Master's Department of Engineering Sciences

MSc in Automation Engineering and Robotics

Name of the unit: Deep Learning and Reinforcement Learning (refresher course)

Lecturer: Louis Annabi Occelli (annabi@isir.upmc.fr)
Course code:
Student workload: 14 h of lectures, 2 h of tutorials, 12 h of labs
Credits: 3 ECTS
Specialization tracks: ☒ ROBOT (elective) ☒ SI (elective) ☐ MeDH
Semester offered: ☐ S1 ☐ S2 ☒ S3 ☐ S4
Language of instruction: ☐ French ☒ English
Targeted audience: ☐ Engineering Sciences students ☐ Other (specify): ENSAM and newly admitted stude
Localization : ☒ PMC Campus ☐ Other (specify):

Course Overview

This course unit trains students in deep learning and reinforcement learning. A first fundamental block focuses on deep learning (neural networks, backpropagation and standard architectures). A second block introduces reinforcement learning.
Keywords: Deep learning, reinforcement learning

Prerequisites

Students should have previously acquired the following prerequisites to follow this course:

- Install and use a programming environment (language, IDE)
- Prepare data for learning
- Develop an appropriate experimental protocol to evaluate model performance

Intended Learning Outcomes

By the end of this course, students will be able to:

1. Choose the paradigm suited to the task and data (supervised, unsupervised or reinforcement learning)
2. Choose a neural-network architecture suited to the task, data and resources (MLP, RNN, CNN)
3. Choose the learning process (loss function, optimization algorithm, initialization)
4. Size a network (number of layers and neurons)
5. Create a graphical representation of a neural network
6. List an algorithm's hyperparameters (for deep learning or reinforcement learning)
7. Implement fundamental algorithms (gradient descent, backpropagation, dynamic programming, temporal-difference learning, etc.)
8. Master a high-level deep-learning library (PyTorch or TensorFlow)
9. Carry out the learning process defined during the design phase by optimizing the associated multiple loss functions
10. Reproduce training processes and experimental results
11. Monitor and interpret the results to ensure optimal learning

Indicative Teaching Sequence and Methods

Week	C/TD/TP*	Content	Preparation	Learn. outc.
S1	C1	Backpropagation, perceptron, MLP, activation function		1, 7
S2	TP1	Backpropagation implementation		7, 9, 10, 11
S3	C2	Optimizers, generalization, initialization, normalization, regularization		1, 3, 4, 6
S4	TP2	Optimizers, improving speed and generalization on a classification task		4, 8, 9, 10, 11
S5	C3	Inductive bias, CNN, RNN		1, 2, 4, 5, 6
S6	TP3	CNN, RNN		4, 8, 9, 10, 11
S7	C4	Loss functions, unsupervised learning, AE, VAE, GAN		1, 3, 5, 6
S8	TP4	AE and VAE		8, 9, 10, 11
S9	C5	MDP, dynamic programming		1, 6
S10	C6	Tabular RL, TD(0), Q-learning, SARSA		1, 6
S11	TD1	Tutorial on lectures C5 and C6		7
S12	TP5	Q-learning		7, 10, 11
S13	C7	Introduction to deep reinforcement learning, DQN, DDPG		1, 6
S14	TP6	DQN		7, 8, 10, 11

* C/TD/TP respectively corresponds to lectures, tutorials and lab sessions.

Sequence of the unit:
The course unit is organized into two successive sequences:
- Sequence 1: deep learning
- Sequence 2: reinforcement learning

Indicative Assessment of Intended Learning Outcomes (1st session)

Week	Individ./group	In-person/remote	Type of exam	Evaluated outcomes	Scale %

2nde session of exam

Session	Individ./group	In-person/remote	Type of exam	Evaluated outcomes	Scale %

Date of generation of this unit description: October 6, 2026