



Joint RL meeting

Andrea Pierré

November 18, 2023

Brown University

Outline

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

Outline

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

Context

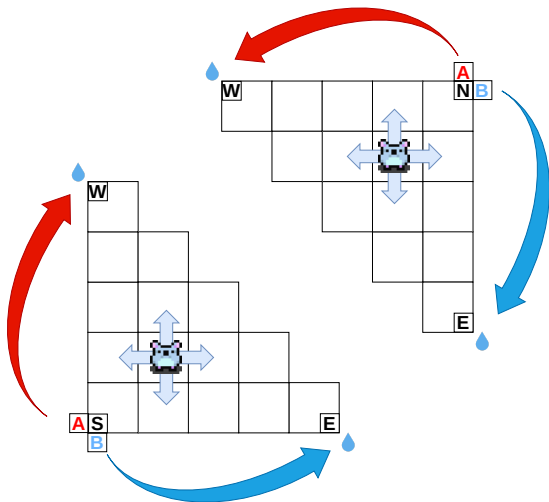
Question

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

Hypothesis

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

Half triangle task



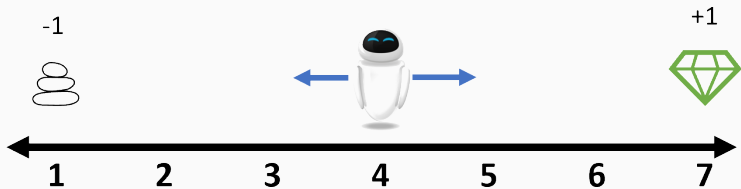
Paths followed until today...

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

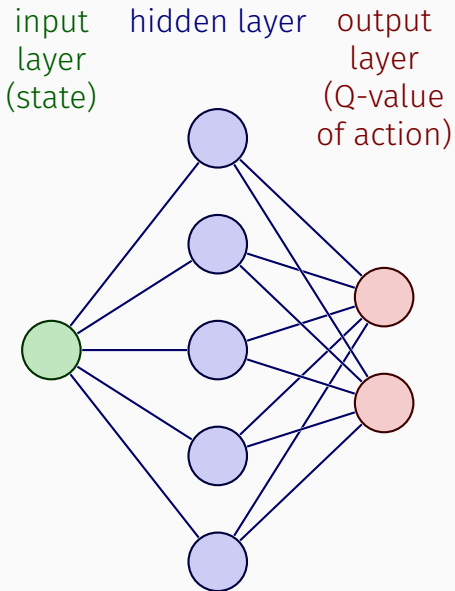
Outline

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

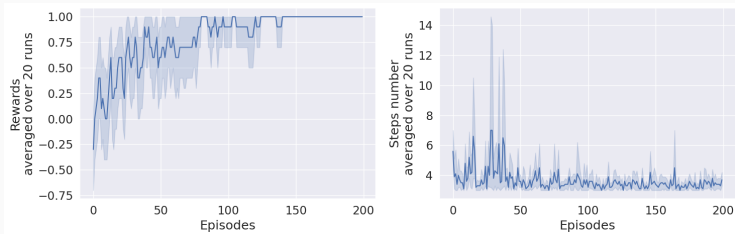
Toy task : Random Walk 1D



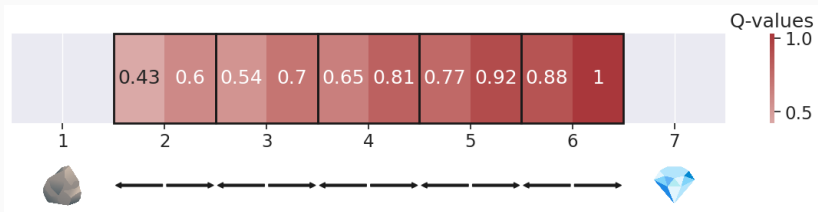
Network used



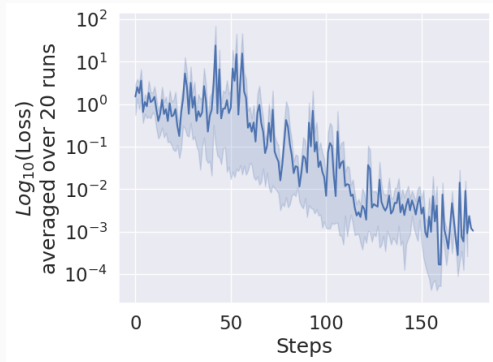
Rewards and steps



Policy learned



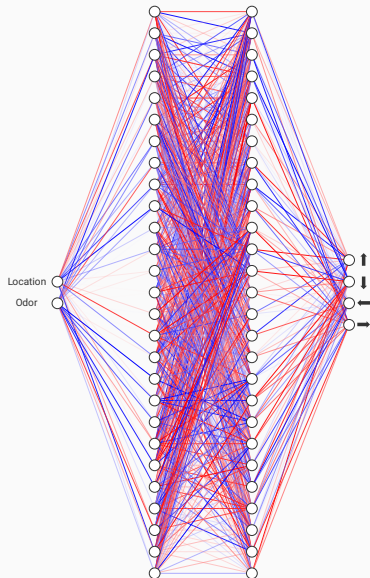
Cost function



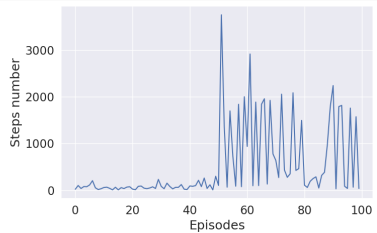
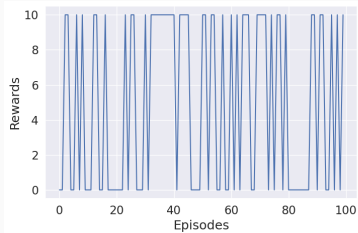
Outline

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

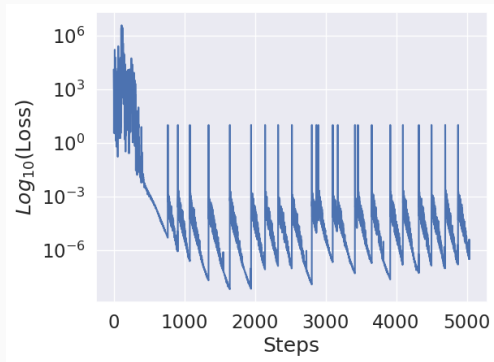
Network used



Rewards and steps



Cost function



Current algorithm

Algorithm 1: Deep RL algorithm implemented

initialize network with random weights

for $episode \leftarrow 1 \dots T$ 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

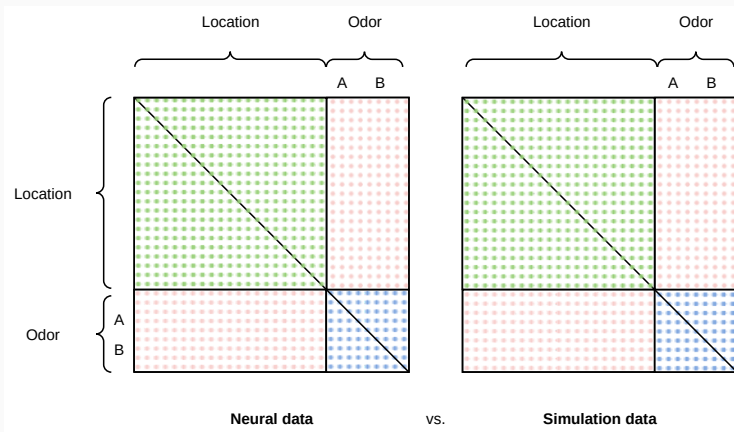
 end

end

Outline

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

Correlation matrices between neural data vs. simulation data

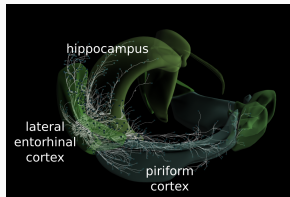


Ablation study?

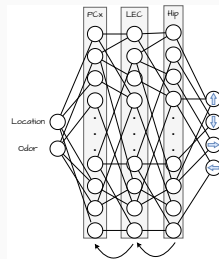
1. Train the model on the task
2. Identify the conjunctive cells
3. Knock-out the conjunctive cells (equivalent to KO LEC?)
4. Measure the proportion of conjunctive cells the model needs to solve the task

Network architecture

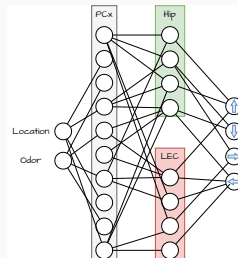
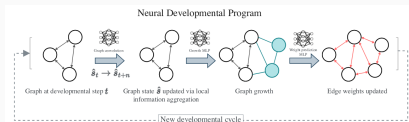
From brain connectivity...



...To ANN architectures



→ Let the architecture being optimized?



Questions ?