



BROWN

Learning useful representations to solve a place-odor association task

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Brown University

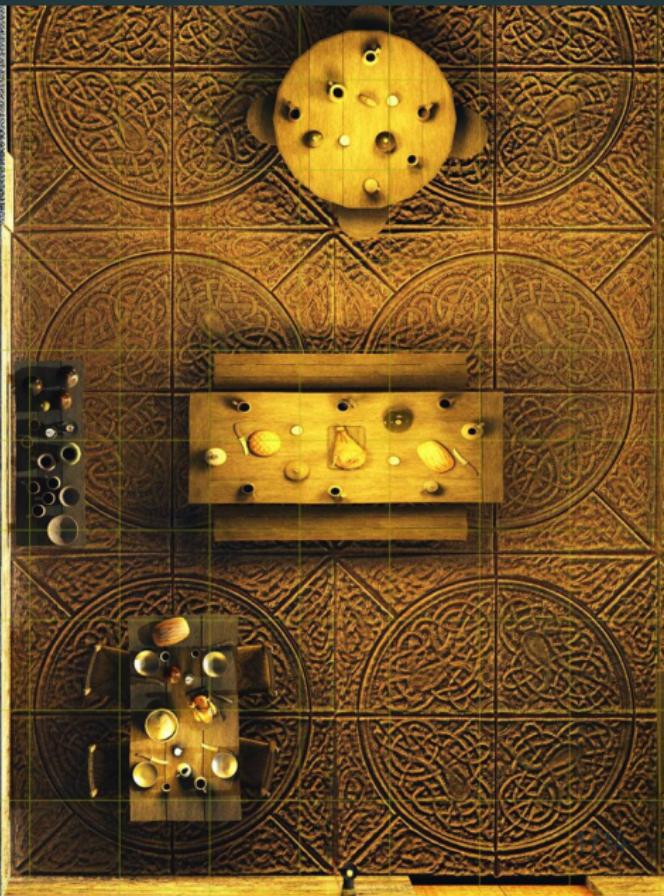
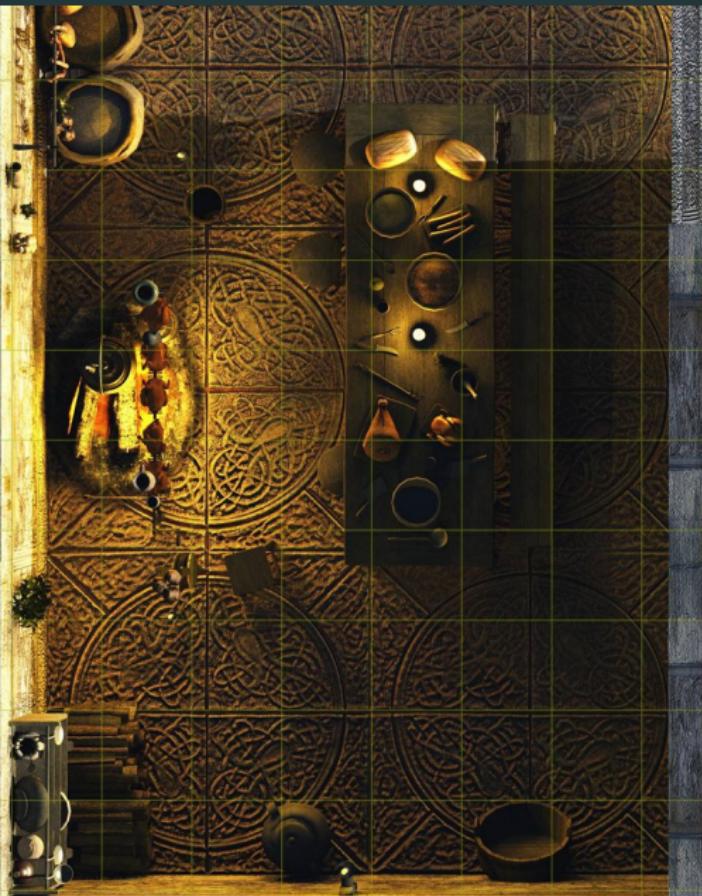
Outline

1. Context of the project
2. Experiments & preliminary results
3. Next steps

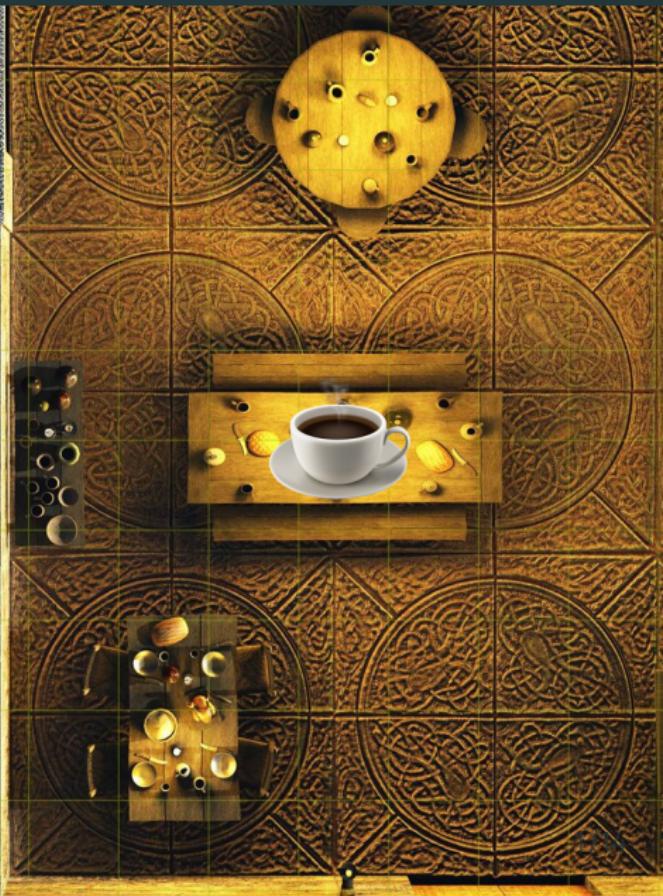
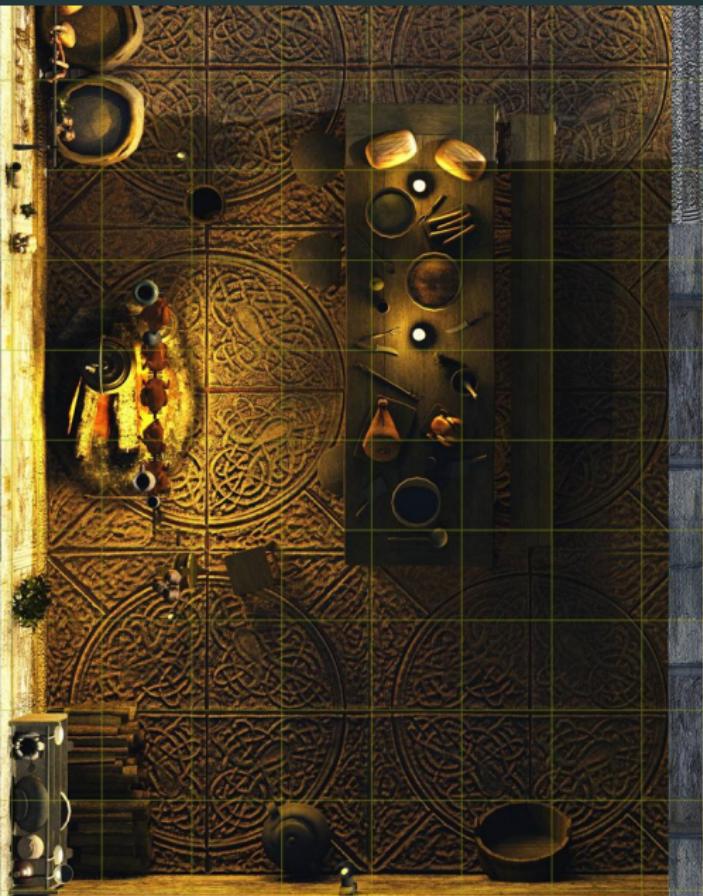
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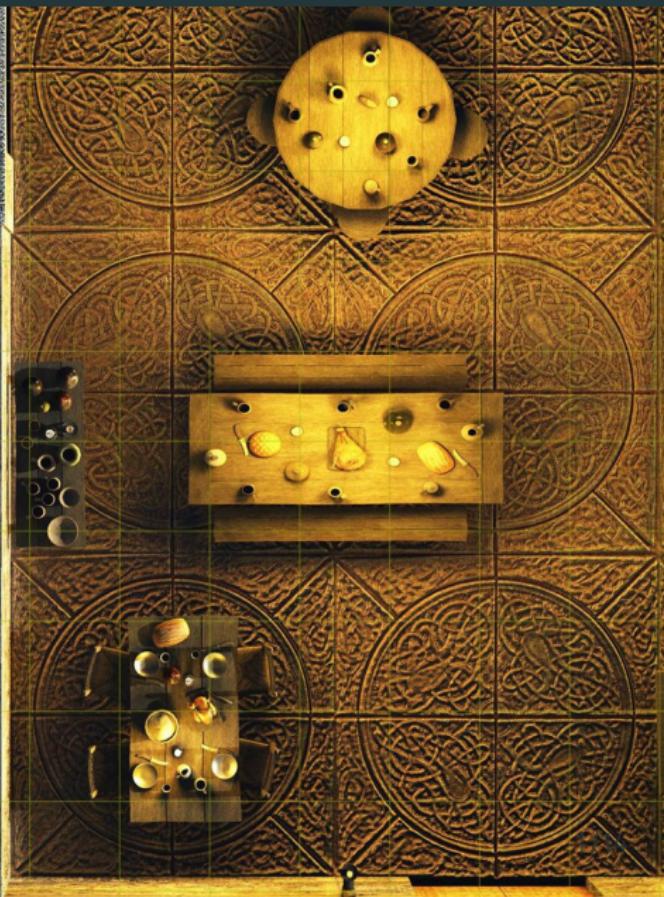
Odor-place association



Odor-place association

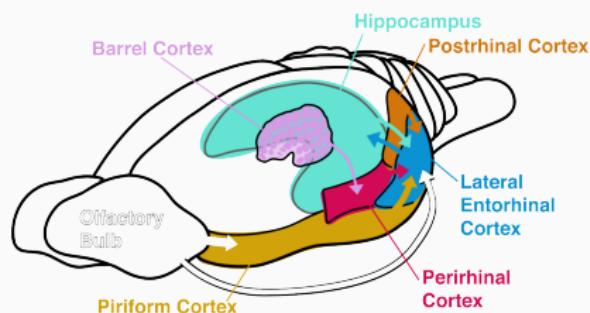


Odor-place association



Why we are interested in the LEC ?

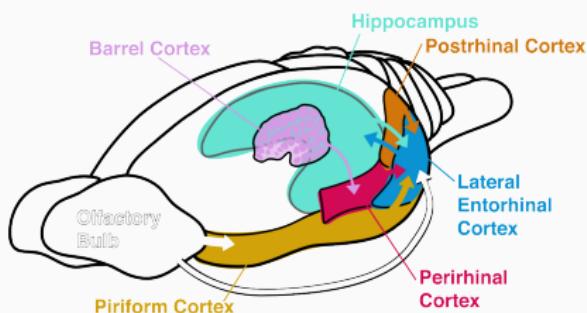
- The LEC is key to memory, associations and spatial memory



- The LEC connects sensory information to the HPC

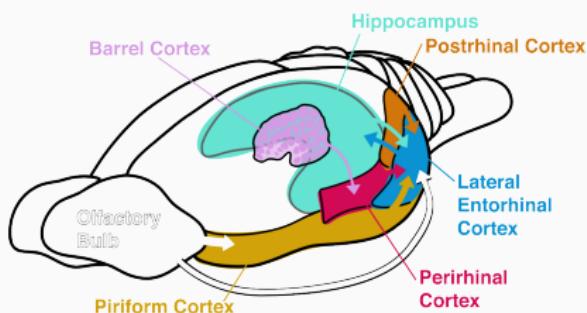
Why we are interested in the LEC ?

- The LEC is key to sensory associations and spatial memory
 - LEC is needed for learning sensory associations and certain spatial memory tasks
 - Individual cells are tuned to goal, object, and sensory cue locations
- The LEC connects sensory information to the HPC
 - LEC and HPC are strongly and reciprocally connected
 - Direct olfactory connections from OB and piriform



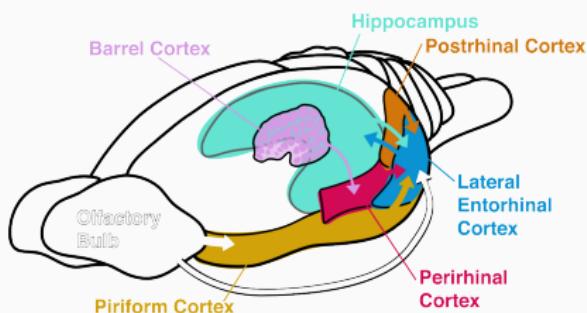
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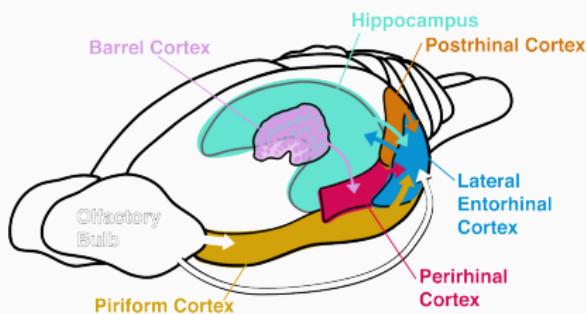
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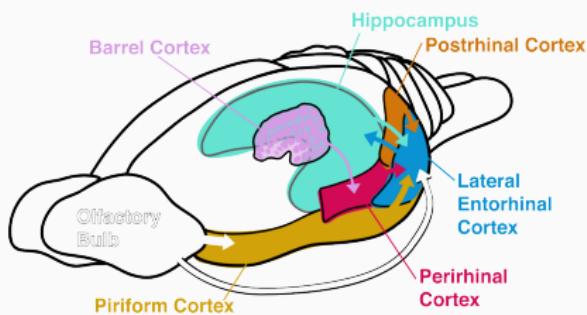
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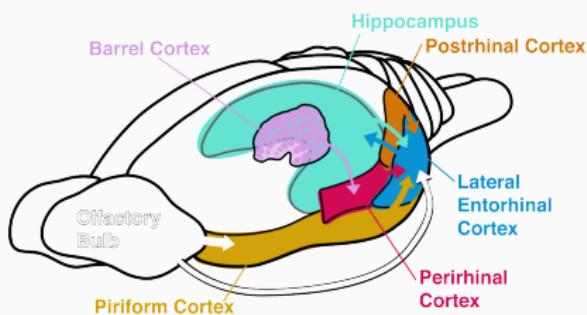
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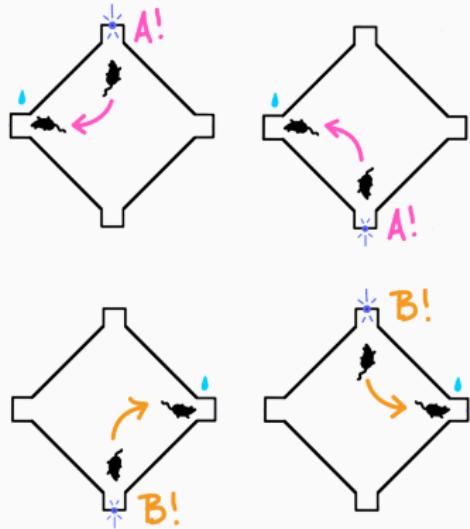
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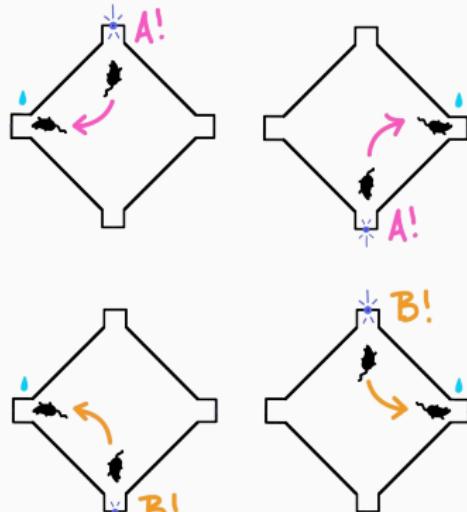


Olivia's diamond arena olfactory task

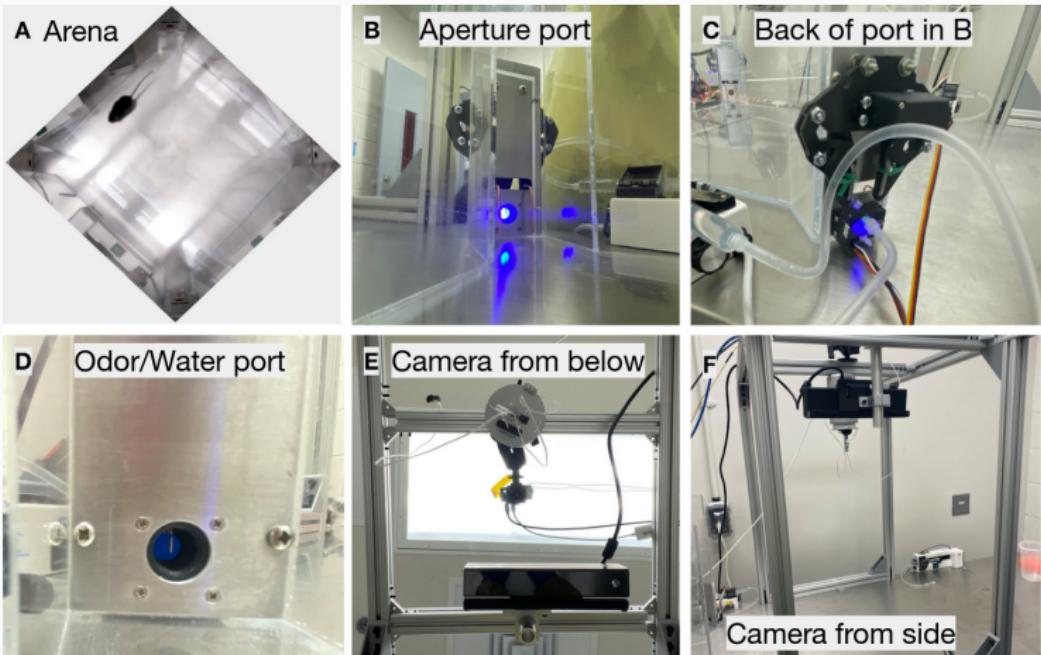
Allocentric
(go west/east)



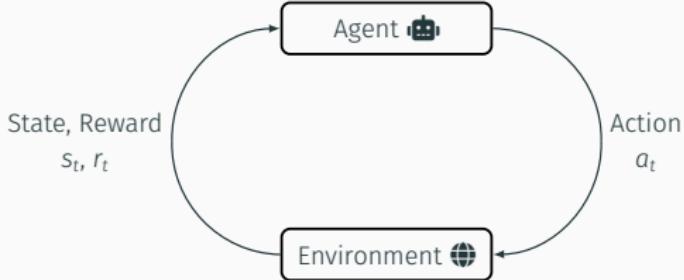
Egocentric
(go right/left)



Diamond arena experimental setup

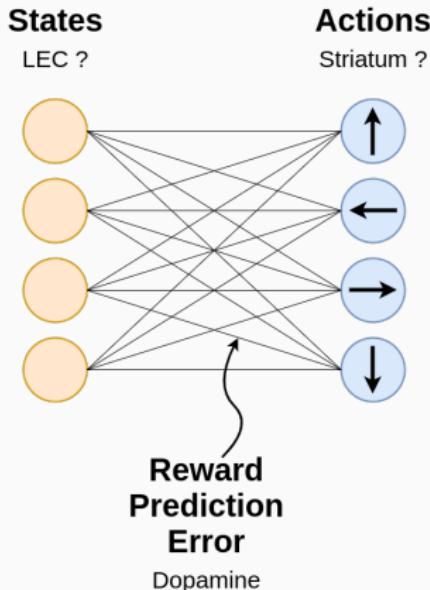


What is Reinforcement Learning and why we want to use it ?



- Goal of the agent : maximize rewards
- Natural fit for behavioral experiments involving rewards and learning

Temporal Difference learning



$$V(S_t) = V(S_t) + \alpha \underbrace{(R_{t+1} + \gamma V(S_{t+1}) - V(S_t))}_{\text{TD target}}$$

NewEstimate \leftarrow *OldEstimate* + *StepSize*[*Target* – *OldEstimate*]

Question

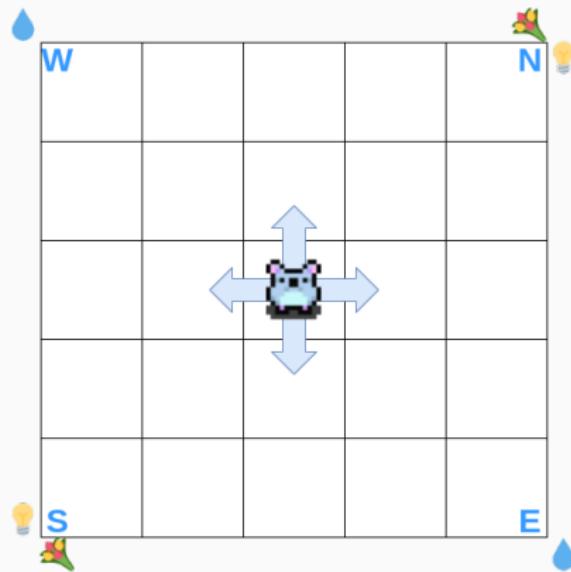
Which representations are needed by the brain to learn a place-odor association task ?

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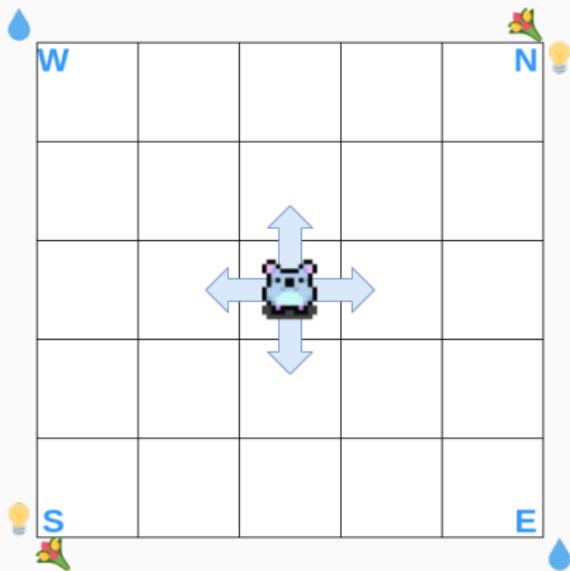
The model

Allocentric

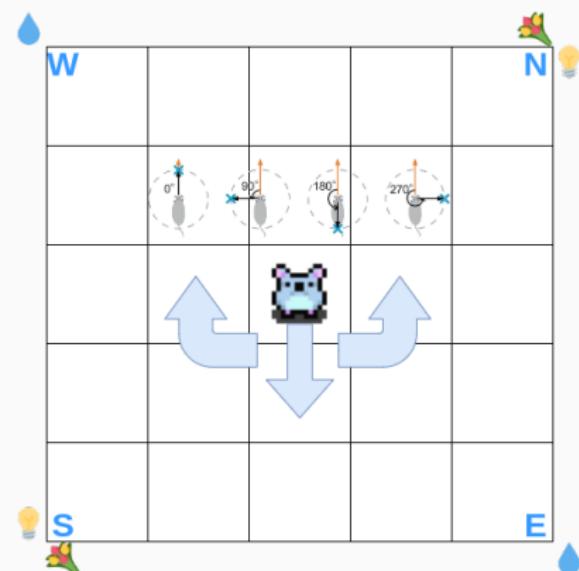


The model

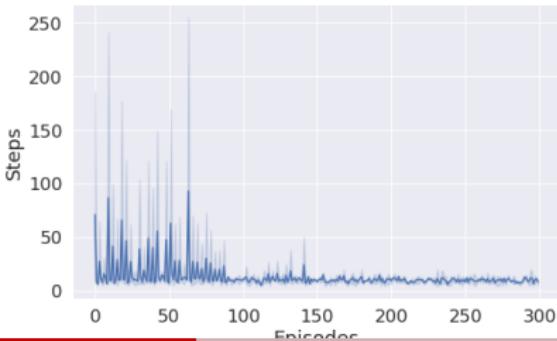
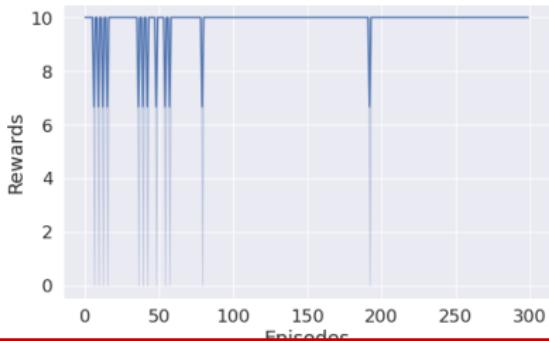
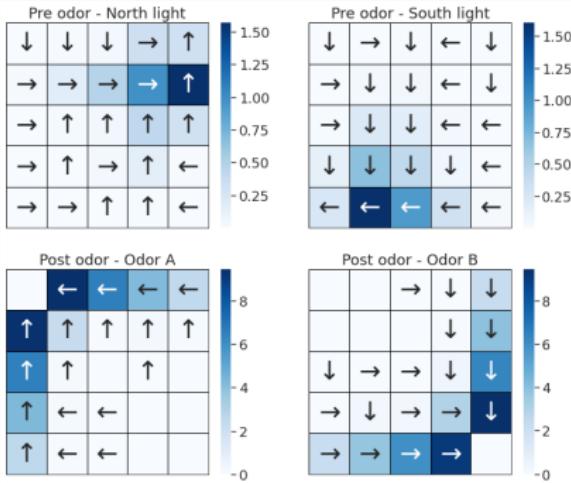
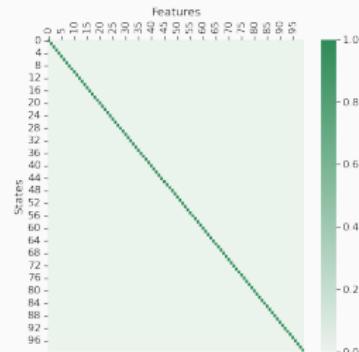
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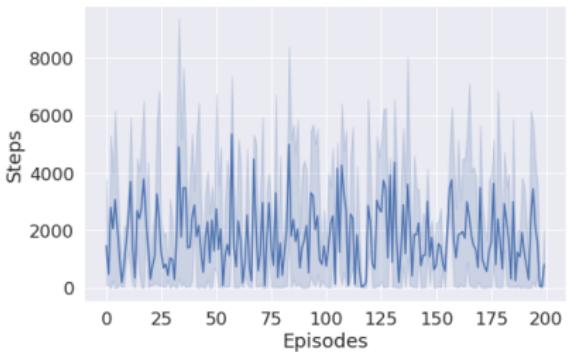
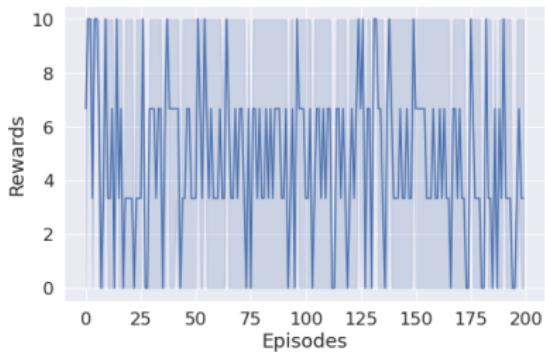
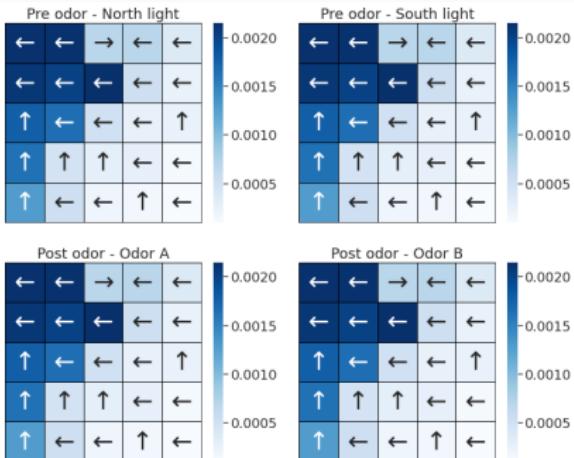
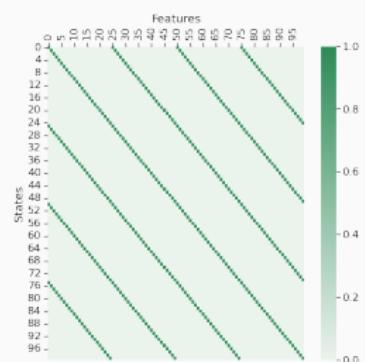
Egocentric



With joint representation



Without joint representation



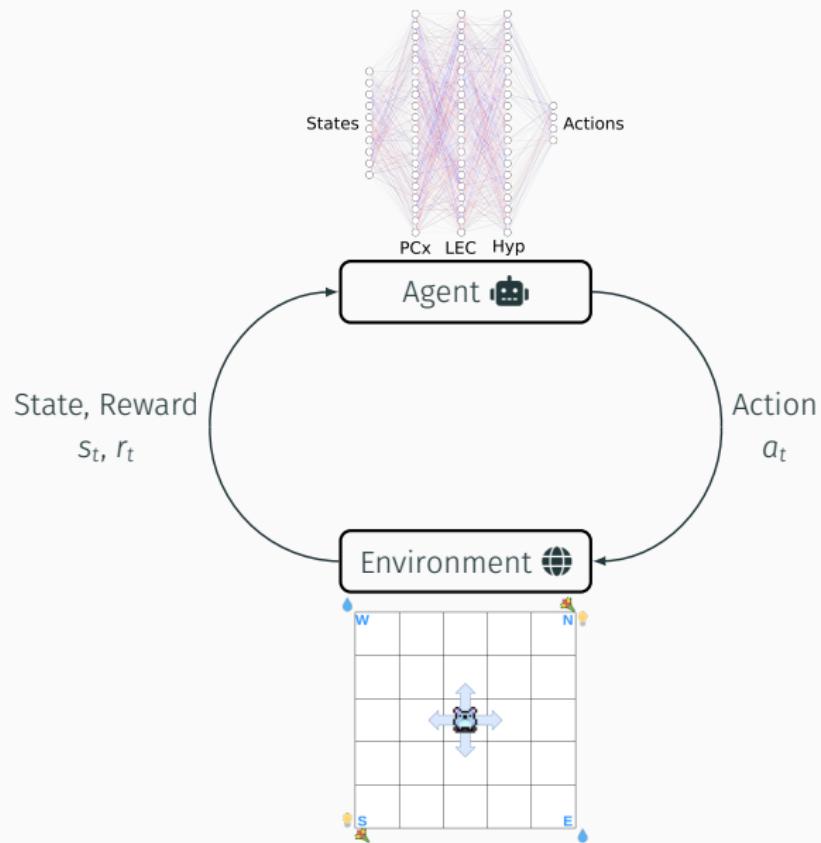
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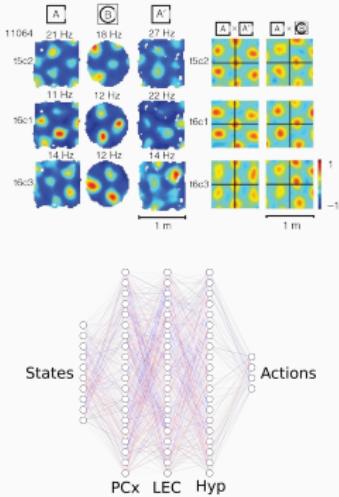
From tabular RL to deep RL



From tabular RL to deep RL



What are the representations needed to solve the task ?



1. Look for candidate patterns in the data:
place cells, grid cells,...?
2. Compare the data with the representations learned from scratch by the neural network

Summary

Acknowledgments

- Fleischmann lab

- Alexander Fleischmann
- Keeley Baker
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