol, Milstein, Fei-Fei (2017).

AI for Parkinsonian Gait Detection



Khan, Westin & Dougherty (2013)

COVID-19 Special

How to take care of seniors while keeping them safe?

- Early Symptom Detection of COVID-19
- Monitor Patients with Mild Symptoms
- Manage Chronic Conditions

Descriptive analytics of clinical status

Can be further interpreted by clinicians and family members

Fever

Urinary frequency

Respiratory rate

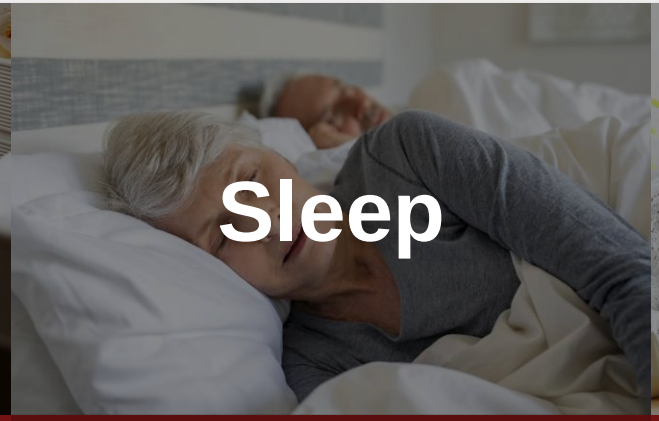
Falls

Slowed movements

Unstable transfers

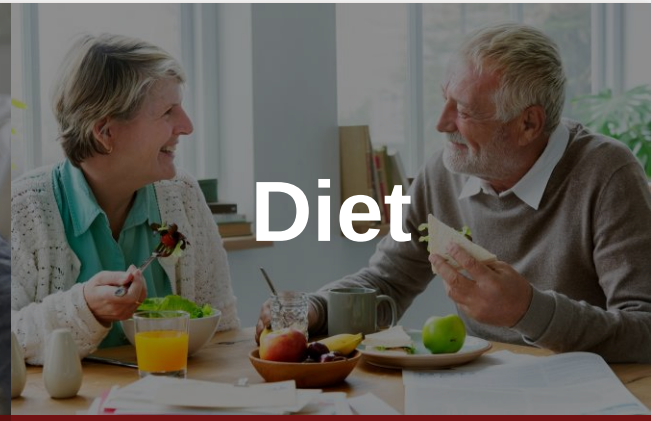
Front door loitering

Immobility



Sleeping

Day/night reversal



Eating

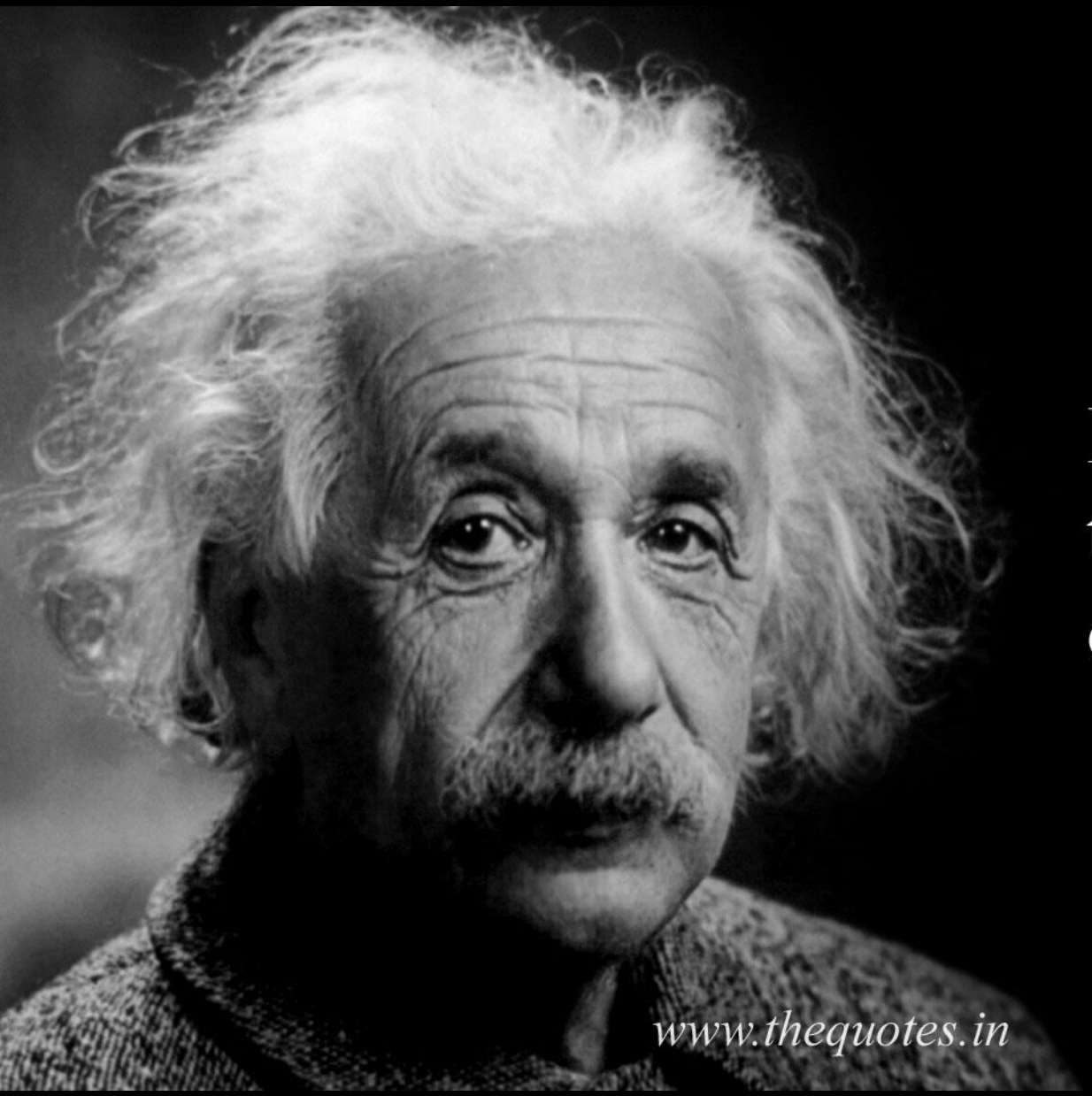
Fluid intake

Alcohol consumption

Pill consumption

Reference: Computer Vision-based Descriptive Analytics of Seniors' Daily Activities for Long-term Health Monitoring, Luo et al., Machine Learning for Healthcare (MLHC) 2018; Video Magnification, MIT CSAIL

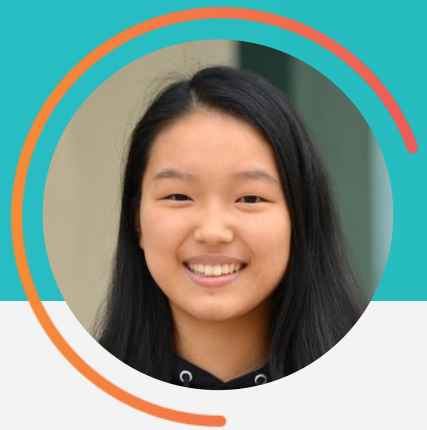
Part II:
Ensuring AI is Human-Centered



It has become appallingly obvious that our technology has exceeded our humanity.

Albert Einstein

The Future of AI



Amy Jin, College Sophomore

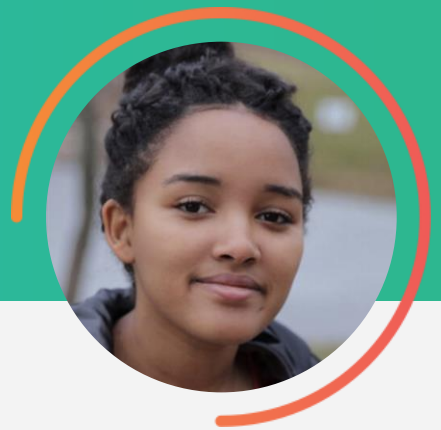
AI4ALL ALUM

- First author on paper about using neural nets to provide surgeons with feedback on surgical technique.
- Won Best Paper at Machine Learning for Health at NeurIPS 2017.

Stephanie Tena-Meza,
12th Grade

AI4ALL ALUM

- Researching AI-assisted methods for tracking the flow of contaminated water in her hometown of Salinas, CA.
- Started AI club at local middle school, which has been running for 3 years.

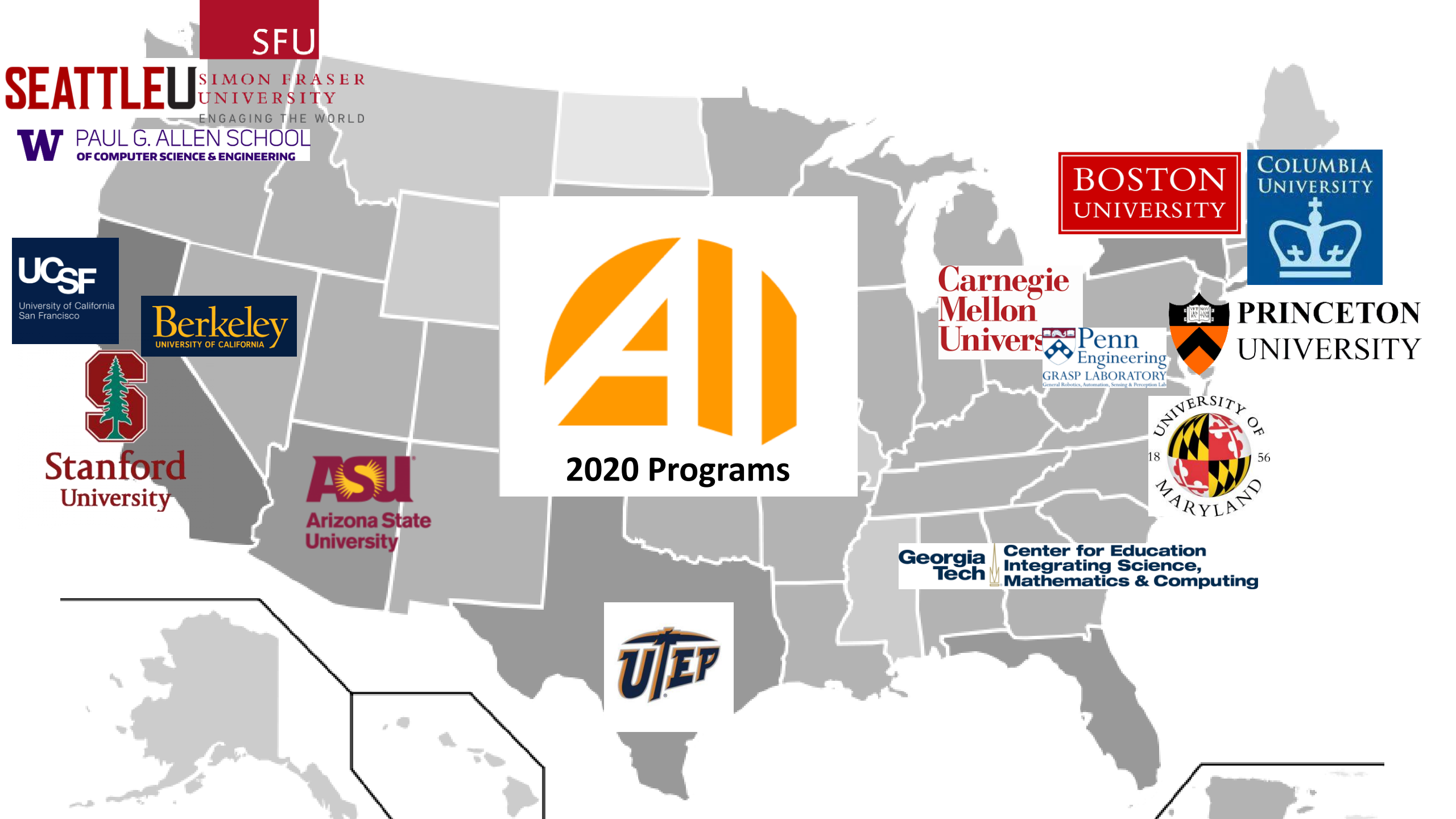


Bekah Agwunobi, College Freshman

AI4ALL ALUM

- Research intern at MIT
- 2018 winner of National Center for Women & Information Technology National Award (NCWIT)

AI4ALL (2015- present)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Georgia Tech
Center for Education Integrating Science, Mathematics & Computing
UTEP

Stanford University
Human-Centered
Artificial Intelligence

To advance AI research, education, policy and practice to improve the human condition.

H

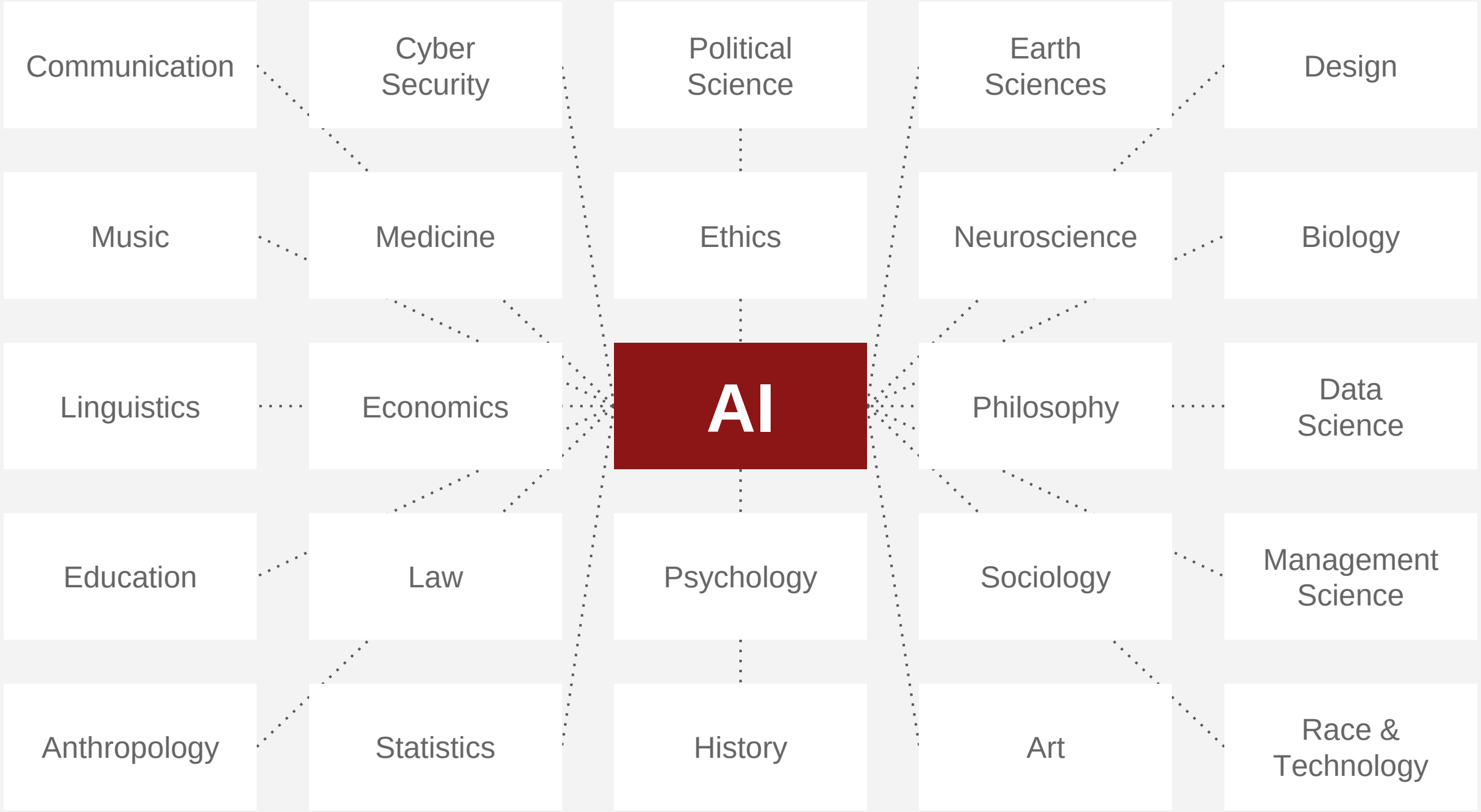
The development of AI must be guided by a concern for its **human impact**.

A

AI should strive to **augment** and enhance us, not replace us.

I

AI must be more inspired by human **intelligence**.


Communication
Cyber Security
Political Science
Earth Sciences
Design
Music
Medicine
Ethics
Neuroscience
Biology
Linguistics
Economics
AI
Philosophy
Data Science
Education
Law
Psychology
Sociology
Management Science
Anthropology
Statistics
History
Art
Race & Technology

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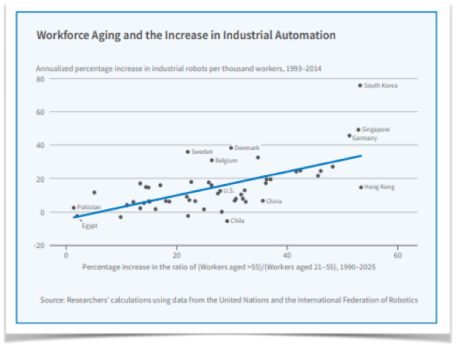
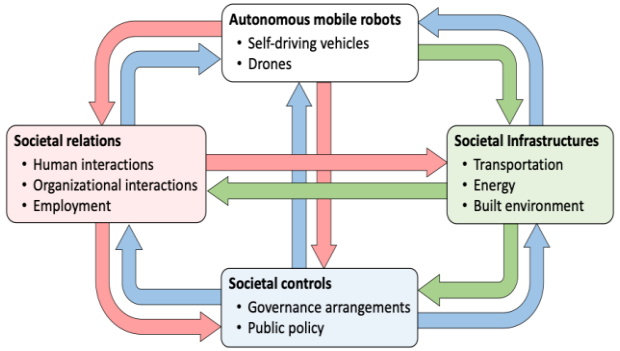
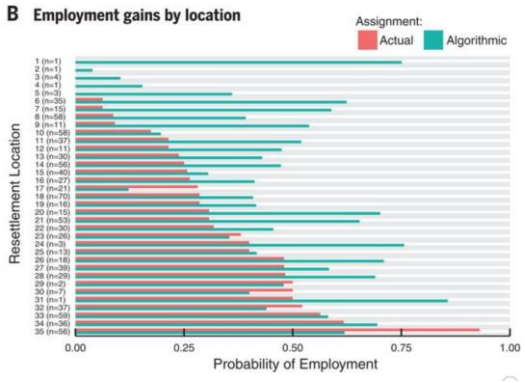


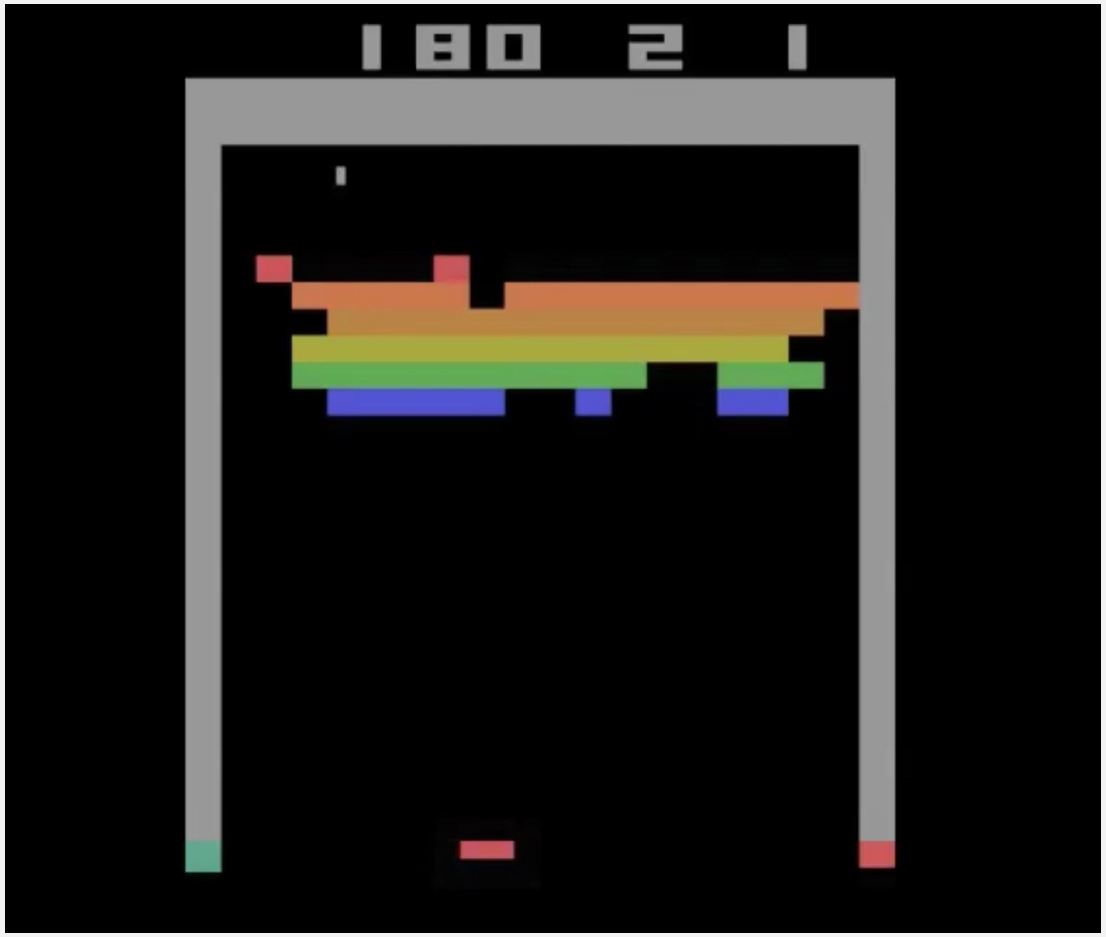
Prof. Susan Athey (Economics)
AI + Future of Work

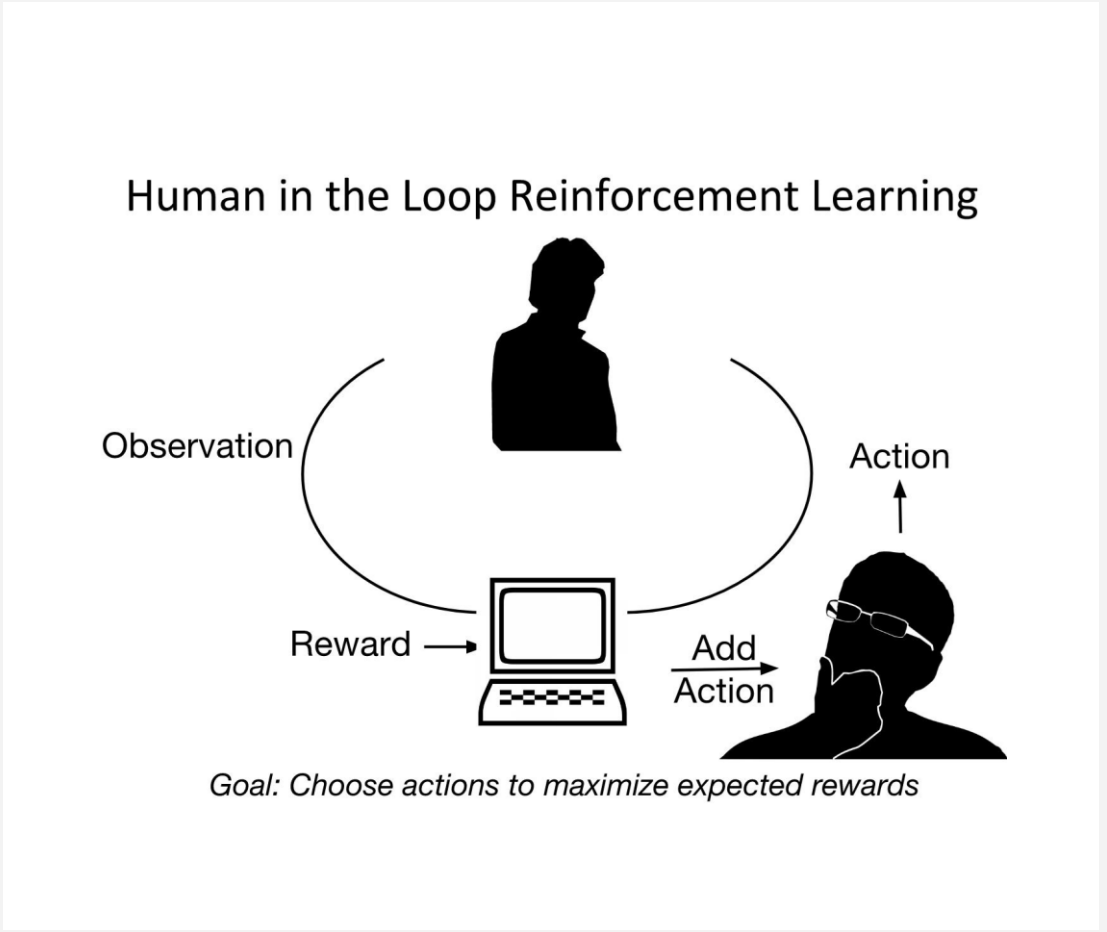


Profs. Marco Pavone (AA), David Grusky (Soc), Mark Duggan (Econ)
Societal Impact on Autonomous Robots



Prof. Jens Heinmueller (Pol. Sci.)
AI + Refugee Policy





Reinforcement Learning in Education

Prof. Emma Brunskill & collaborators, Stanford University

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From ML Bias To ML Fairness

Prof. Rob Reich
(Political Science)

Stanford | ETHICS TECHNOLOGY & PUBLIC POLICY

Computers, Ethics, and Public Policy
Winter 2019 M/W/F 1:30-2:50 PM
Cubberley Auditorium

Course Website: cs181.stanford.edu

Professor Rob Reich	Professor Mehran Sahami	Professor Jeremy Weinstein
reich@stanford.edu	sahami@cs.stanford.edu	jweinst@stanford.edu

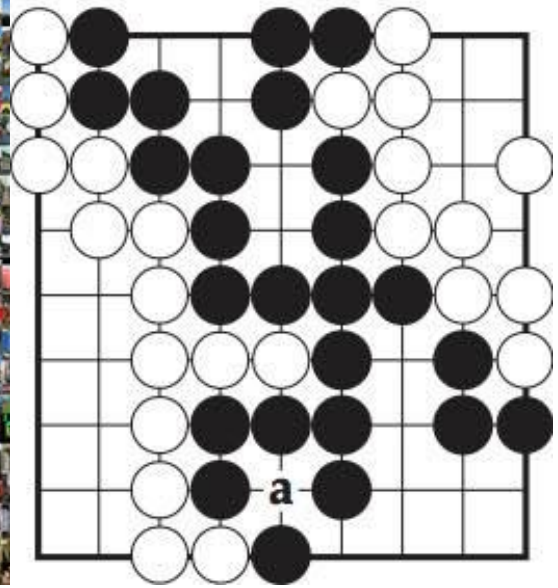
CASE STUDY
ALGORITHMIC DECISION-MAKING AND ACCOUNTABILITY

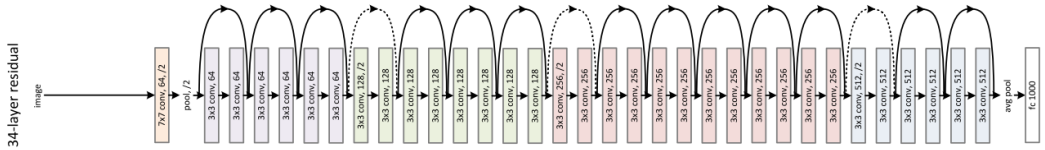
CASE STUDY
PRIVATE PLATFORMS

CASE STUDY
AUTONOMOUS VEHICLES

Today's AI

Static, Simple goals, Disembodied

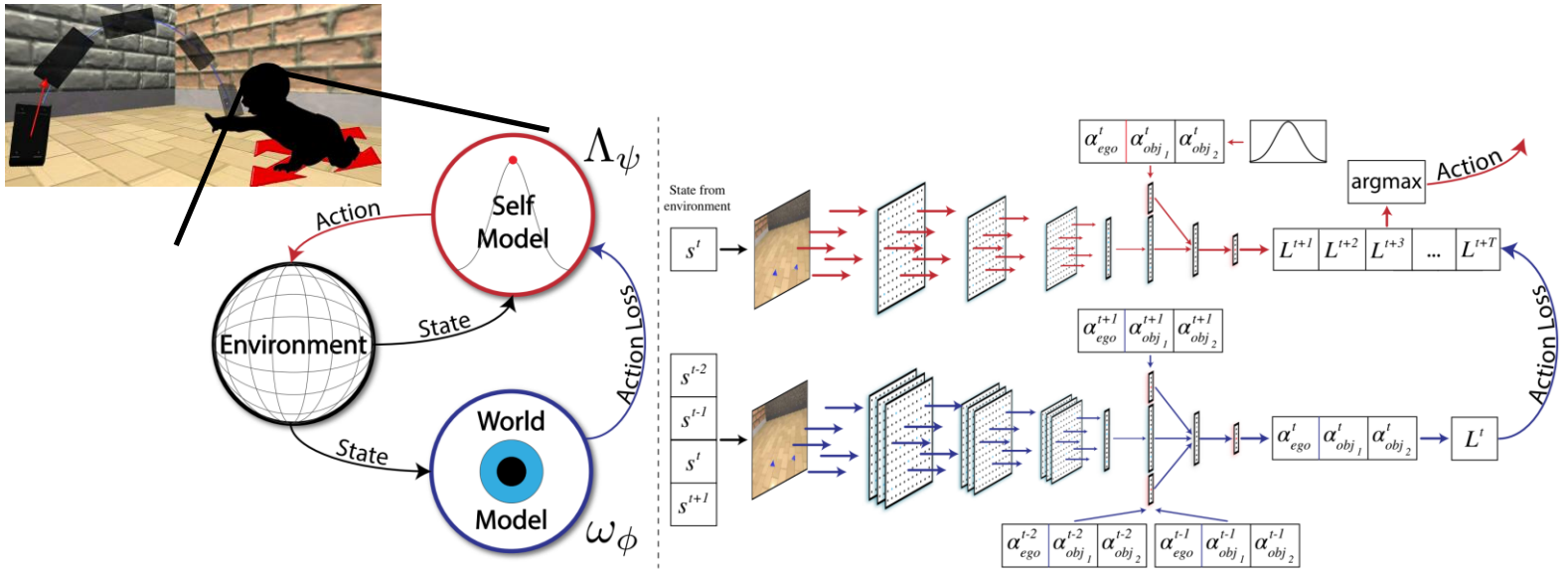




Human

Dynamic, Multi-sensory, Complex, Uncertain, Interactive

Curiosity-driven Learning for AI Agents (Profs. Dan Yamins, Nick Haber, Li Fei-Fei)



World Model network: to predict consequences of actions

Self Model network: to predict errors of world-model ("self-aware")

Action choice: self-model is **adversarial** to world-model ("curious intrinsic motivation")

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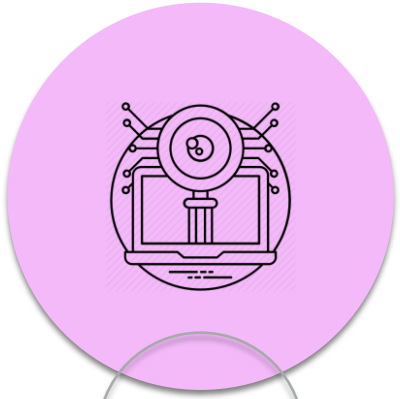
Artist in Residence (2019): Stephanie Dinkins

Our Goals

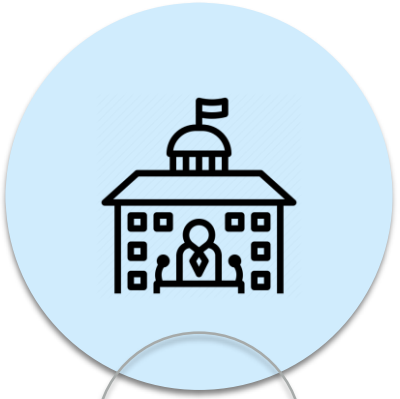


1

Conduct breakthrough **interdisciplinary research** at the forefront of AI technology, impact and application

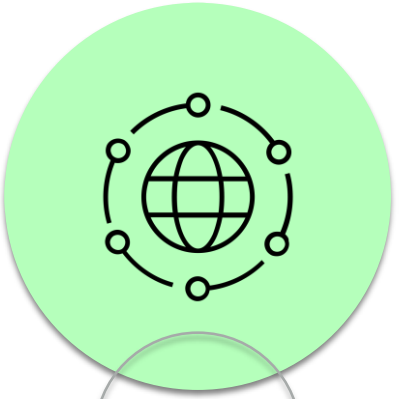
2

Create **educational programs** for a wide range of external constituencies



3

Become a global leader **shaping policies** and practices to guide AI technology



4

Act as a hub for an international community of like-minded organizations

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Part III:
The National Research Cloud

Our nation’s talent reflects the rapid growth of AI.

4%

Average growth rate in AI PhDs from **2010-2017**

22%

Average growth rate in AI PhDs in **2018**

A growing problem: The resources necessary to innovate in AI are virtually **inaccessible** outside the world's biggest corporations and a handful of elite universities.

$1.5 Million

To train Google’s next-generation Chatbot

300,000x+

Increase in compute overhead needed for AI leadership in the past 6 years


High-Performance
Compute


AI Deployment
Expertise


High-Performance
Compute


AI Deployment
Expertise


Large-Scale
Datasets

We propose convening a task force to explore the creation of a **National Research Cloud**, to democratize the resources required to innovate in AI.

The National Research Cloud

Democratizing Compute

Substantially-discounted access to state-of-the-art AI hardware at scale.

Democratizing Expertise

The personnel necessary to deploy these technologies across the country.

Democratizing Data

Safe, secure access to high-quality, large-scale data that preserves privacy.

An expert-led task force can ask the right questions and present a robust strategy:

- How can we keep research secure?
- How can we keep data private at a national scale?
- Who can we partner with for optimal results?

Support for the NRC is strong in academia…

…as well as the NSCAI.

America is a country of incredible talent. It’s time to build the infrastructure to harness it—and ensure it continues into the next generation.

Thank you.

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