Research plan

Fleischmann – Nassar joint meeting

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May 17, 2024

Brown University

Outline

1. Conceptual directions & questions ❓

2. Experiments & expected results 🔬📈

3. Roadmap 🛣️

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1. Conceptual directions & questions ❓

2. Experiments & expected results 🔬📈

3. Roadmap 🛣️

What do we want to know?

- Understand what the network learns → What function does it learns?

- How the constrains of the task affect learning & the representations learned?

- Does the network learn something related to the real neurons? (million $$$ question)

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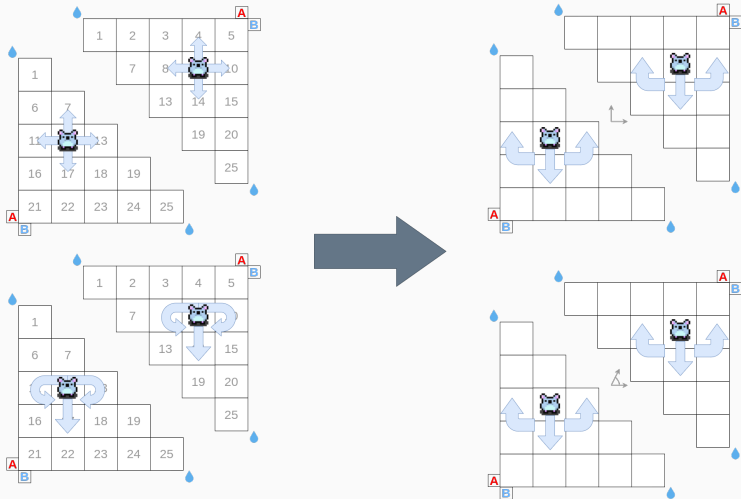- Does the network learn something related to the real neurons? (million $$$ question)
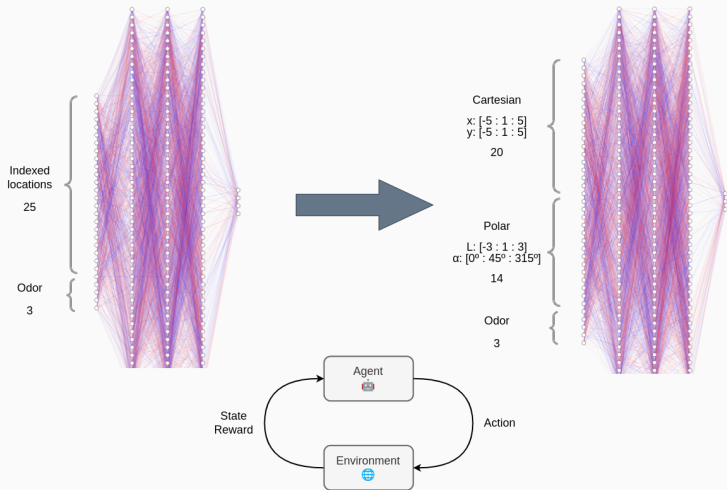
Compositional hypothesis

- From indexed locations (current) to coordinate system $\rightarrow$ does the network learn a generalizable policy?
- Merged actions space

Indexed
locations

25

Odor

3

Cartesian

x: [-5 : 1 : 5]
y: [-5 : 1 : 5]

20

Polar

L: [-3 : 1 : 3]
α: [0º : 45º : 315º]

14

Odor

3

Agent

State
Reward

Action

Environment

Outline

1) How training impacts the representations learned?

- Feed both coordinates information (Cartesian & polar) to the input layer (+ merge actions spaces in a common one)
- Train on left/right task → we expect the weights are close to zero on Cartesian representation?
- Train on east/west task → we expect the weights are close to zero on polar representation?
- Not clear to me how to extract/define which neurons belong/contribute to Cartesian/polar representation

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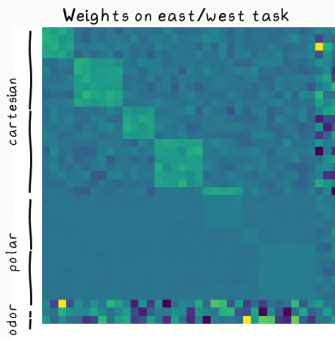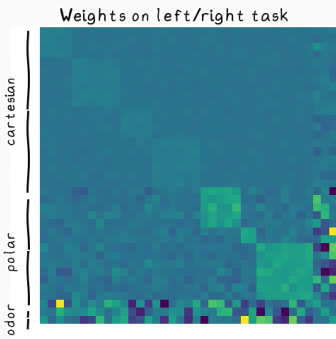
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2) Does the network learn a coordinate system?

1. After training, move the population of agents in a translated coordinate system → we expect the population of agents to be able to solve the task with zero shot learning

2. Train with both coordinates information (Cartesian & polar), after training feed incorrect polar angles

   - On the left/right task → we expect the population of agents still solves the task consistently
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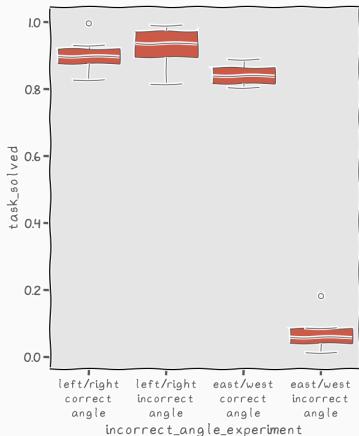
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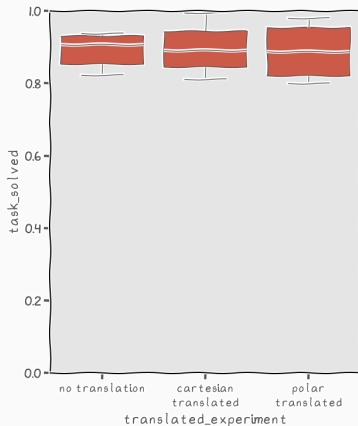
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3) Conjunctive odor-place coding

- Train a population of agents, then after training, flip odor A and odor B in the task
- In general we expect to find a population of conjunctive neurons that get active with the combination of both odor and specific location
- Do the conjunctive cells get conserved or remapped? (Not clear to me, I'd expect they get remapped)

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Milestones/how to get there

1. Rewrite the environment(s) ★★☆
   1.1 Code logic for new environment [~1 week]
   1.2 Check everything works as expected (unit testing) [~1 week]
   1.3 Bugs? [~1 week]
2. Baseline training on new environment (convergence, hyperparameter tweaking, etc.) ★★★⚠ [1 week – 1 month]
3. Experiments
   3.1 Test code ★☆☆ [~1 week]
   3.2 Training ★★☆⚠ [~2 week]
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