

How do we understand an intelligent system?

Readings for today

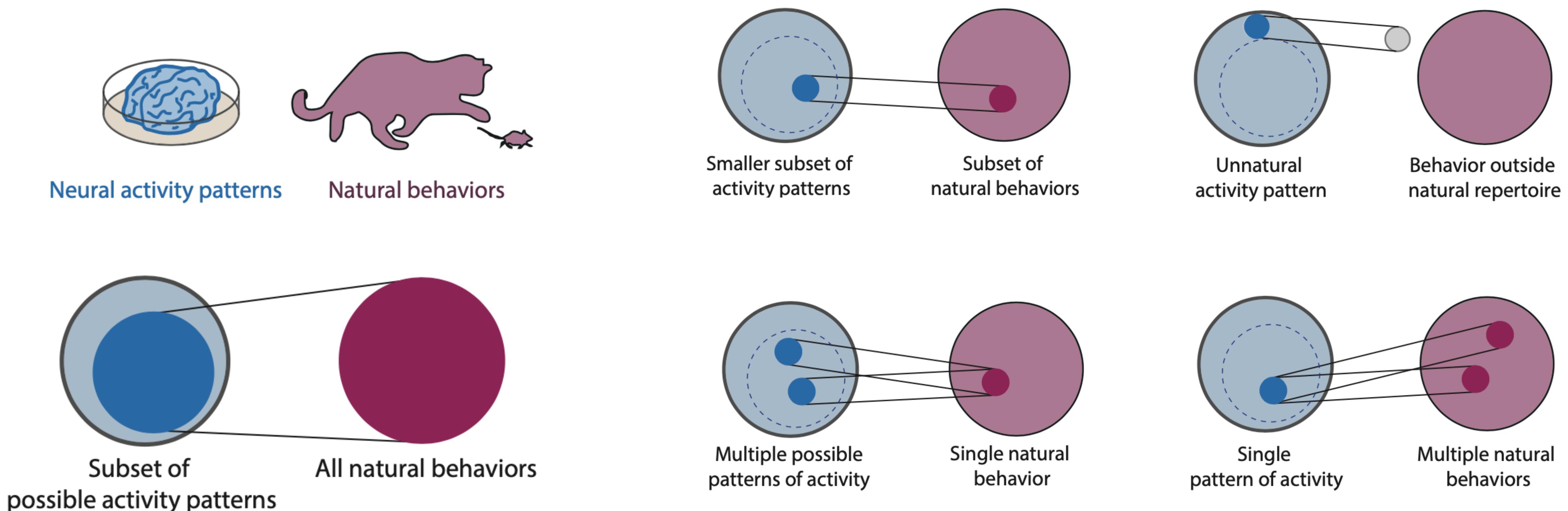
- Krakauer, J. W., Ghazanfar, A. A., Gomez-Marin, A., MacIver, M. A., & Poeppel, D. (2017). Neuroscience needs behavior: correcting a reductionist bias. *Neuron*, 93(3), 480-490.

Topics

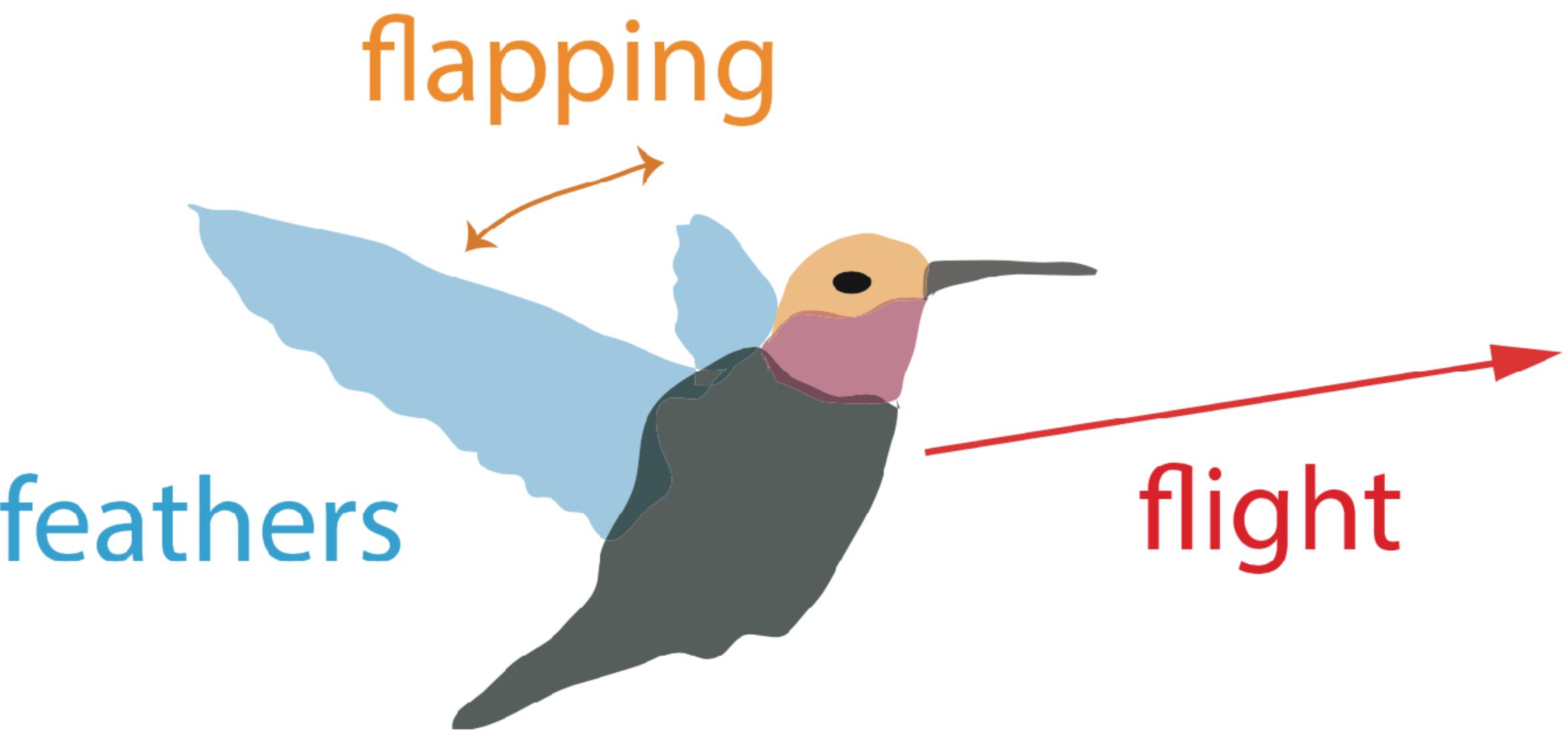
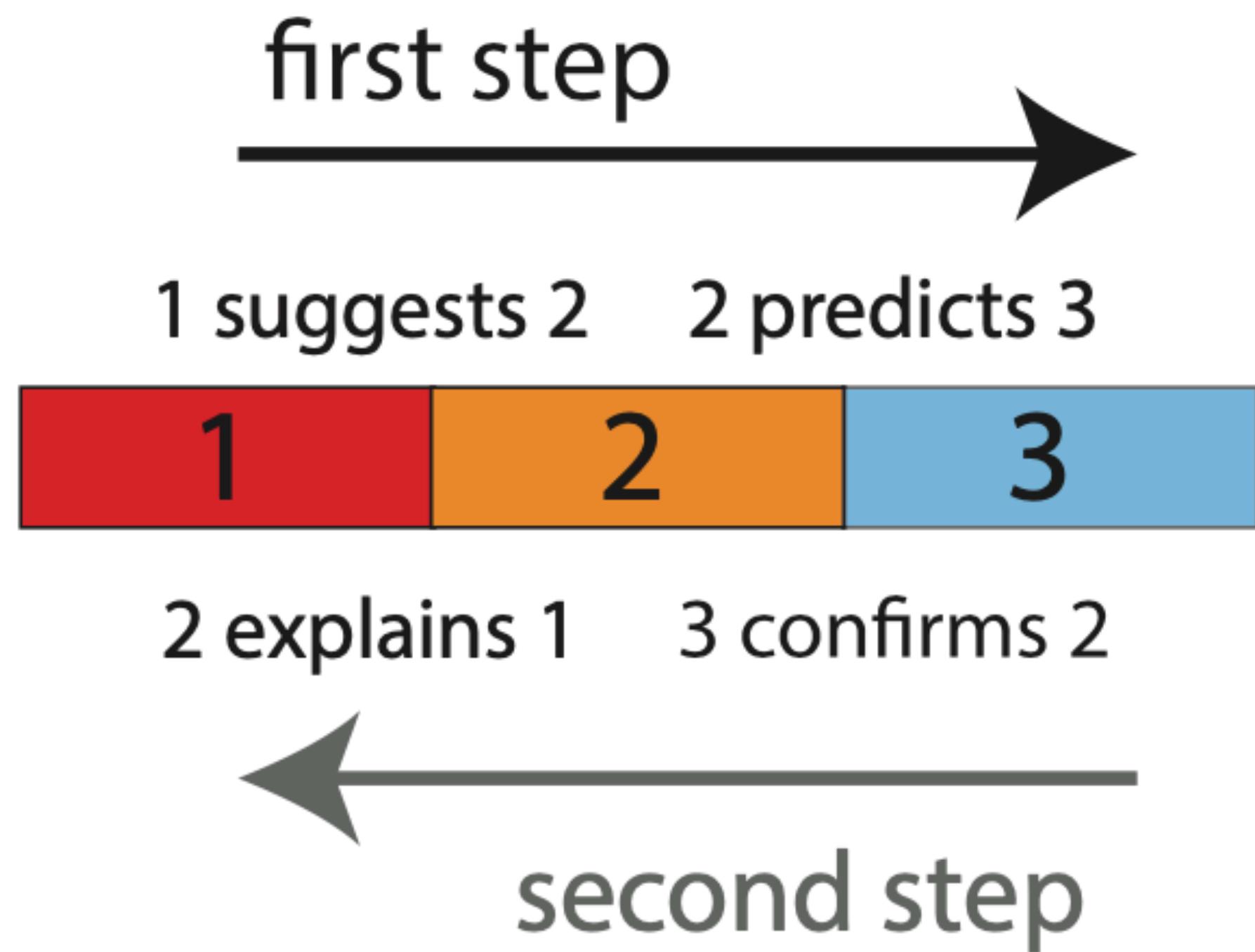
- Levels of analysis (forward and back)
- How we make inferences

Levels of analysis

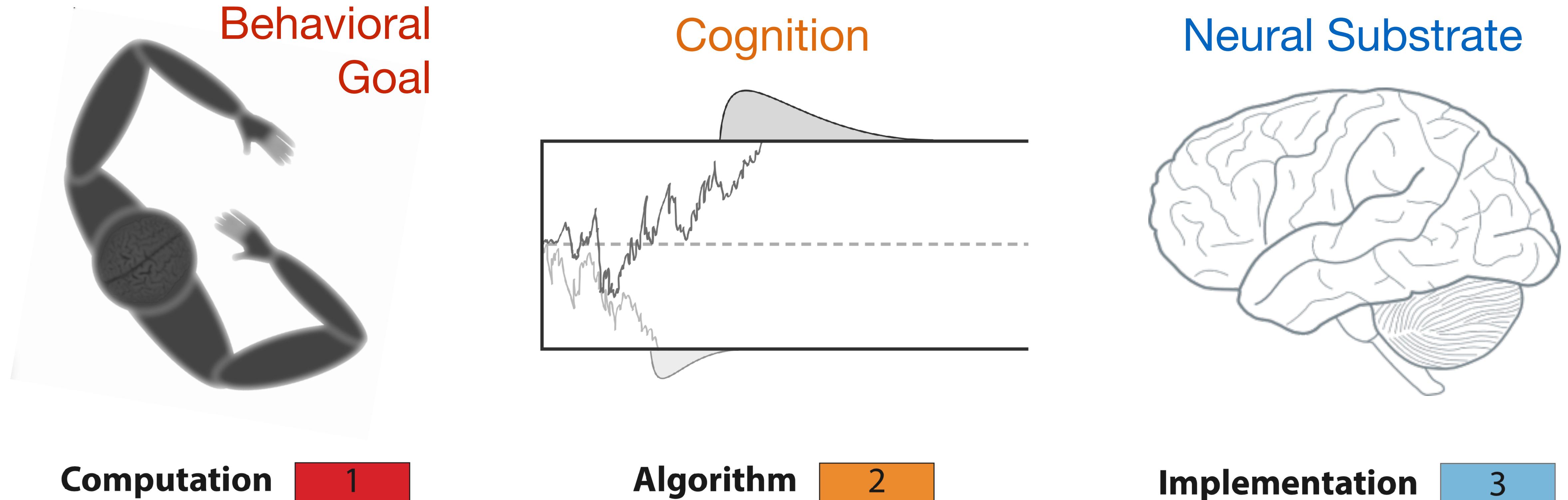
Multiple realizations of brain → behavior



Marr's levels of analysis



Levels of analysis: intelligence

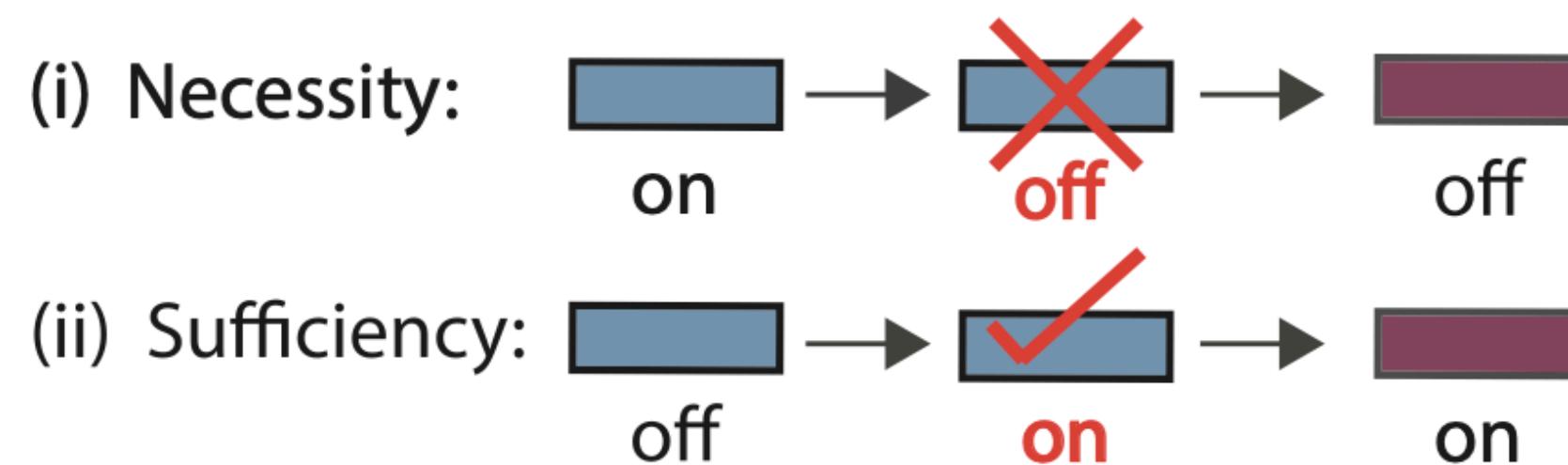


How we make inferences

Inferential logic or fallacy?

What is done

Manipulating a circuit
as a way of intervening in behavior



Most used “filler” verbs

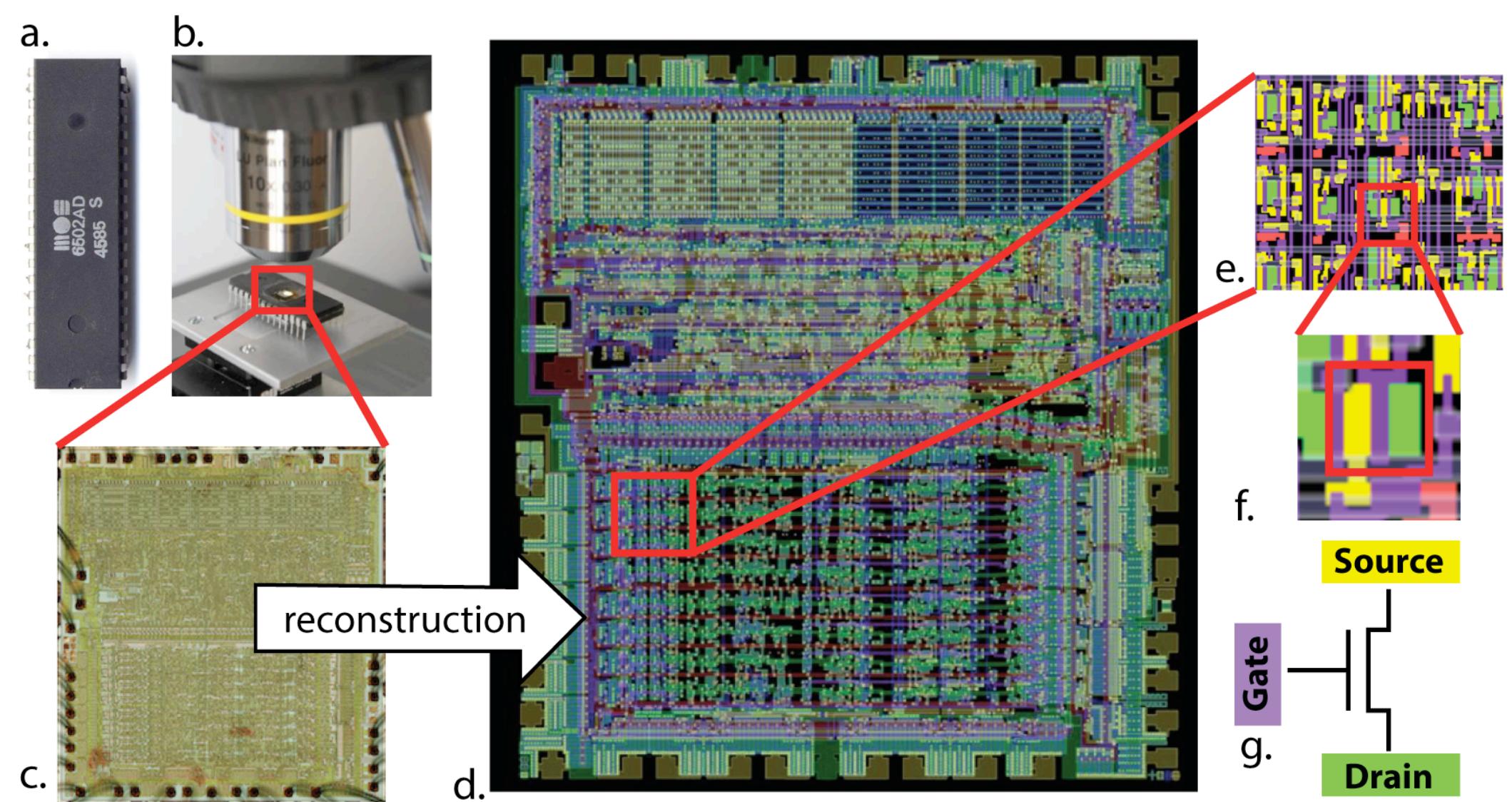
reflects	encodes
reveals	induces
involves	enables
regulates	ensures
mediates	supports
generates	promotes
modulates	determines
shapes	plays a role in
underlies	contributes to
produces	is associated with

What is claimed

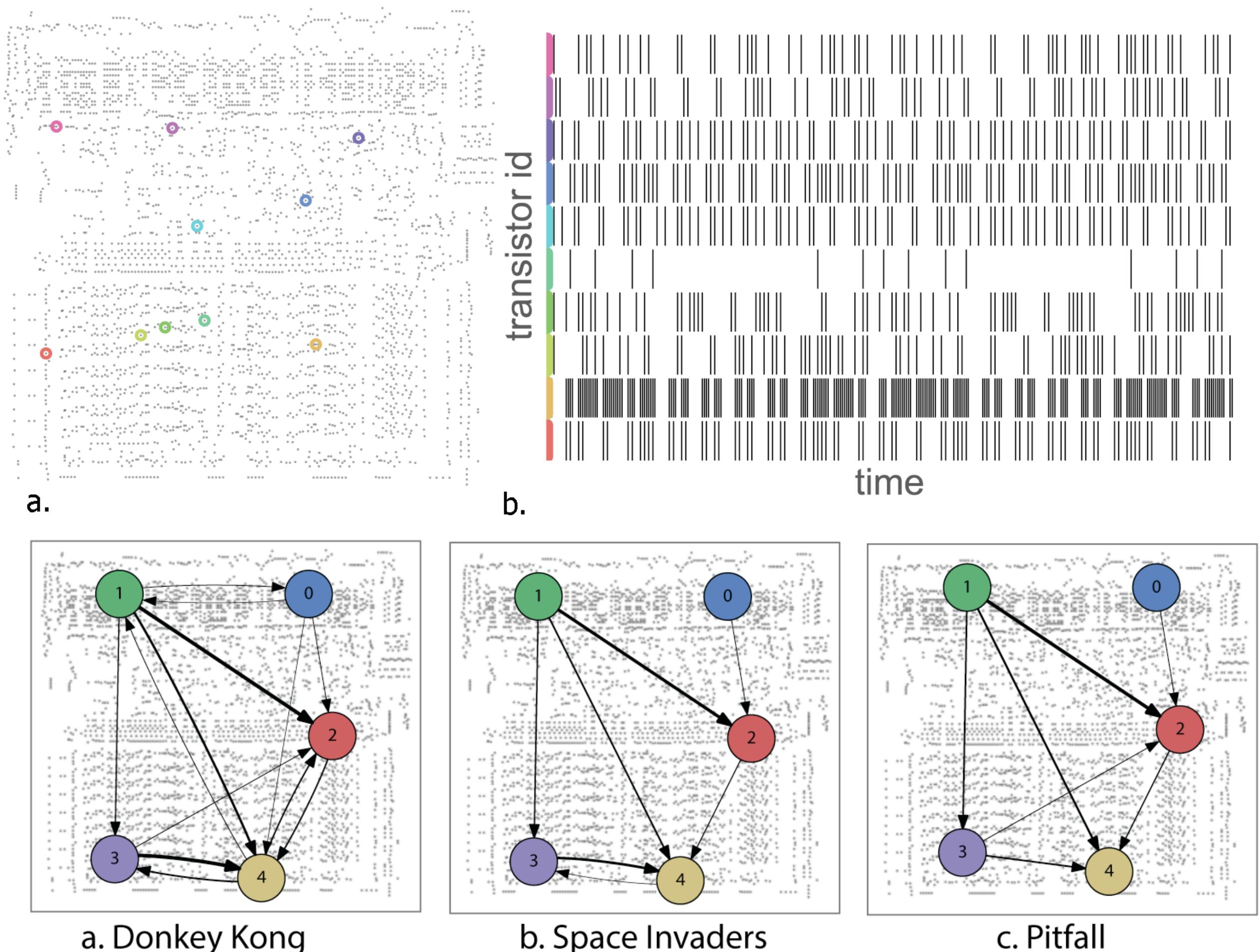
[blue box] is the cause of [purple box]
[blue box] + “filler” verb = explanation of [purple box]

Could we understand a microprocessor?

Microprocessor

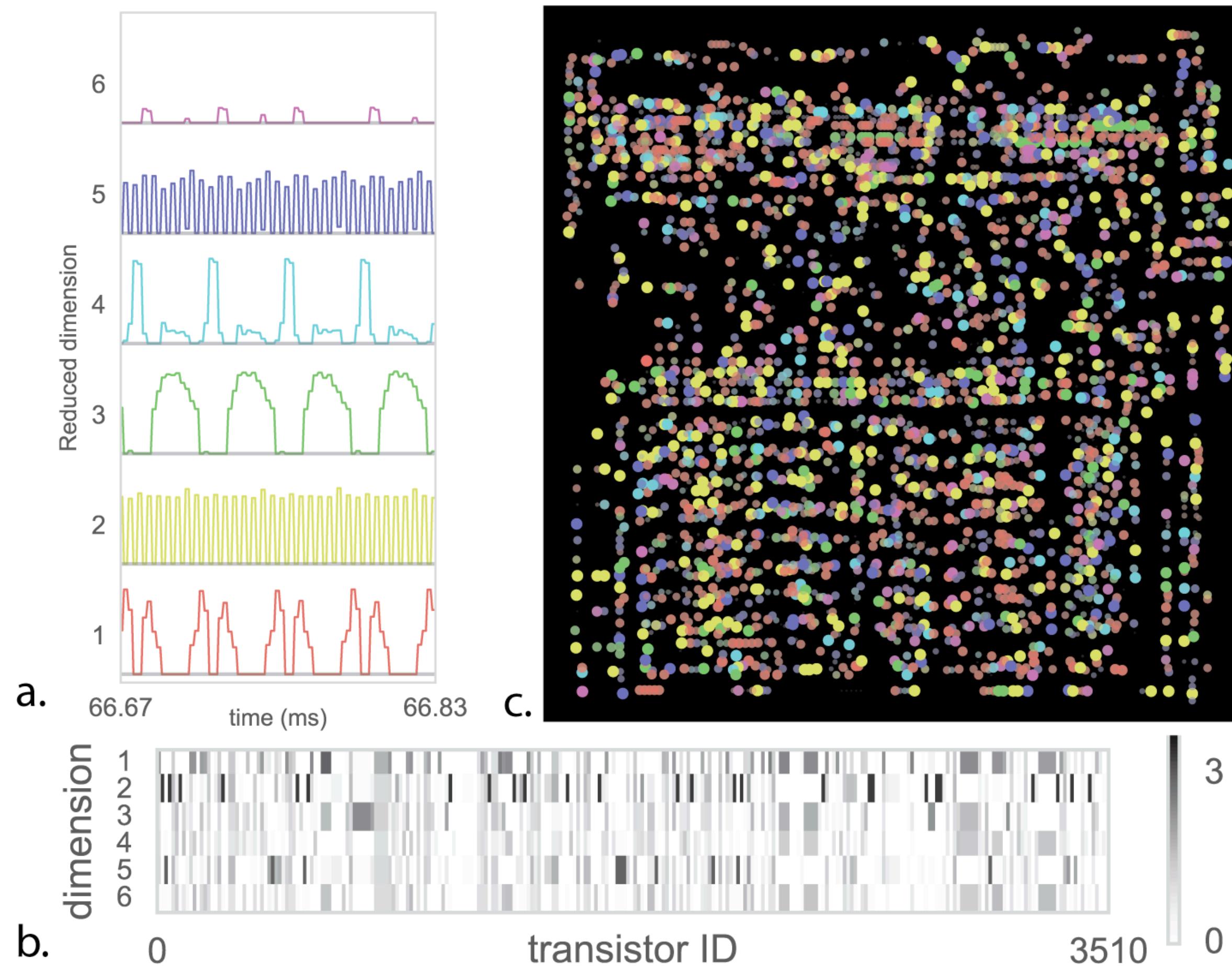


Neuro techniques



Could we understand a microprocessor?

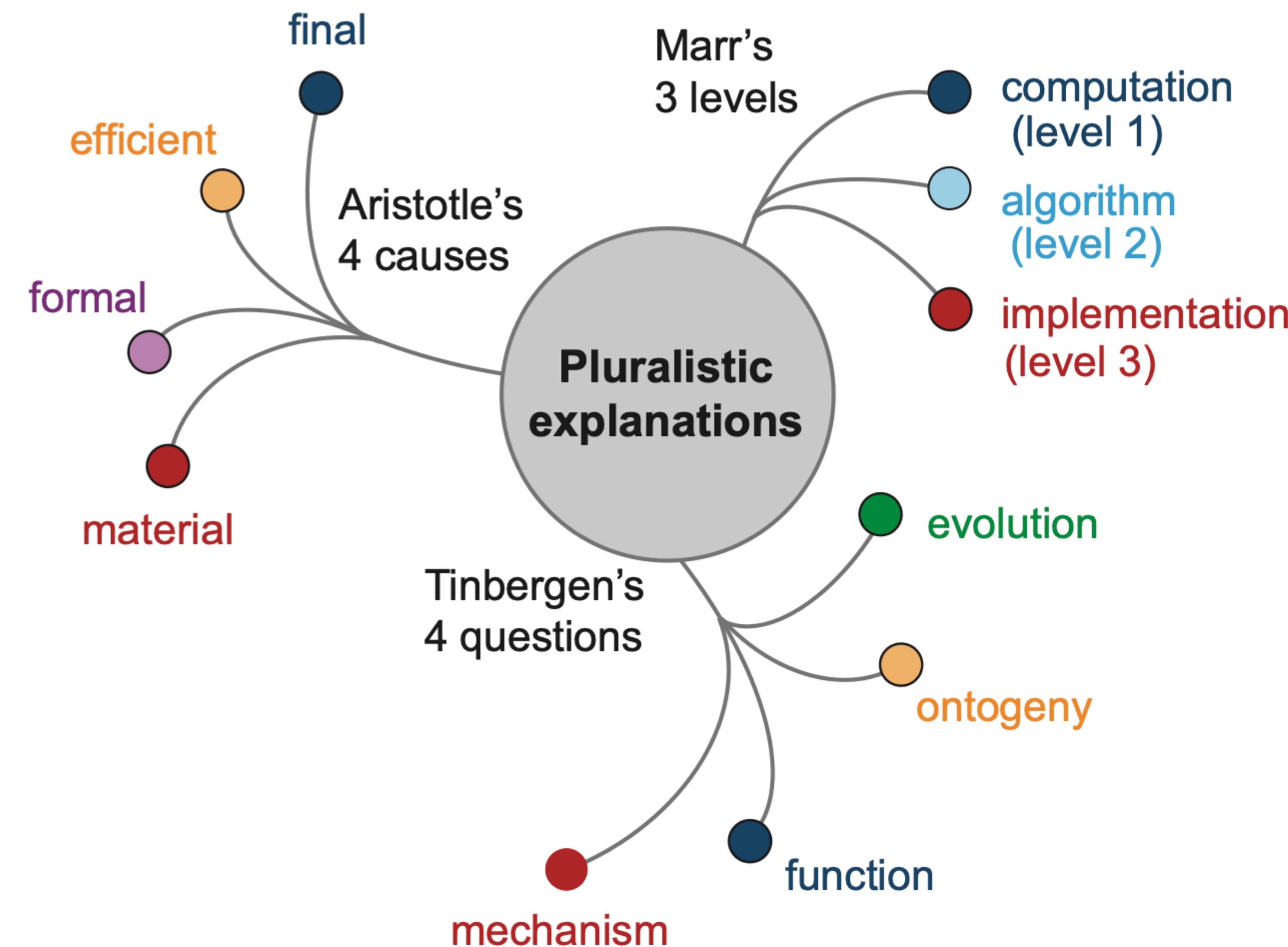
Inferred system



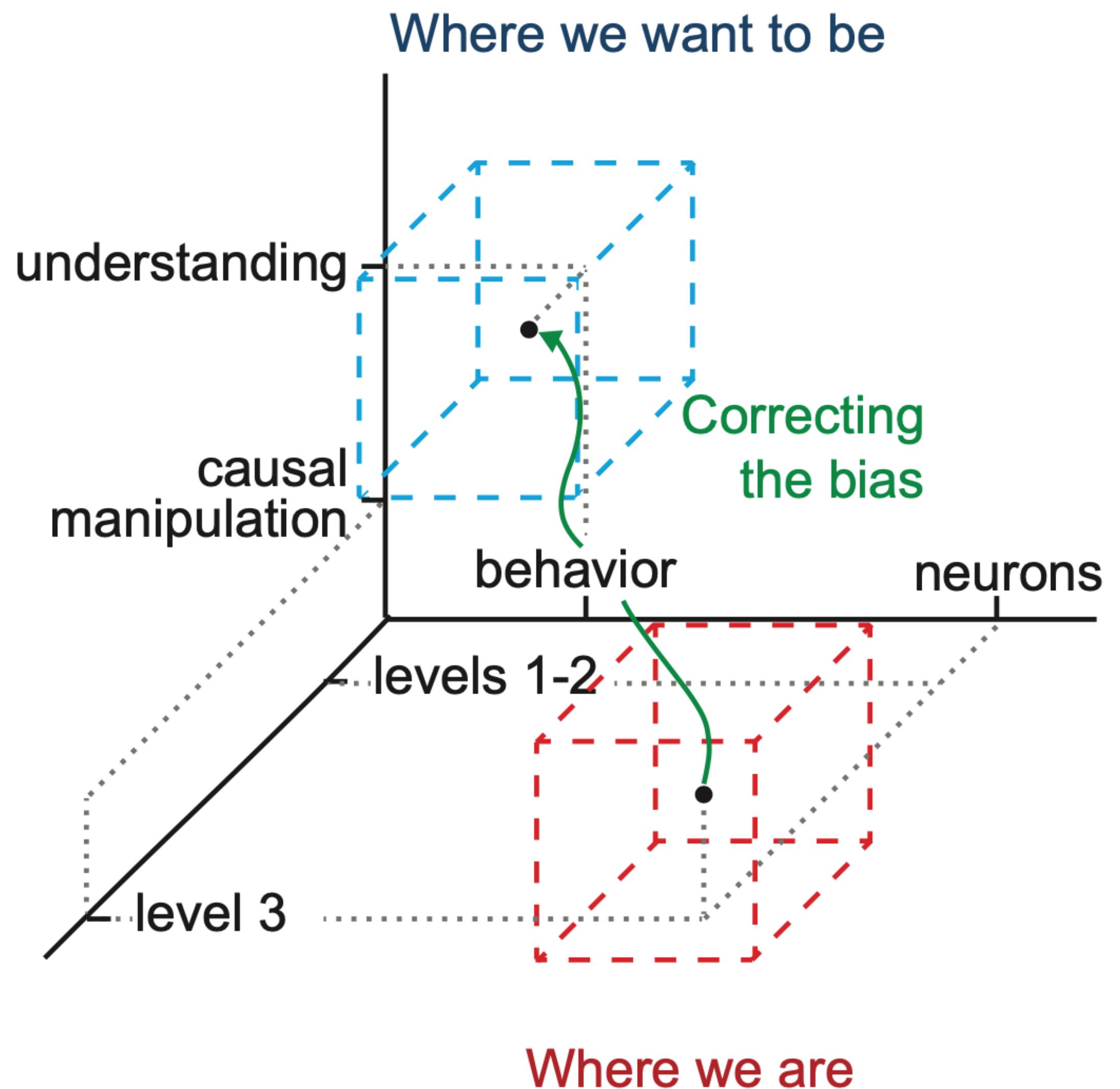
Conclusions

- The microprocessor has a clock mechanism of some kind.
- The microprocessor has a low-dimensional state.
- Unable to reconstruct other known properties of the microprocessor or the chip itself.

Towards a plurality



Where we need to be



“Understanding something is not the same as just describing it or knowing how to intervene to change it.”

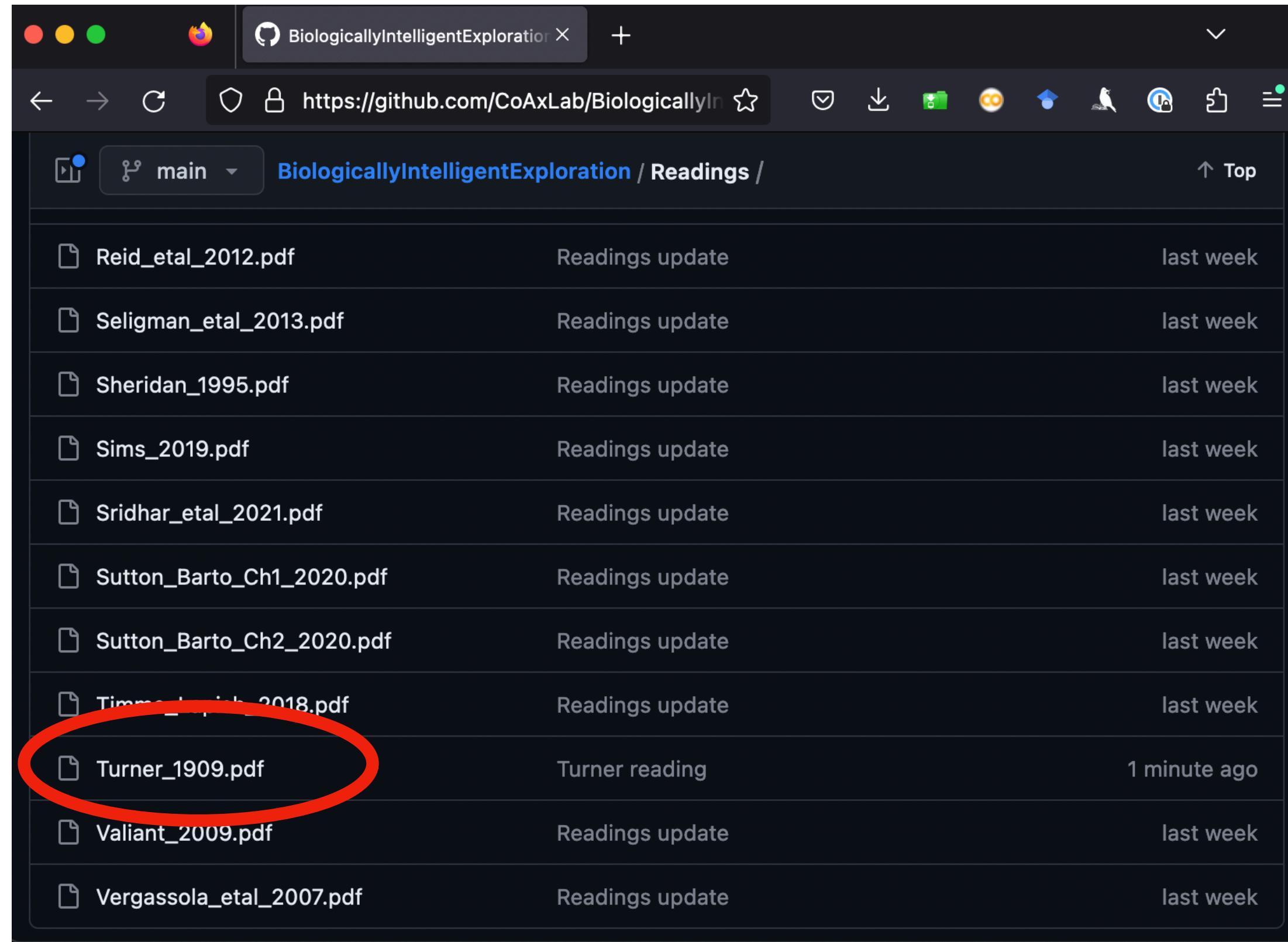


Theory

Take home message

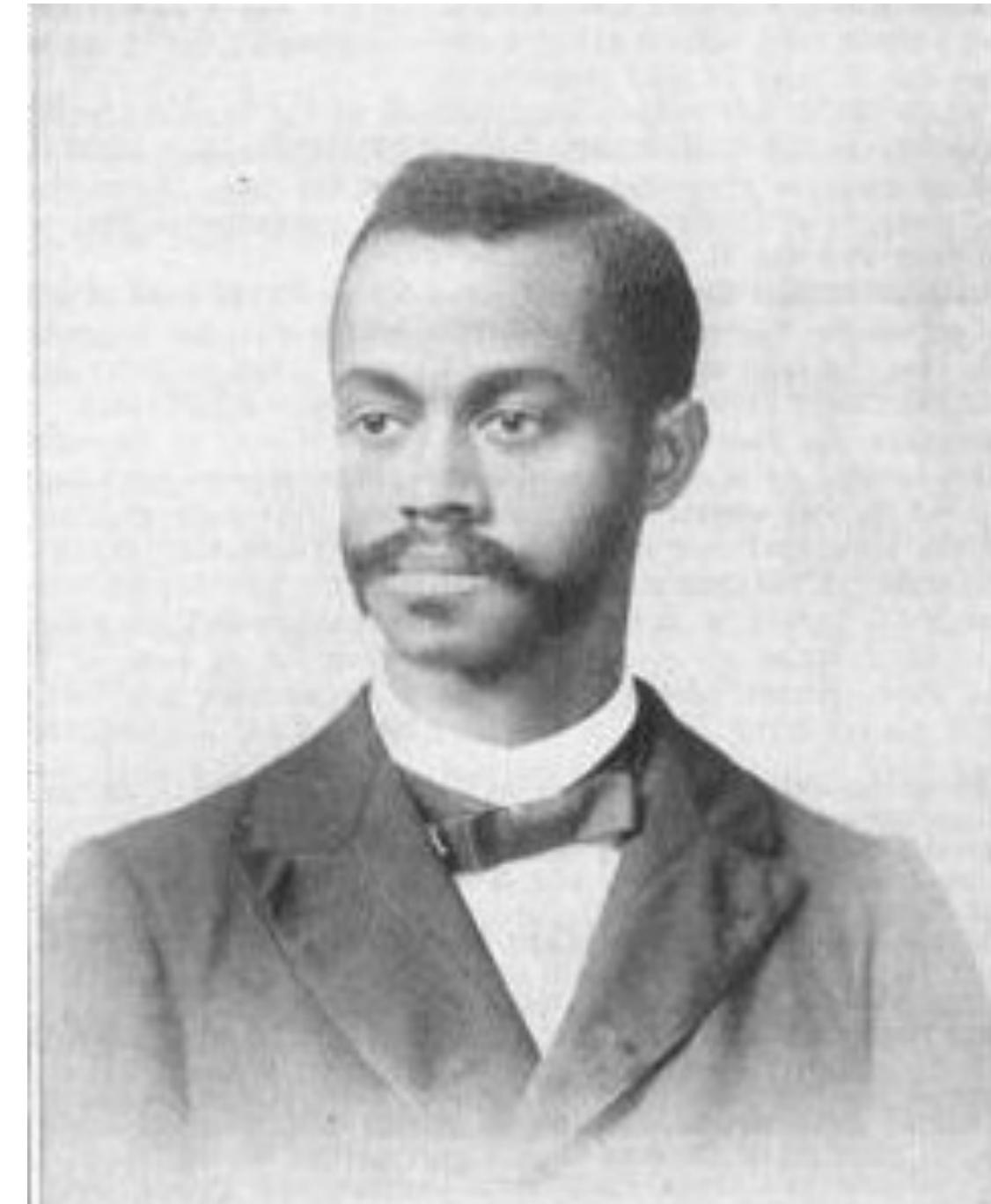
- We need to understand intelligent behaviors at multiple levels: from computation to neurons and back again.
- Current bottom-up approaches (neurons→behavior) are fundamentally limited in what we can understand.
- A pluralistic top-down approach, starting with behavior, is what we need in order to understand intelligent systems.

Break out group discussions



A screenshot of a GitHub repository page titled 'BiologicallyIntelligentExploration / Readings /'. The page lists several PDF files with their last update times. A red circle highlights the file 'Turner_1909.pdf', which was updated '1 minute ago'.

File	Last Update
Reid_et.al_2012.pdf	Readings update last week
Seligman_et.al_2013.pdf	Readings update last week
Sheridan_1995.pdf	Readings update last week
Sims_2019.pdf	Readings update last week
Sridhar_et.al_2021.pdf	Readings update last week
Sutton_Barto_Ch1_2020.pdf	Readings update last week
Sutton_Barto_Ch2_2020.pdf	Readings update last week
Timmons_2018.pdf	Readings update last week
Turner_1909.pdf	Turner reading 1 minute ago
Valiant_2009.pdf	Readings update last week
Vergassola_et.al_2007.pdf	Readings update last week



[https://en.wikipedia.org/wiki/Charles_Henry_Turner_\(zoologist\)](https://en.wikipedia.org/wiki/Charles_Henry_Turner_(zoologist))

THE BEHAVIOR OF A SNAKE

SEVERAL years ago, while Mr. Lester and I were sauntering along a country road near Newnan, Ga., a commotion was heard in the dry leaves along the side of the road. On quietly entering the underbrush, it was noticed that the noise was caused by a struggle between a coach-whip snake (*Zamia flagellum* Shaw) and a lizard that was unknown to me. The snake was about four feet long; the lizard less than a foot. They were not fighting; the snake was trying to make a meal of the unmanageable lizard. Frequently the lizard escaped from the snake. Then would follow a chase resulting in the recapture of the lizard. The snake invariably caught the lizard by the body. I knew that, if the snake were to capture the lizard by the tail, the lizard would break off the tail and escape. The snake, behaving as though aware of this, attracted my attention and caused me to remain and study its movements.

Task: Read the Turner (1909) article. Come up with a process-level description of the snake's behavior.