What can we learn from a **billion** agents?

Ayush Chopra
ayushc@mit.edu

AgentTorch

mit media lab

Massachusetts Institute of Technology

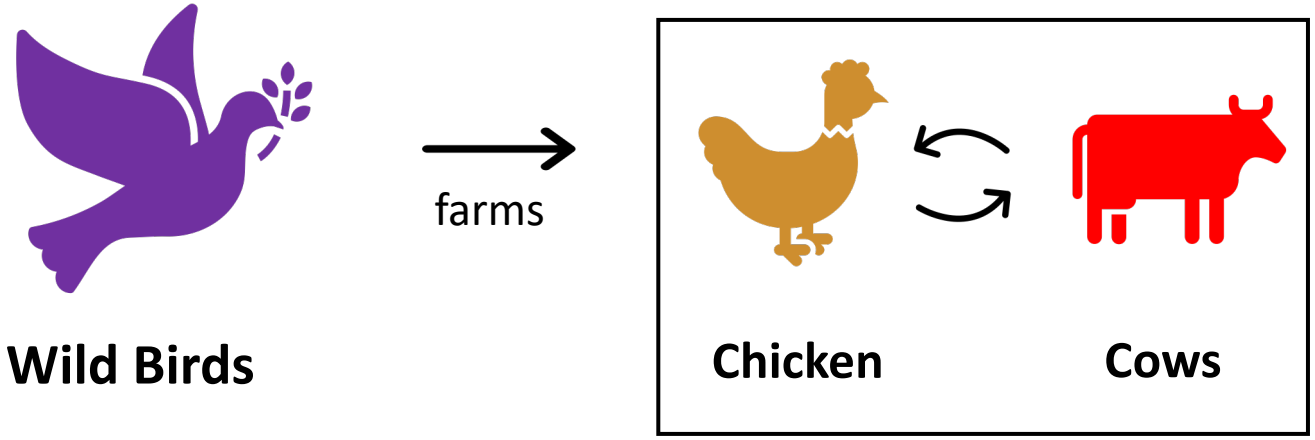

108 SQ FT PER HEN
ROTATED PASTURES
Vital FARMS
TENDED BY HAND ON SMALL FAMILY FARMS
PASTURE-RAISED
18
108 SQ FT PER HEN
ROTATED PASTURES
Vital FARMS
TENDED BY HAND ON SMALL FAMILY FARMS
PASTURE-RAISED
18
VF PTR RSD LRG EGGS 18 CT
18CT
10.99
EQUIVALENT TO 9 LARGE EGGS PER CARTON
KEEP REFRIGERATED
FARM FRESH EGGS

Eggs so expensive? Blame bird migration, not inflation…

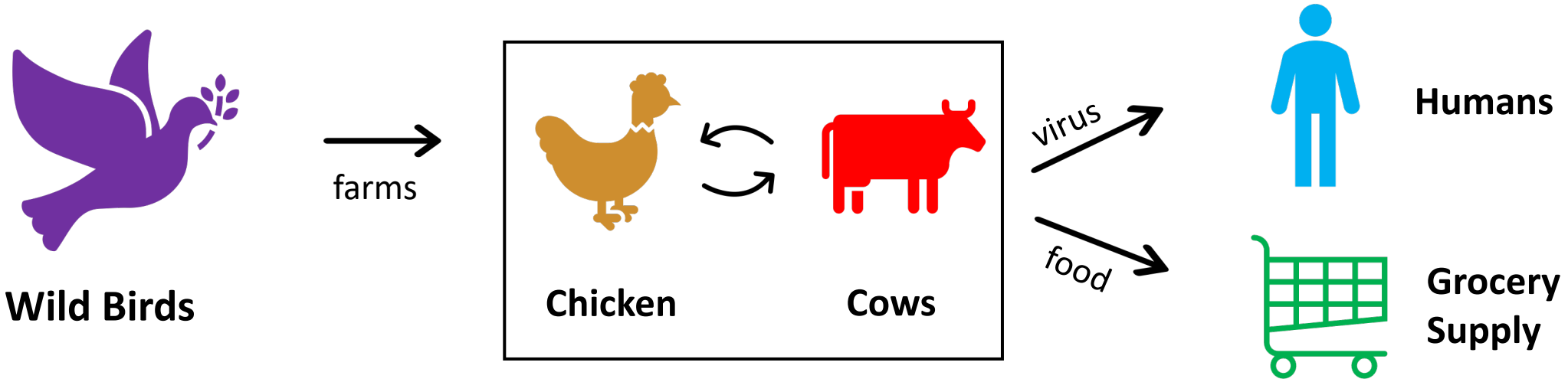
The H5N1 Crisis

Wild Birds

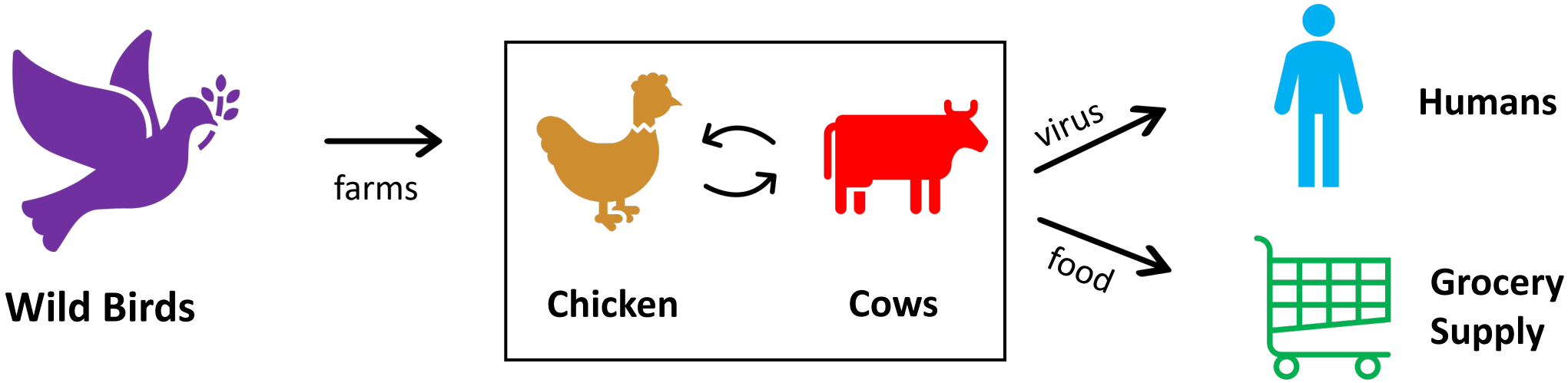
The H5N1 Crisis



The H5N1 Crisis



The H5N1 Crisis



The H5N1 Crisis

100 million chicken culled

$4 billion revenue loss

Human-human infections!

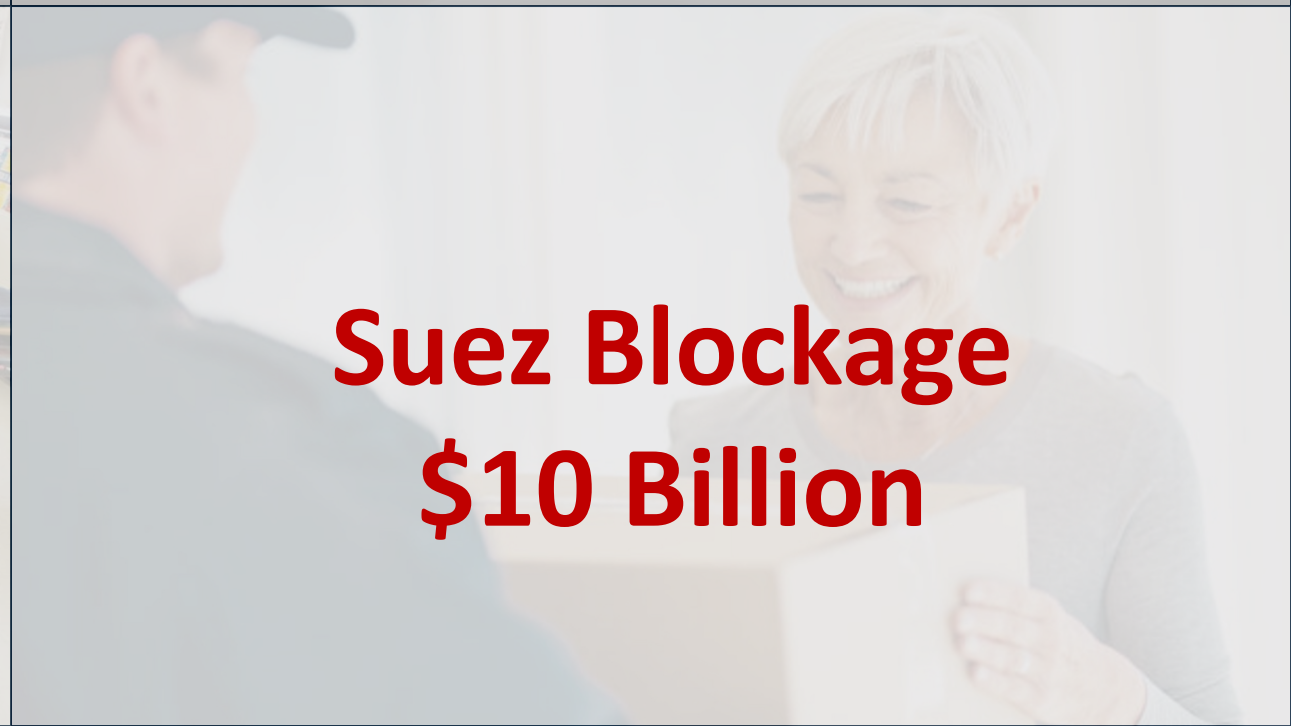

PUSHING DAISIES


Payment Completed
QR CODE PAYMENT
Please Scan

COVID
$3.5 Trillion

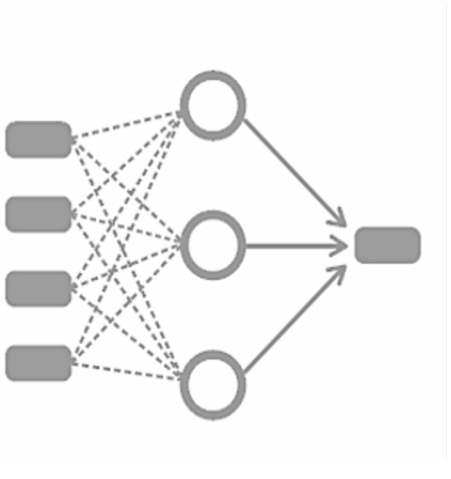
CrowdStrike
$1.7 Billion

Hurricane Ida
$80 Billion



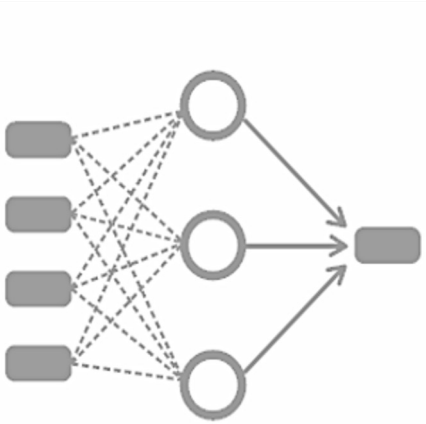
Suez Blockage
$10 Billion

Imagine if… God's Eye View



Capture	Analyze	Act
Bird Migration Disease Transmission	Farmer Incentives Supply Disruptions	Stop Spread Control Prices

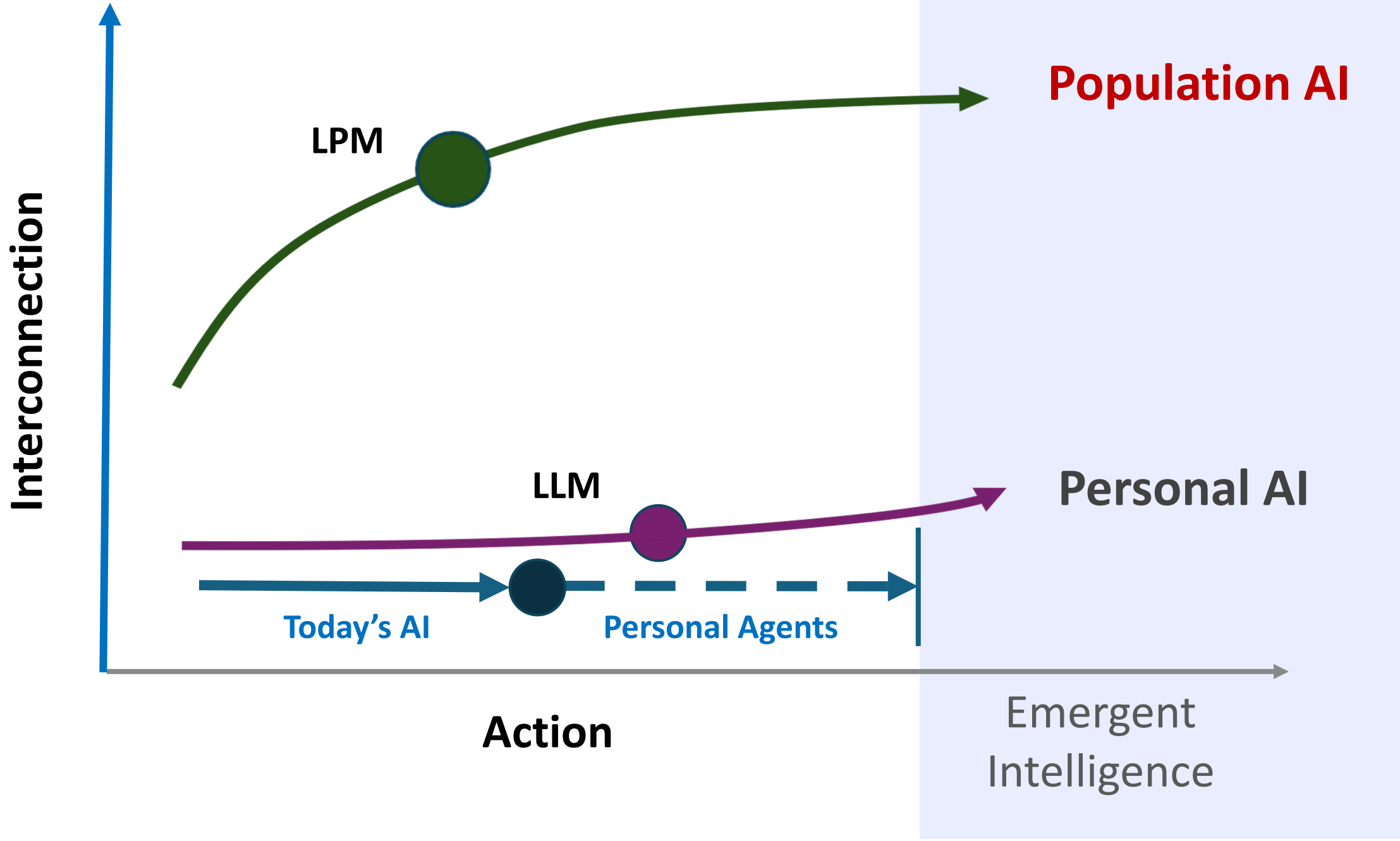
God's Eye View is Not Trivial

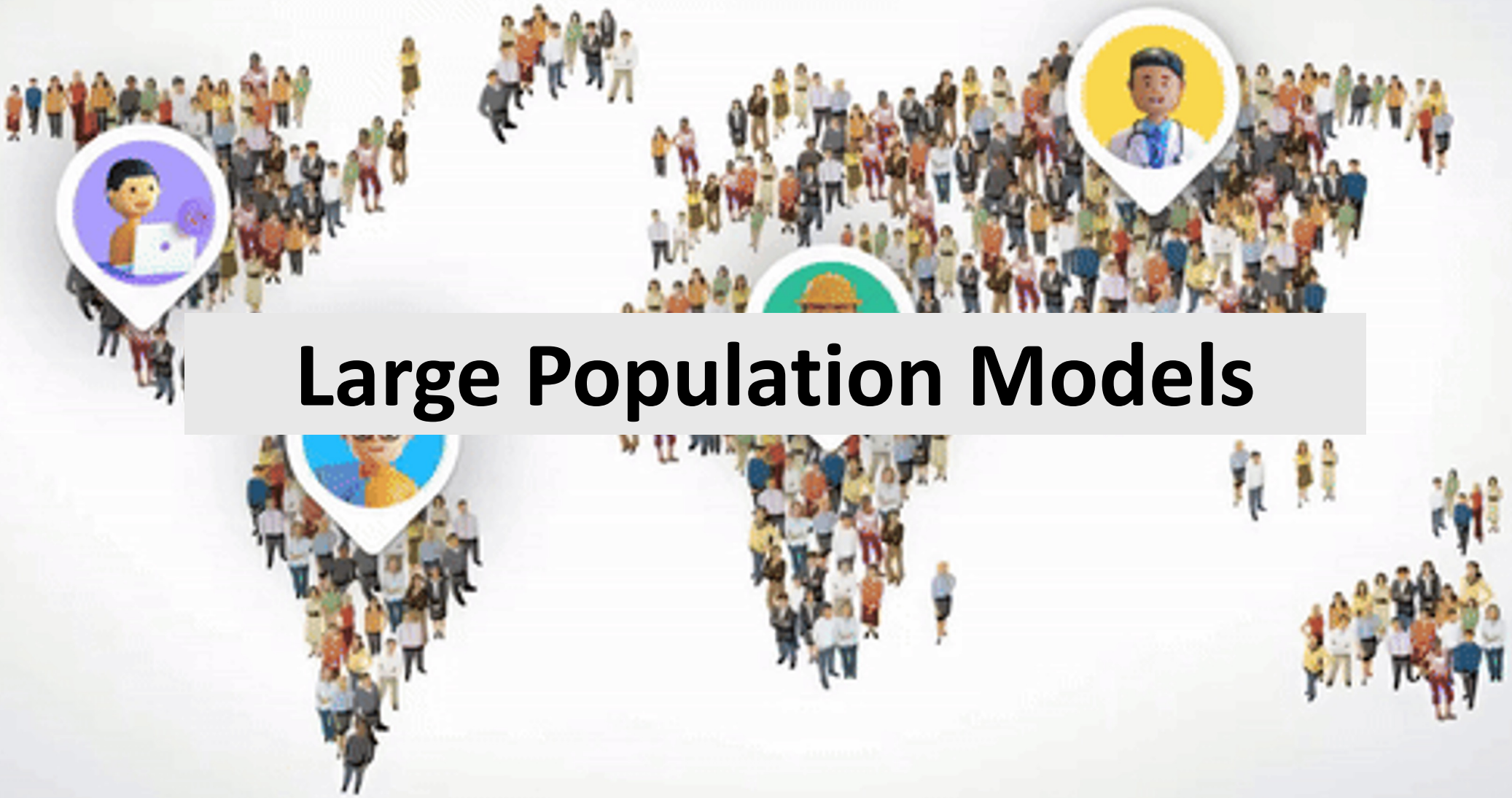


Capture	Analyze	Act
Bird Migration Disease Transmission	Farmer Incentives Supply Disruptions	Stop Spread Control Prices
Web of Interconnections	Heterogeneous Behaviors	Multi-scale Decisions

Large ~~Language~~ Population Models

It’s not *just* about smarter AI individuals, but grasping our interconnected world


Population AI
LPM
Interconnection
LLM
Personal AI
Today's AI
Personal Agents
Action
Emergent
Intelligence



Large Population Models

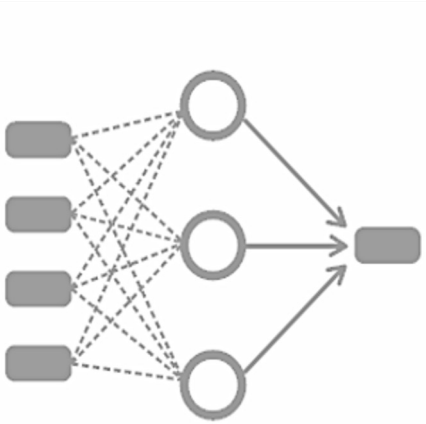
lpm.media.mit.edu

LPMs: Building the God's Eye View

Capture

Bird Migration
Disease Transmission

Web of Interconnections



Analyze

Farmer Incentives
Supply Disruptions

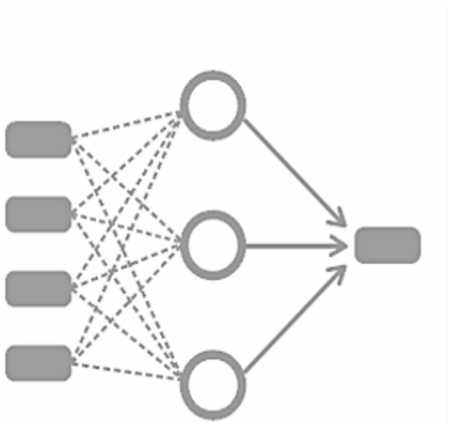
Heterogeneous Data

Act

Stop Spread
Control Prices

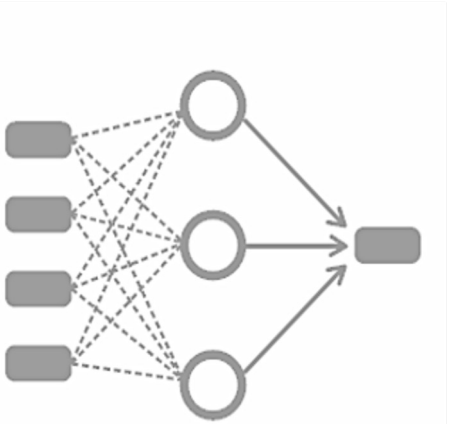
Multi-scale Decisions

LPM: Technical Pillars



Capture	Analyze	Act
Multi-scale Dynamics Stochastic Protocols	Multi-modal data Adaptive behavior	Multi-objective Decisions Real-time Response
Compositional Simulations	Differentiable Learning	Decentralized Analysis

LPM: Technical Pillars



Capture	Analyze	Act
Multi-scale Dynamics Stochastic Protocols	Multi-modal data Adaptive behavior	Multi-objective Decisions Real-time Response
Compositional Simulations	Differentiable Learning	Decentralized Analysis
AAMAS'23, AAMAS'24, Nature Medicine'25	AAMAS'24 (Best Paper Runner-Up), AAMAS'23	British Medical Journal'21, AAMAS'24, ICML-W'22 (Best Paper)

LPM: Simulate a country on your laptop

Execute 300,000 interactions/sec and scale to 60 million agents/GPU

Method	Simulation	Calibration	Analysis
Conventional ABM*	50 hours	100,000 hours	5,000 hours
LPM	5 minutes	20 minutes	10 seconds
	+ 600x	**+ 3000x**	**+ 5000x**

Chopra et al – a framework for learning in agent-based models (AAMAS'24, Oral)

8.4 million agents

AgentTorch

Large Population Models: Reaching millions around the world

World Health Organization

MAYO CLINIC

Te Kāwanatanga o Aotearoa
New Zealand Government

5 million citizens

30 million households

$ billion supply chains

Imagine… your enterprise a living lab

AgentTorch