

# Introduction to AI

## REINFORCEMENT LEARNING

Lab Session

May 3, 2024

In this lab session, we will illustrate Reinforcement Learning (RL) and Q-Learning on PyRat using an example implementation that we provide. The goal of this lab session is to decompose this implementation and understand each of its part, with respect to what we say in the course.

Make sure to update ("pull") the course repository.

The course on RL is here :

<https://github.com/brain-bzh/introduction-to-ai/tree/main/session5/course>

And the lab session code is here <https://github.com/brain-bzh/introduction-to-ai/blob/main/session5/lab/>.

Problems 1 and 2 do not need to run the code. You'll need to run the code from problem 3.

### **Problem 1.** Understanding the basics of RL

For all these questions, your answer should include the relevant lines of code (unmodified) and a written explanation.

- (a) How is the state defined ?
- (b) What are the possible actions ?
- (c) What is the reward ?
- (d) How is the next action selected ?

### **Problem 2.** Training Mechanisms

The goal of this part is to understand how learning happens.

- (a) Describe the experience replay mechanism.
- (b) What is the discount factor?
- (c) Describe the architecture that is used to learn the Q-function.
- (d) What are batches and why do we need them ?
- (e) A very "code specific" question : make sure to understand how to use the code to train, save and reload your work.

### **Problem 3.** Analysis and hyperparameter tuning

In this part, run specific experiments to better understand the role of each hyperparameter and answer the questions. For each part, explain which experiments you have done and the results obtained. Results can be analyzed using the win rates obtained as well as the number of epochs needed to get this result.

- (a) What is the influence of the discount factor?
- (b) What is the role of the learning rate ?
- (c) Using all other default parameters, what is the minimum number of parameters (model size) that still enable learning ? Hint - changing the model size may need to change the learning rate and the batch size.