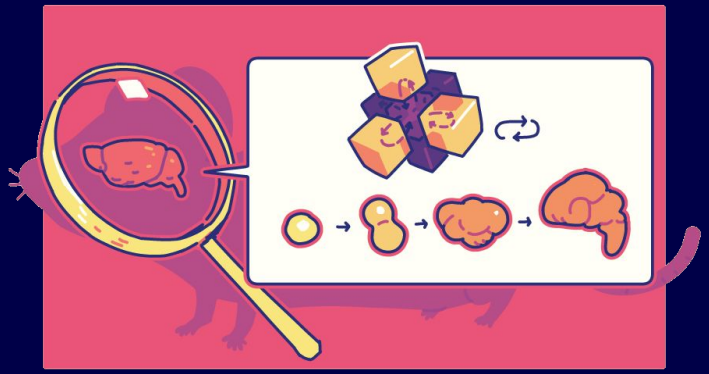
Self-Organizing Models of Brain Wiring: Developmental Programs for Evolving Intelligence



TEXAS
The University of Texas at Austin

Jamieson Warner & Risto Miikkulainen
University of Texas at Austin • Cognizant AI Lab

cognizant

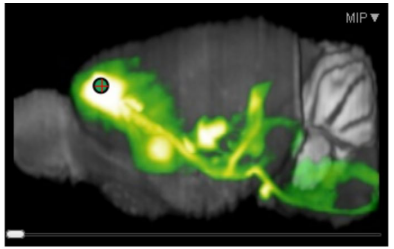
Part 1:

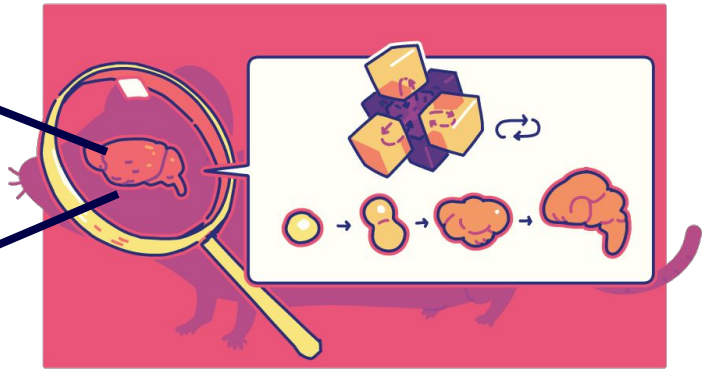
Why I Trained an NCA to Produce Mouse Brain Connectivity

Part 2:

Challenge for EvoSelf Research

Connectomic:
Secondary Motor Area





Transcriptomic:
Gene Hhipl1 expression

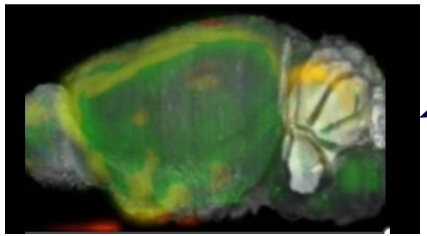
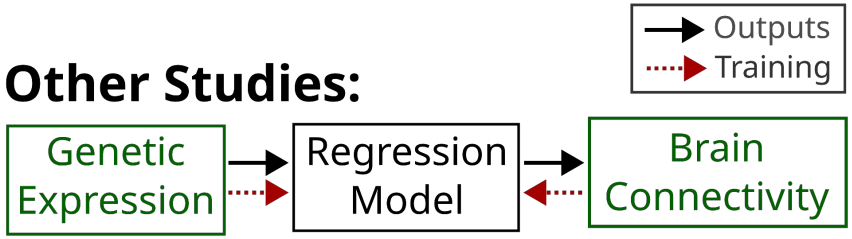
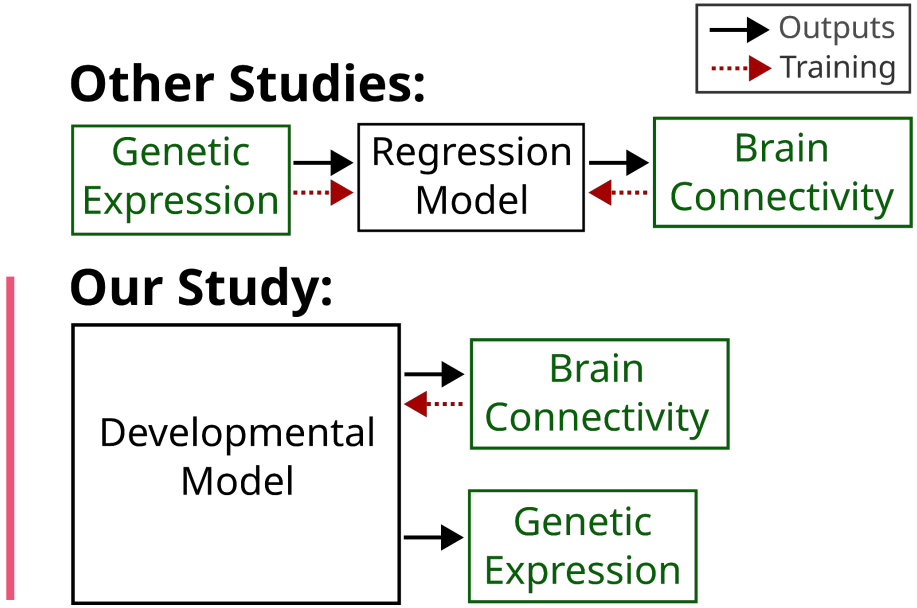


Image credit: Allen Institute for Brain Science.
http://help.brain-map.org/display/mouseconnectivity/API

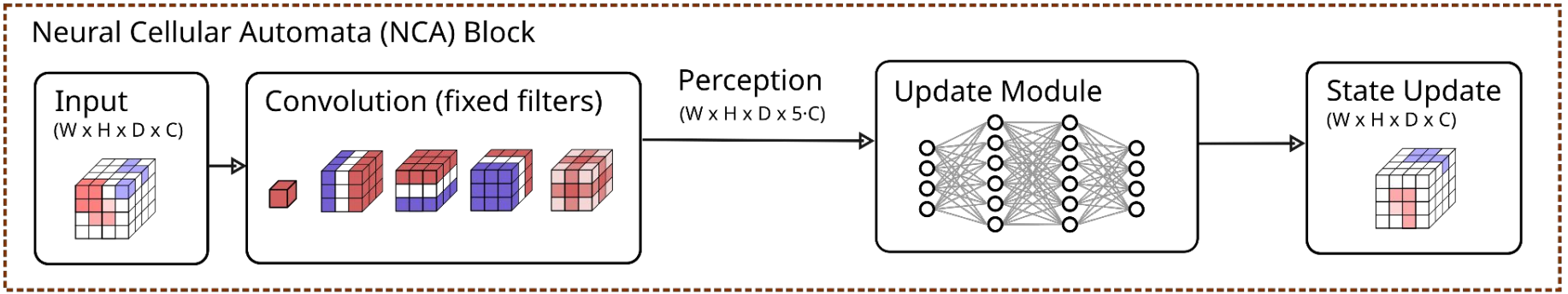
Can We Derive Where Connectivity Comes From?



Can We Derive Where Connectivity Comes From — *by Looking at the Connectivity Data Only?*



Explaining the Connectivity Data



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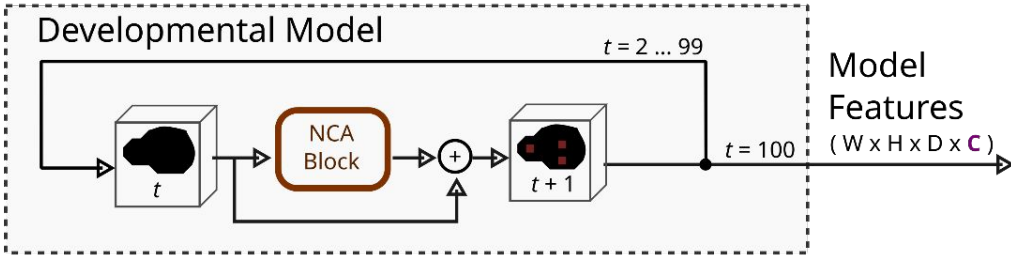
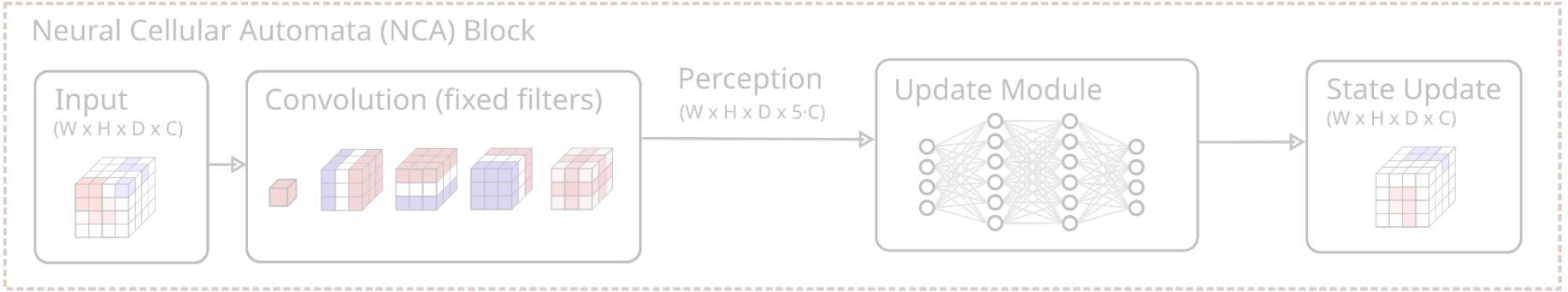
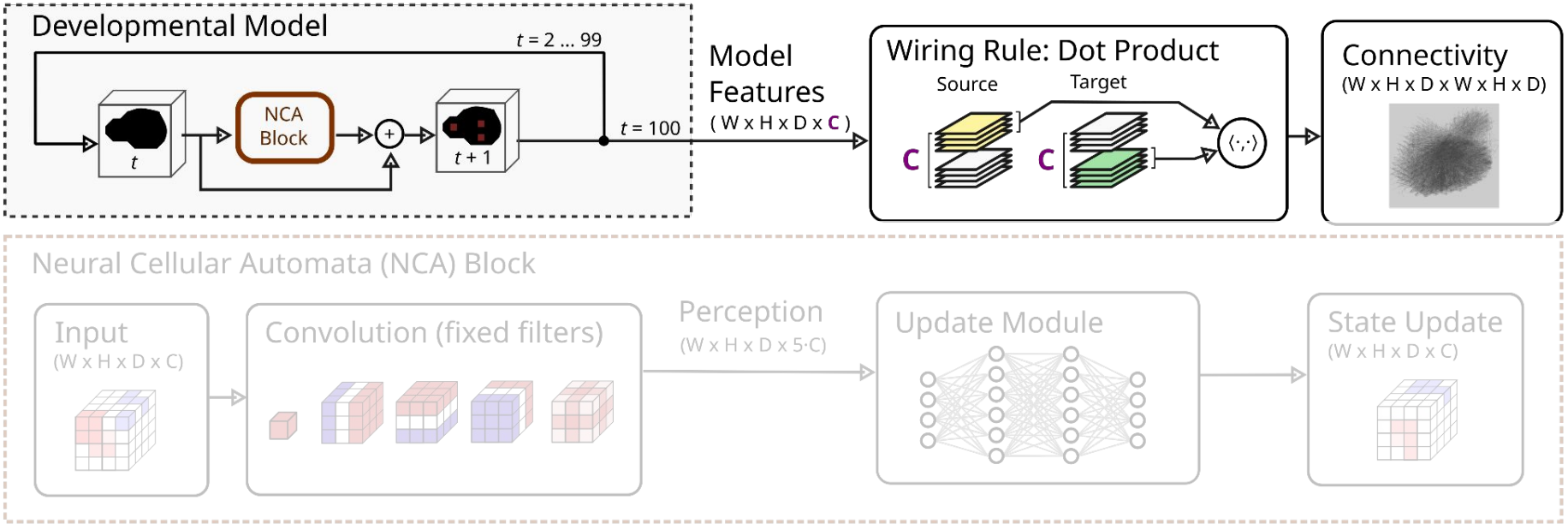




Explaining the Connectivity Data



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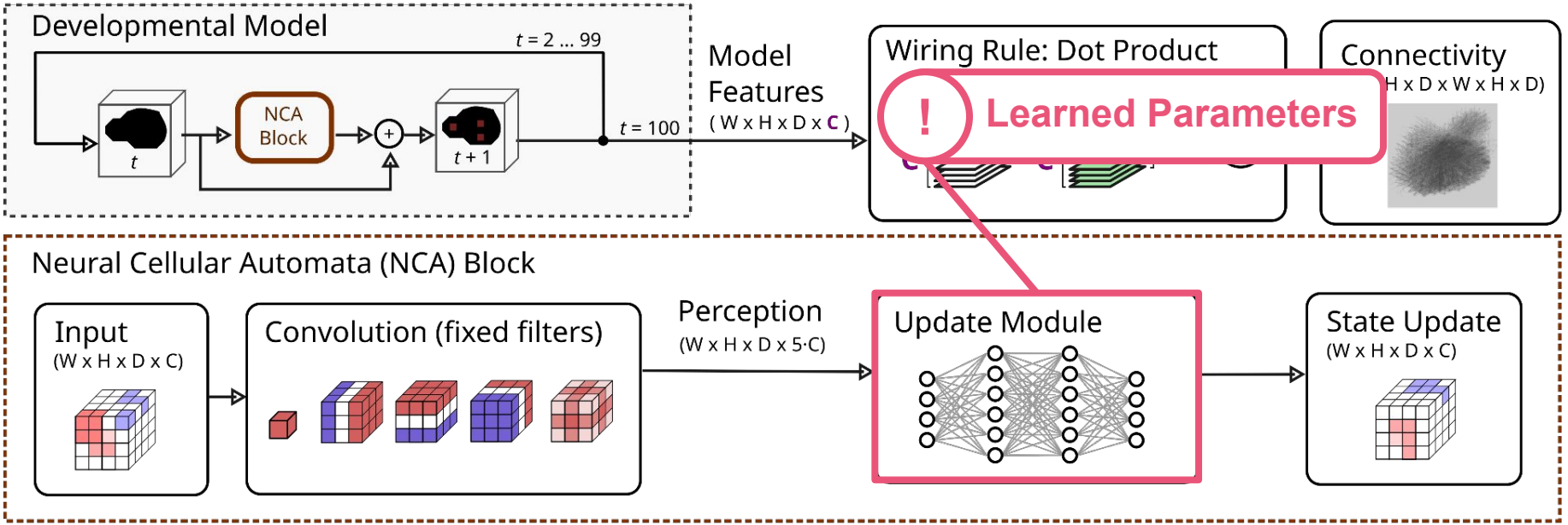
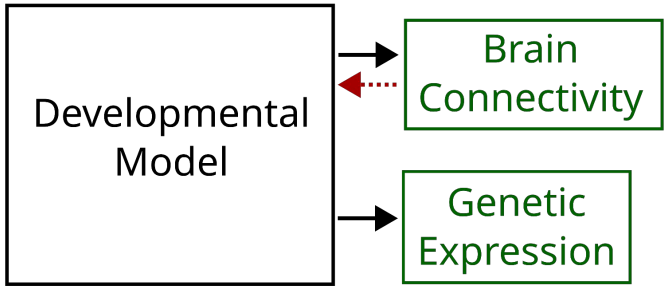


What Can NCA Tell Us About Biological Self-Organization?

Our Study:



Static Model = No NCA; direct learning

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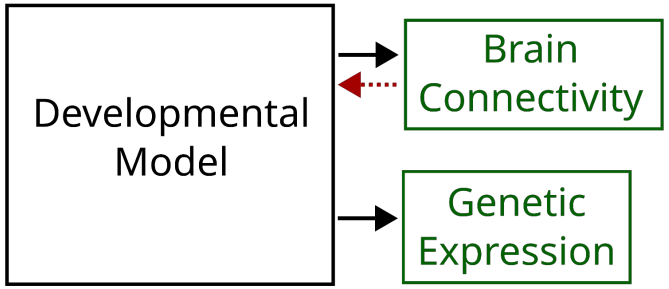

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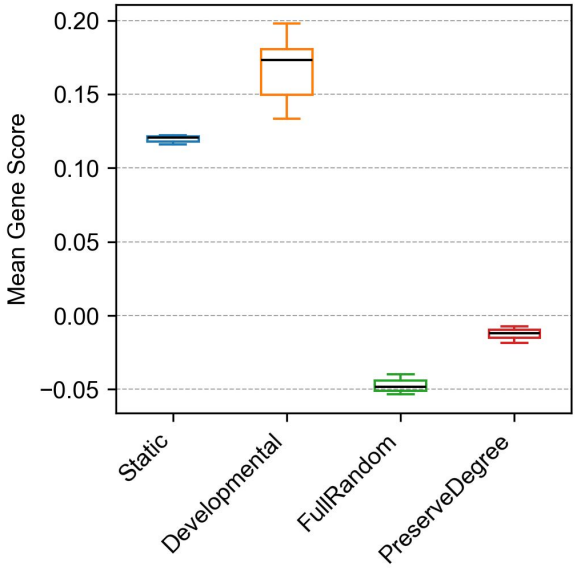
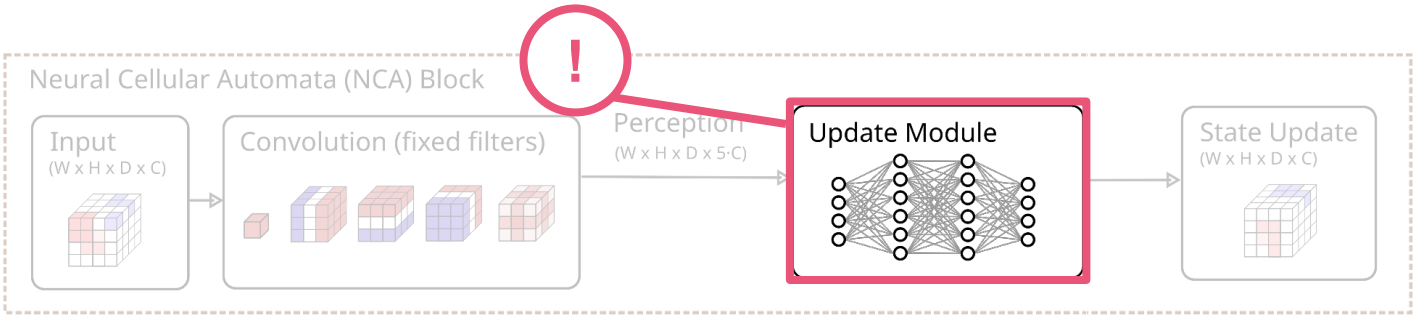


Surprising Finding: Simplicity is Key



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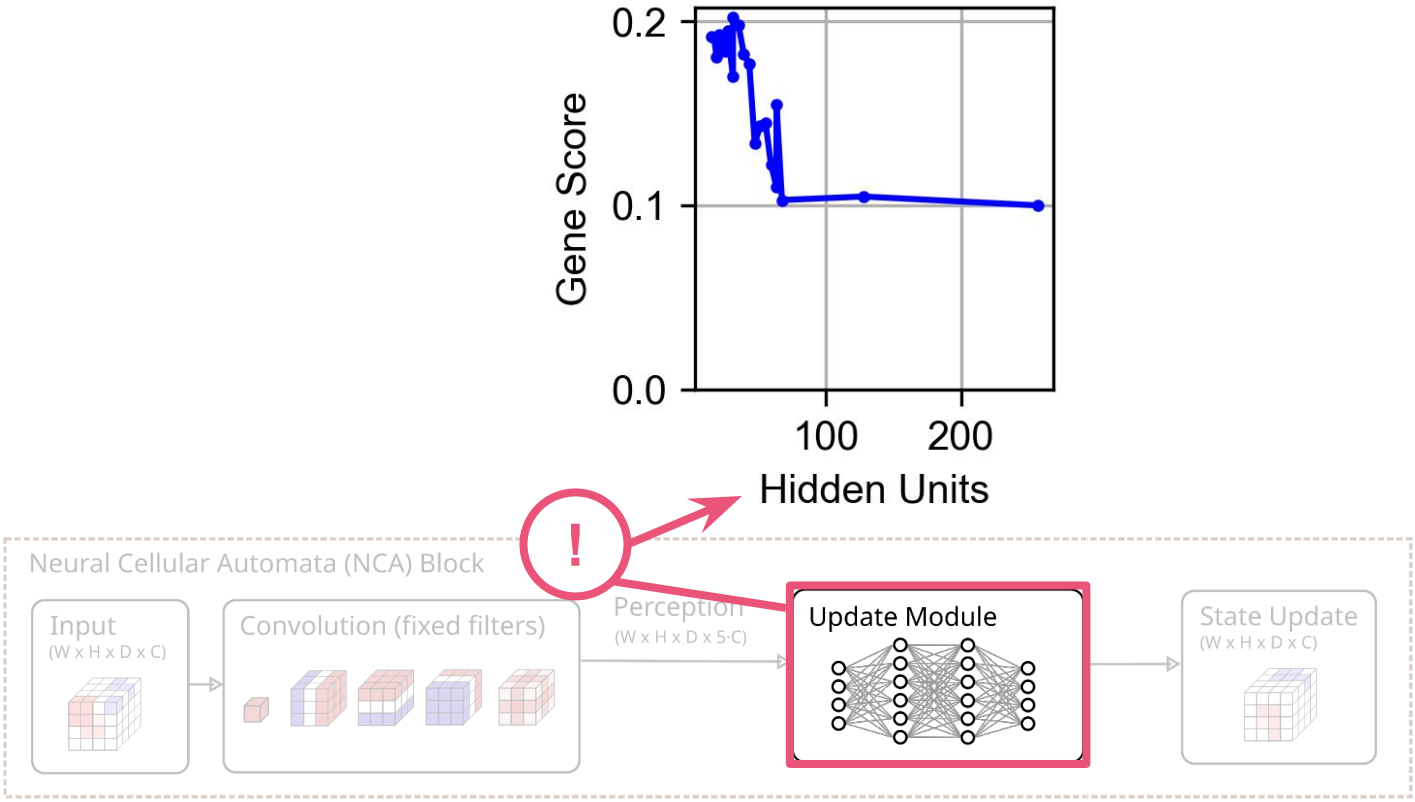
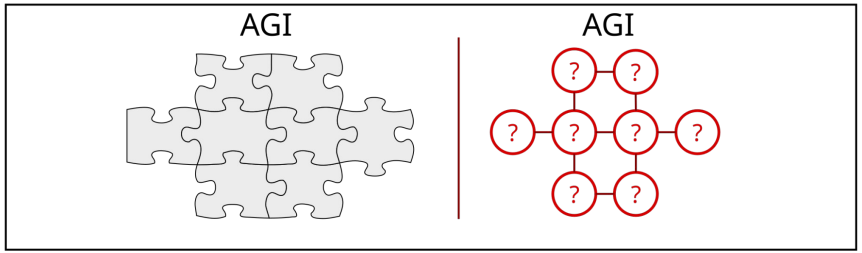


Part 1:
Why I Trained an NCA to Produce Mouse Brain Connectivity

Part 2:
Challenge for EvoSelf Research:
Reproduce Connectome Using Developmental and Ecological Priors

Nobody Knows What Brains Do or How to Make Them

Human Intelligence



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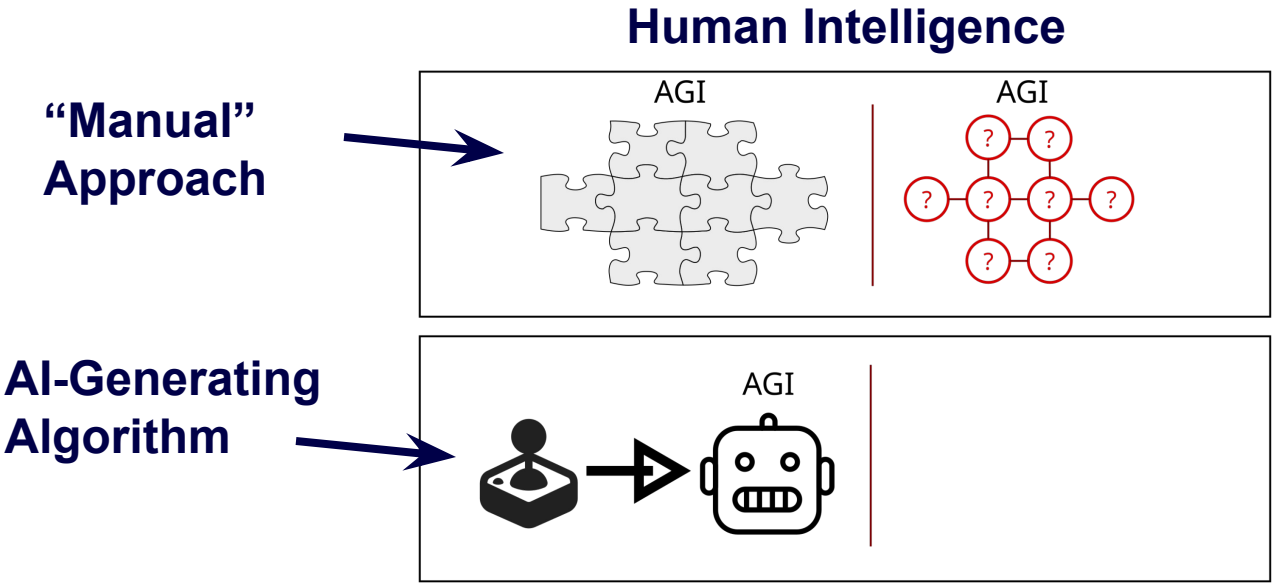

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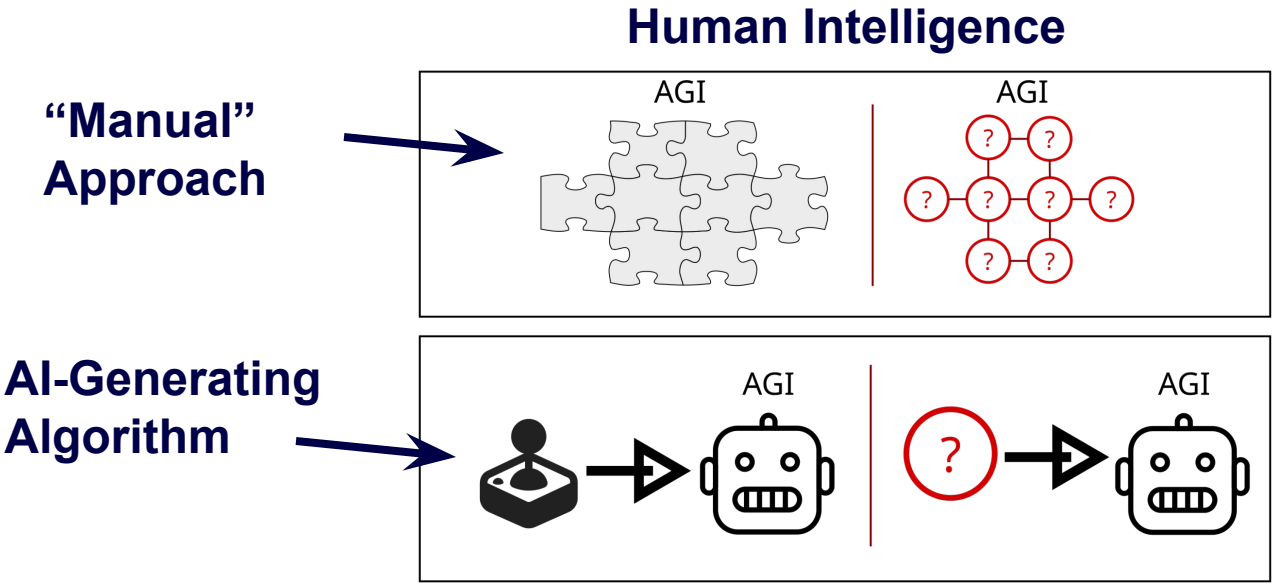
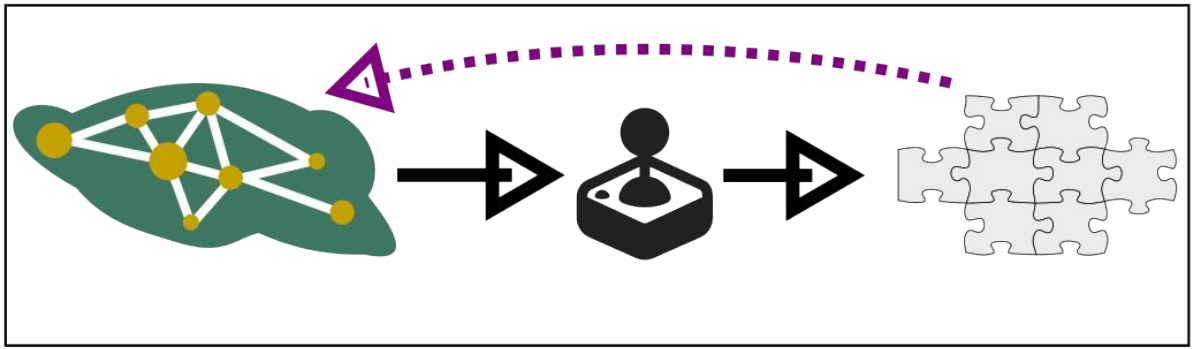
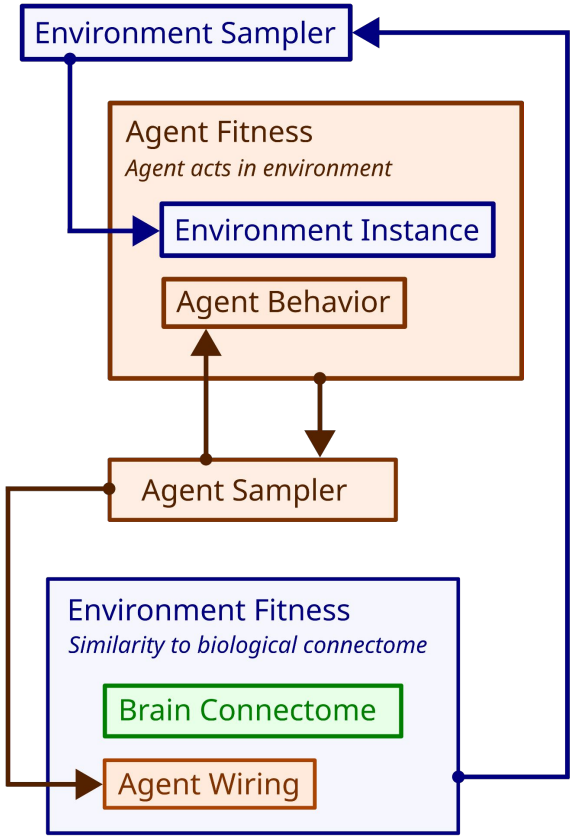


Connectome as a Beacon for Brain-like Intelligence



Proposal:

Connectome-Generating, AI-Generating Algorithms



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> “What is the ... fitness function for the environment generator?
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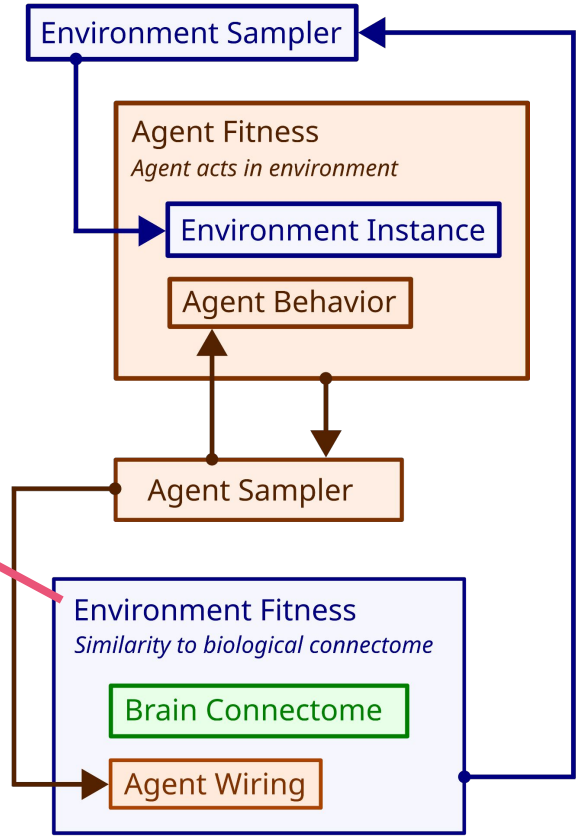

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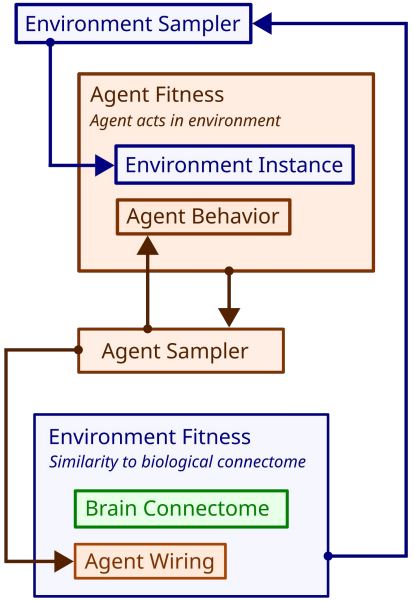
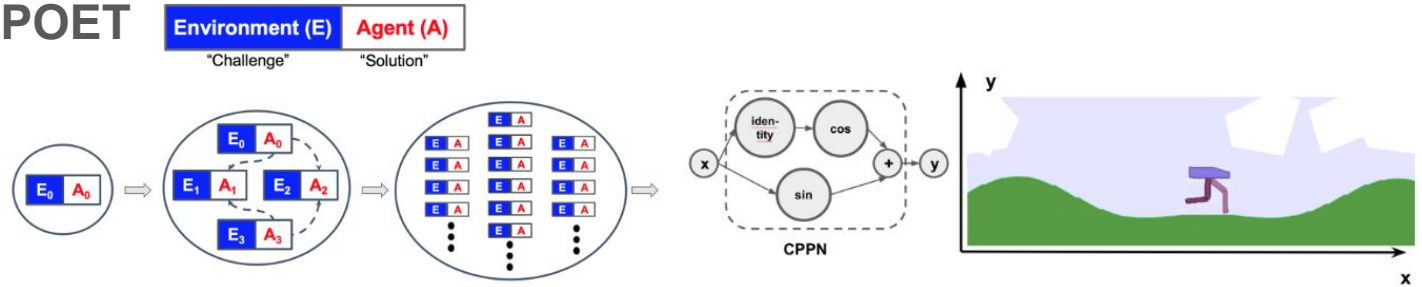


POET



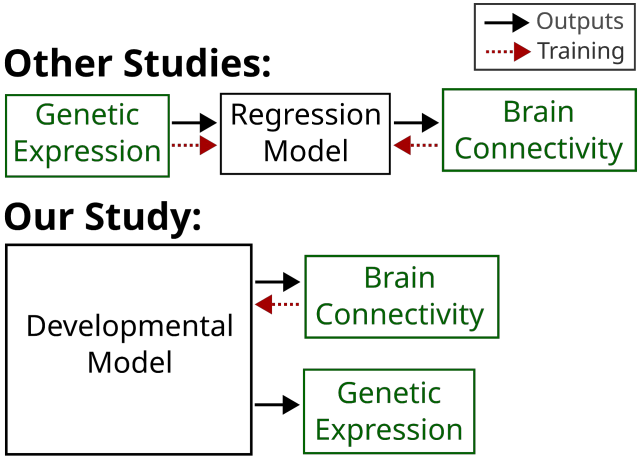
Wang 2020

Wang 2020

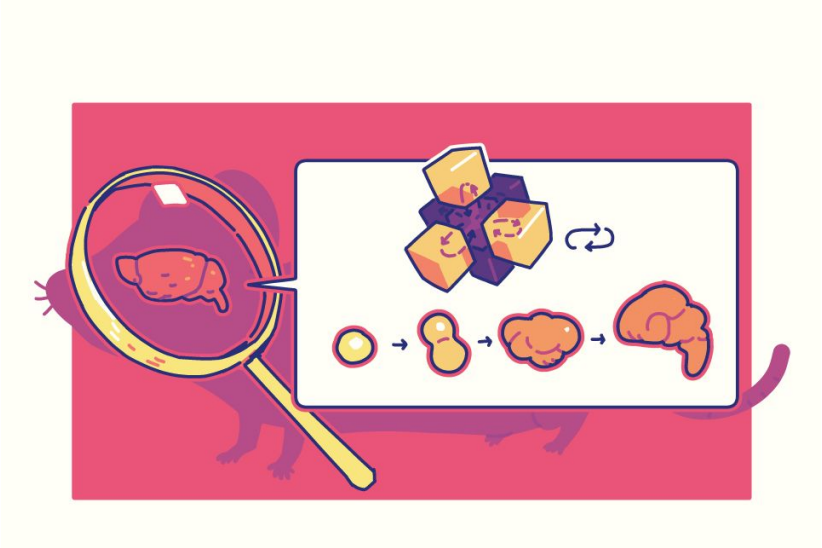
Path to brain-like intelligence = Development + Ecology

- **Ecology**: plausible environments
- **Development**: brain-like architectures
- **Model the connectome**

Conclusion



Simple rules → best gene scores



For more info:
jamiesonwarner.com

Contact:
jamiesonwarner@gmail.com

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