Joint RL meeting

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Brown University

Outline

1. Context
2. Deep RL on toy task
3. Deep RL on half triangle task
4. Next steps brainstorming

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Context

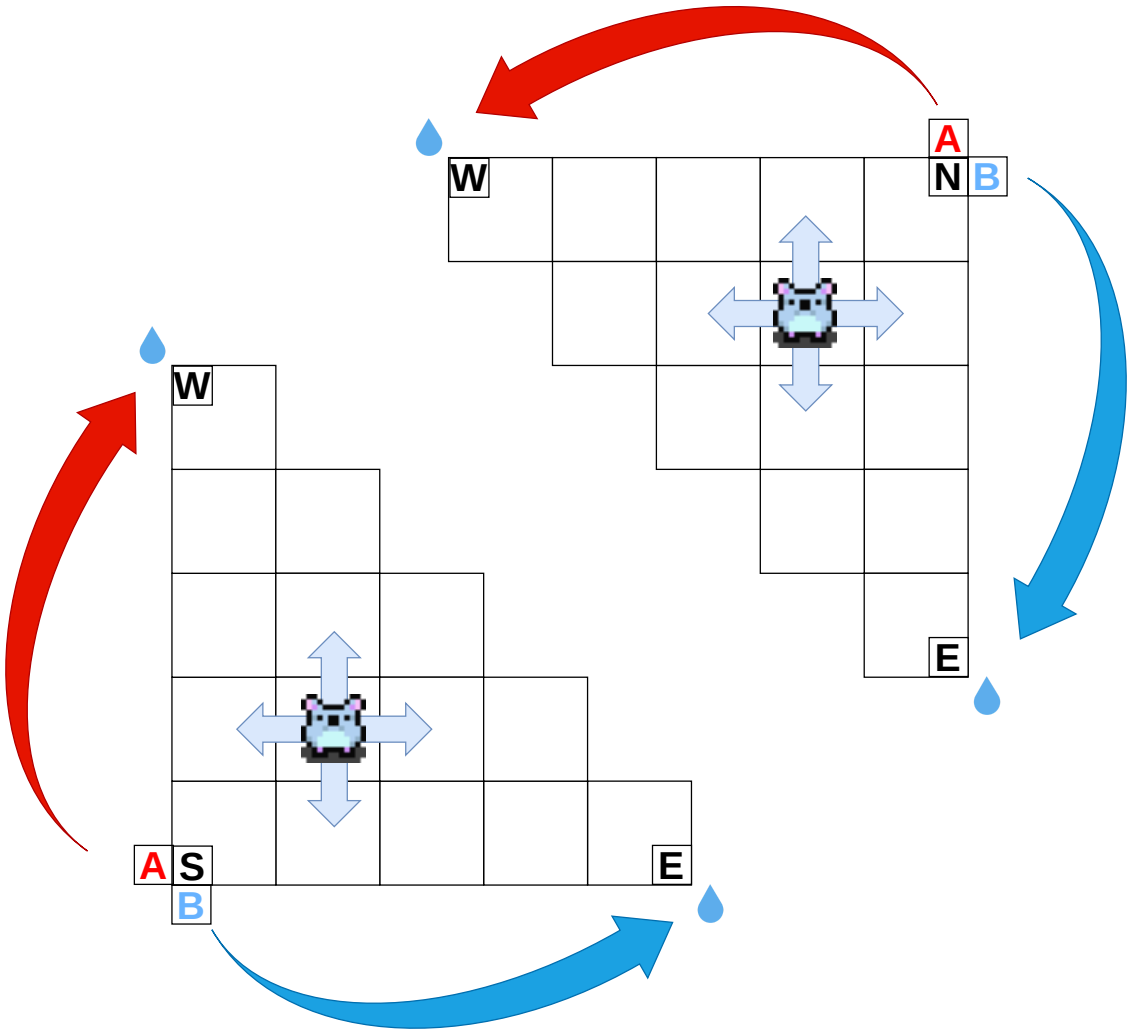
Question

What are the representations needed to solve an spatial olfactory task?

Hypothesis

Both the agent & the animal need a conjuctive representation of {location + cue} to solve the task

Half triangle task



Paths followed until today...

1. RL package in Julia
2. Rewrite everything in Python and do backprop by hand
3. Rewrite in PyTorch
    3.1 Run on GPU on Oscar
    3.2 Downscaled task to run on CPU

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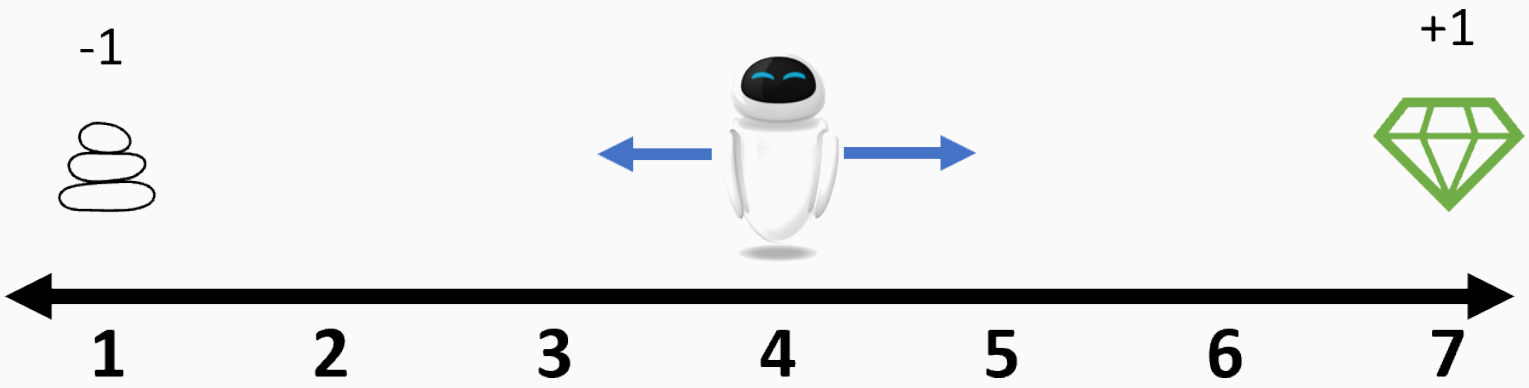
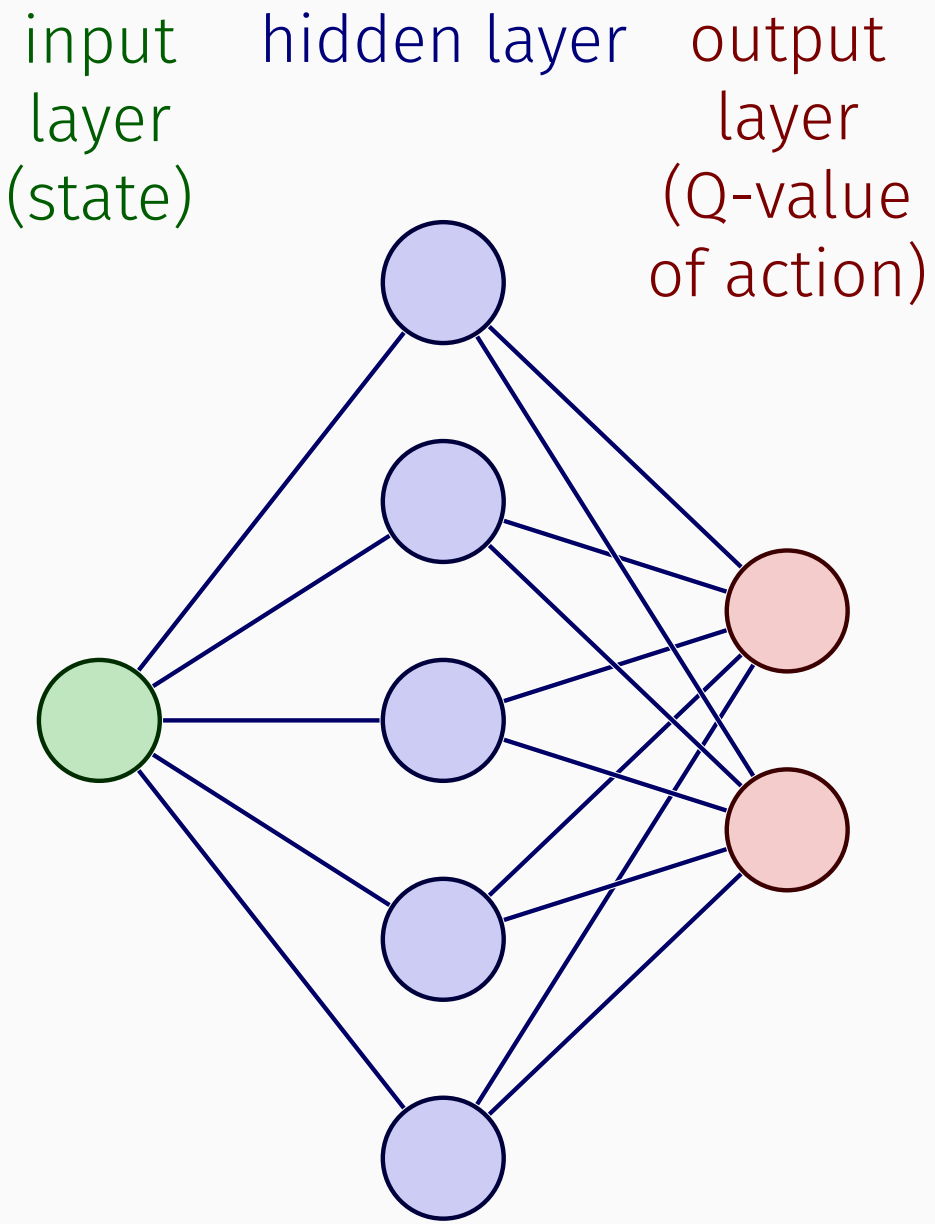
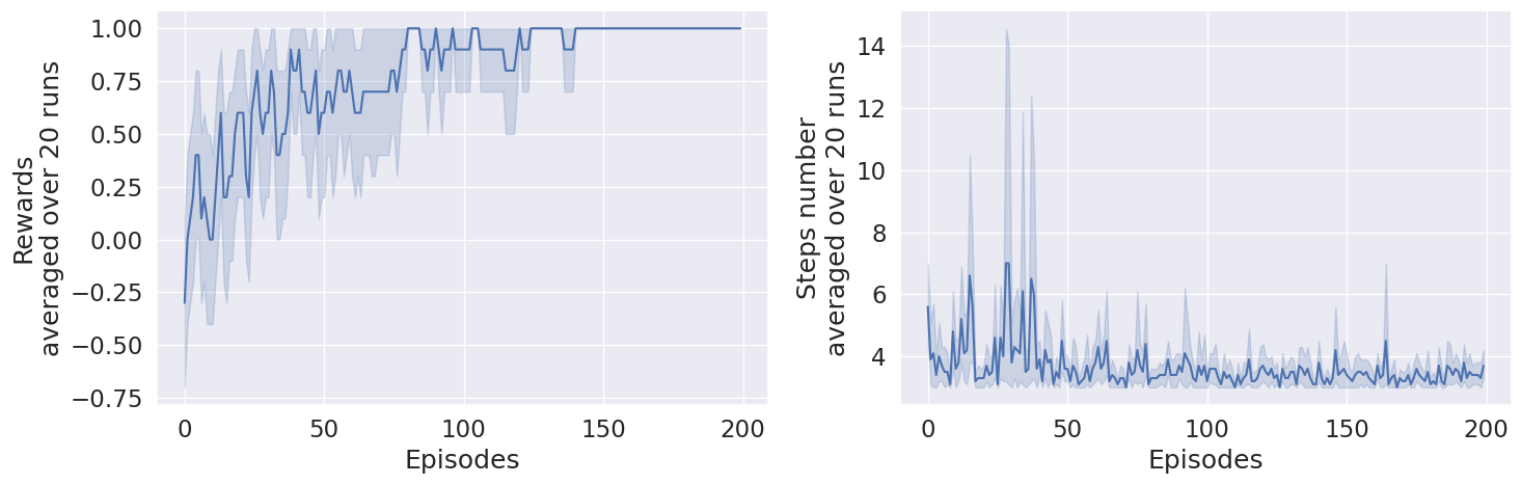
Toy task : Random Walk 1D



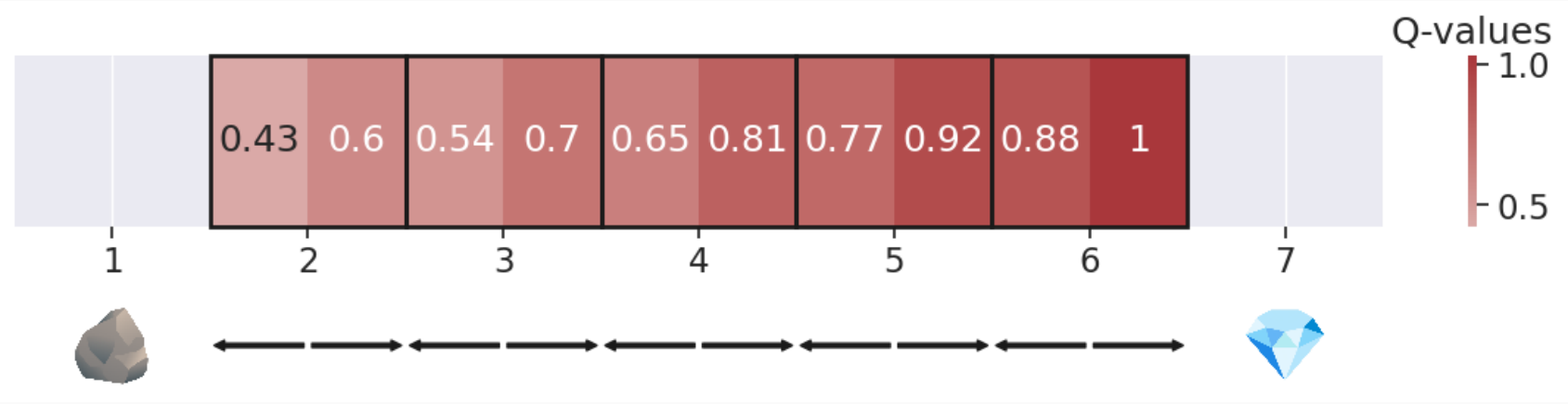
Network used



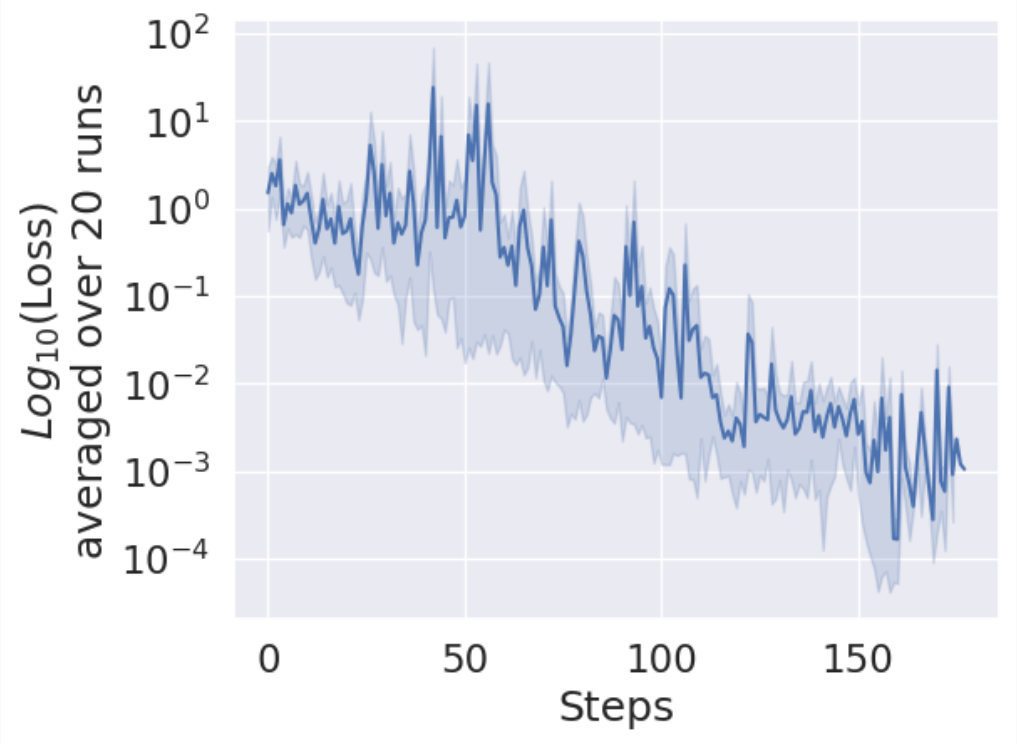
Rewards and steps



Policy learned



Cost function



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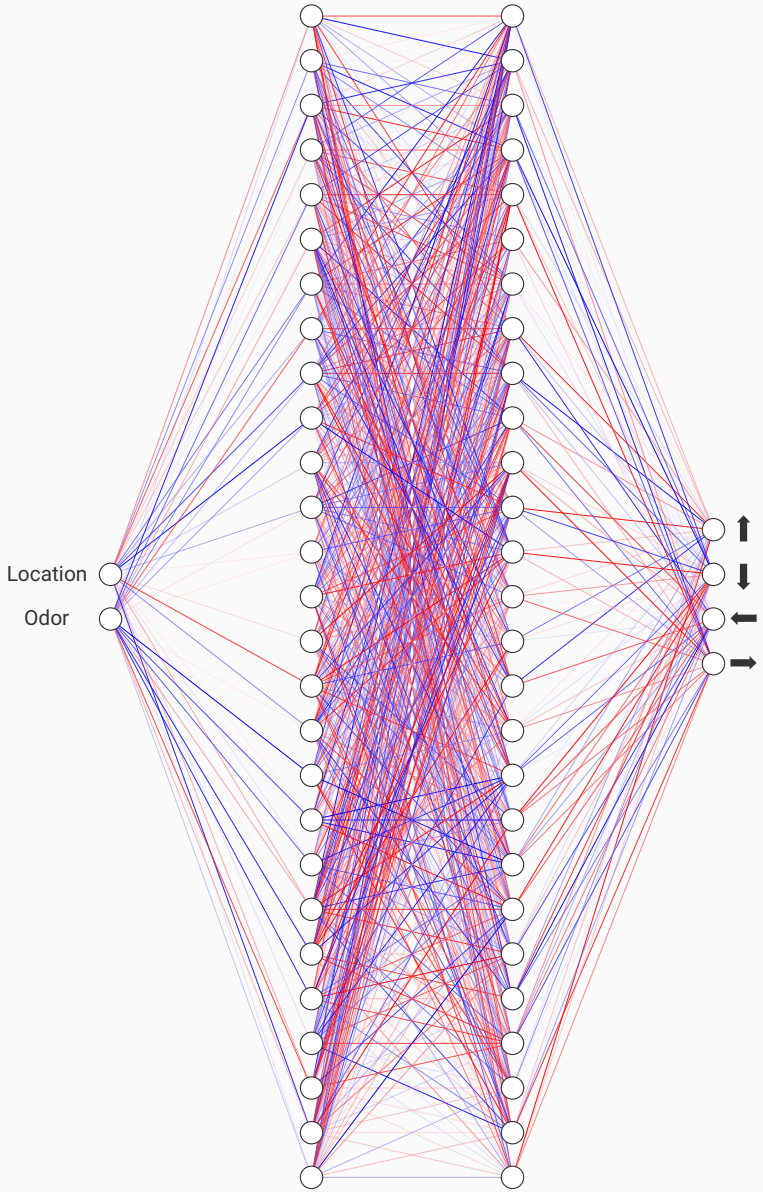

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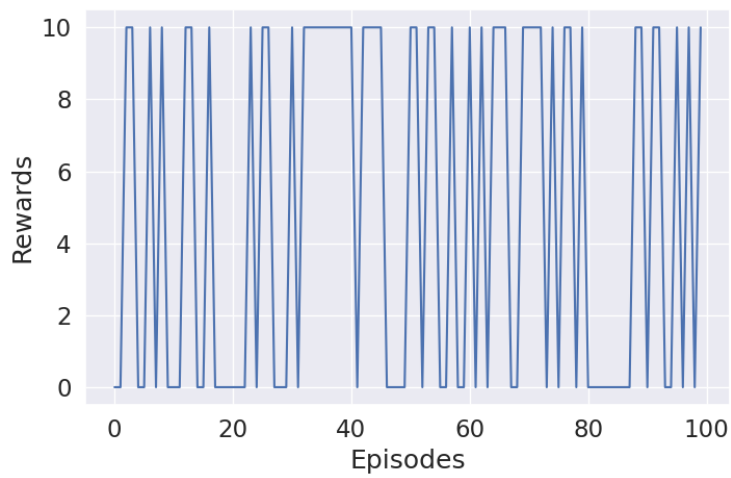

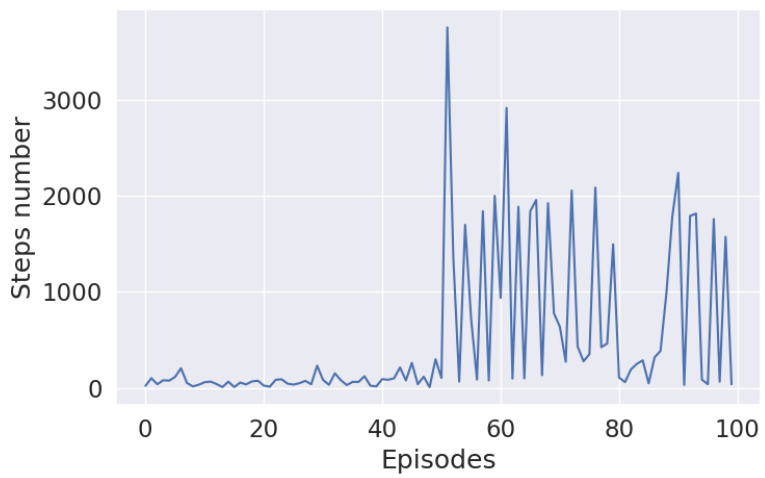

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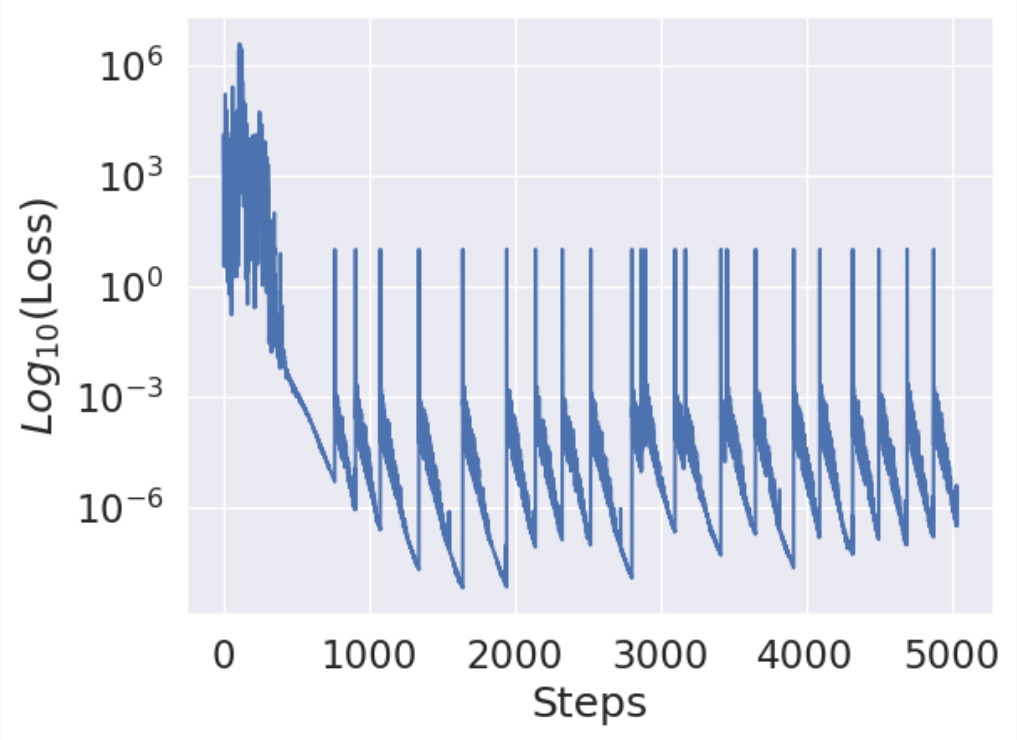

Current algorithm

Algorithm 1: Deep RL algorithm used

initialize network with random weights
for $episode \leftarrow 1 \ldots T$ **do**
    $state \leftarrow reset(env)$
    $done \leftarrow False$
    while $done \neq True$ **do**
        $Q \leftarrow forward_pass(state)$ /* 4 values vector */
        $action \leftarrow \epsilon_{greedy}(action_space, state, q)$
        $state_{new}, reward, done \leftarrow env.step(action, state)$
        $Q \leftarrow forward_pass(state_{new})$ /* 4 values vector */
        $Q_{new} \leftarrow reward + \gamma max(Q)$ /* scalar */
        $y \leftarrow max(Q)$ /* scalar */
        if $done = True$ **then**
            $\hat{y}_{pred} \leftarrow reward$ /* scalar */
        else
            $\hat{y}_{pred} \leftarrow Q_{new}$ /* scalar */
        end
        $Loss \leftarrow (y - \hat{y}_{pred})^2$
        update network weights to minimize Loss
    end
end

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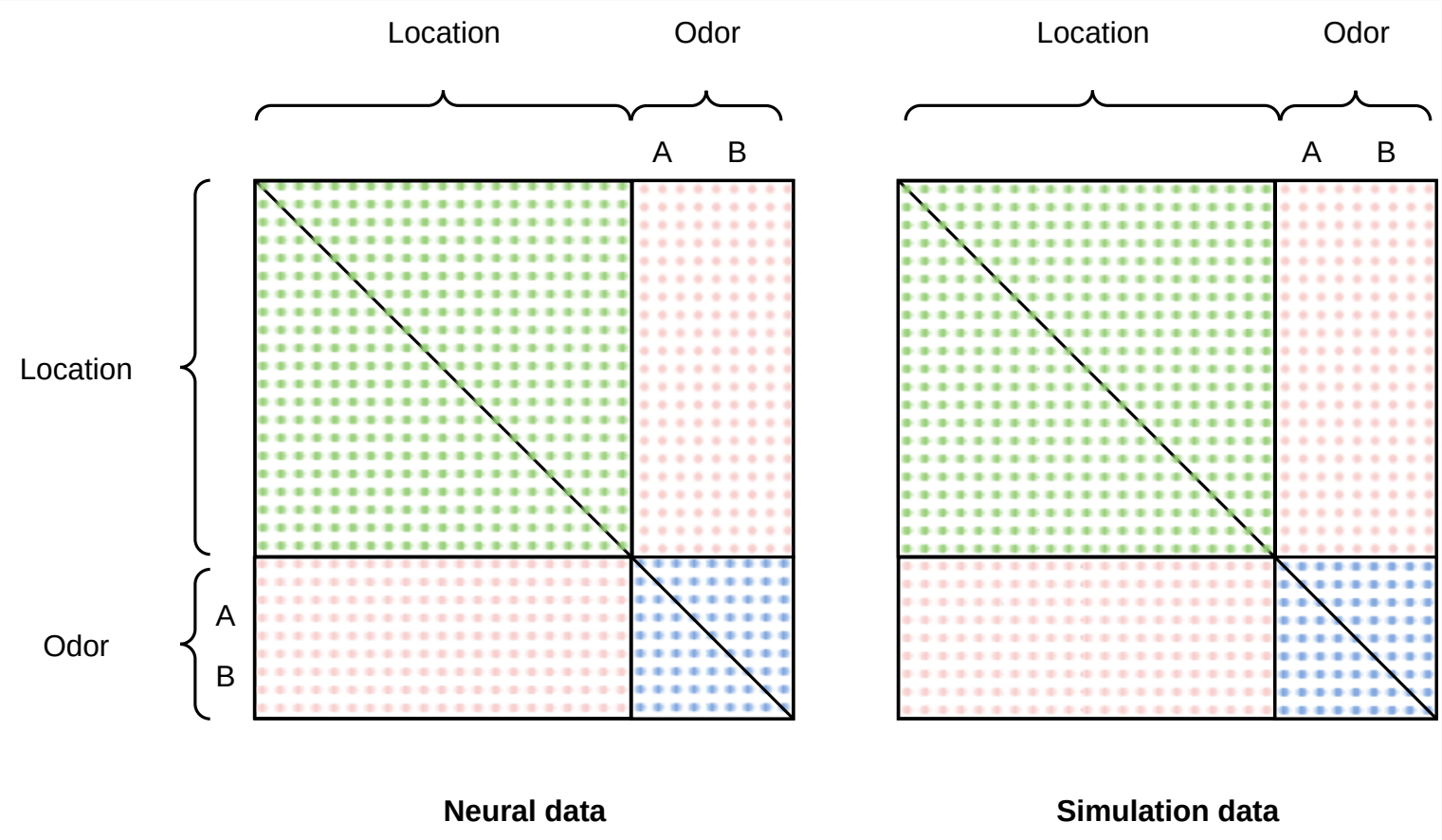
Correlation matrix between brain data vs. simulation data

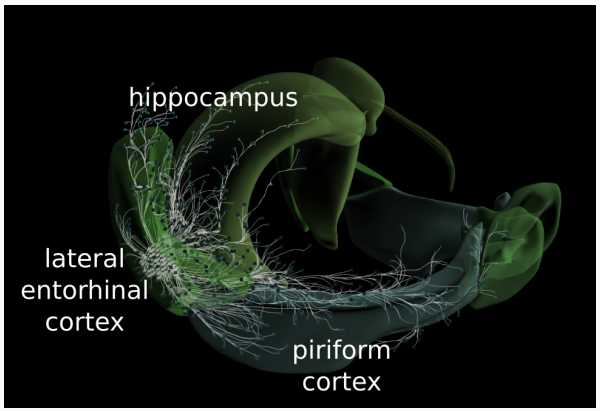


Ablation study?

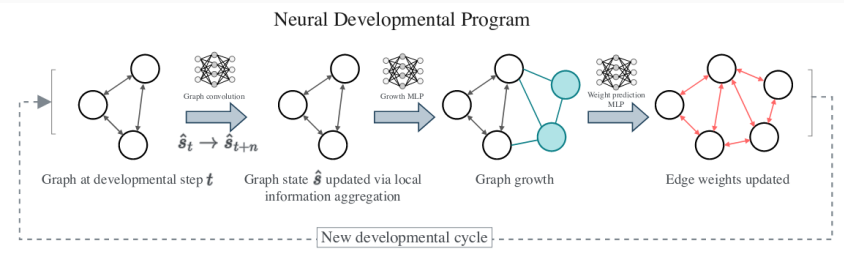
1. Train the model on the task
2. Identify the congunctive cells
3. Knock-out the congunctive cells (equivalent to KO LEC?)
4. Measure the proportion of congiuntive cells the model needs to solve the task

Network architecure

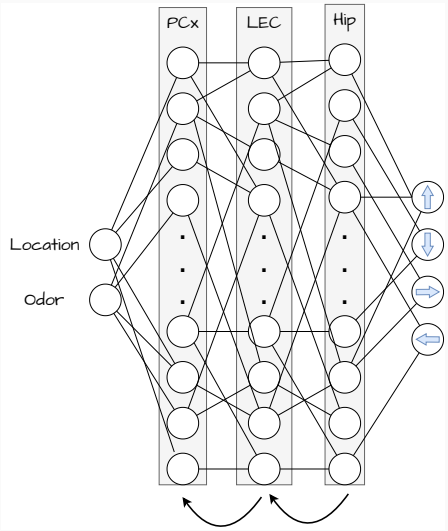
From brain connectivity...

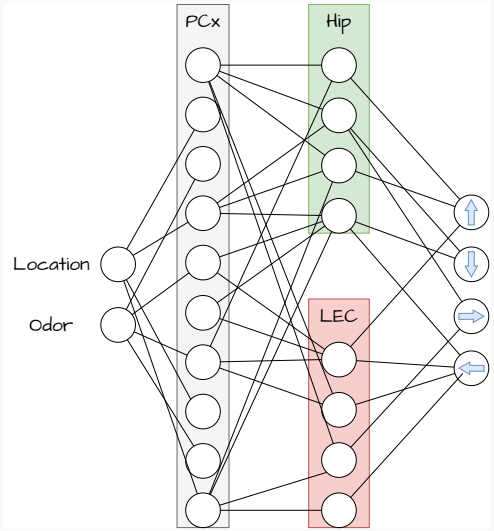


→Let the architecture being optimized?



...To ANN architectures





Najarro, et al. (2023)

Questions ?