

TABLE C1 - FRAMEWORK LESSON PLAN

This document must briefly describe the course content, the objectives, the teaching methods and the evaluation.

SIGLE	IFT 6XXX
NUMBER OF CREDITS	4
LONG TITLE	Machine Learning for Robotics
SHORT TITLE	Robot Learning

1. COURSE CONTENT

Learning methods such as deep reinforcement learning have shown success in solving simulated planning and control problems but struggle to produce diverse, intelligent behaviour, on robots. The goal of this class is to discuss these limitations and to study methods to overcome them and enable agents capable of training autonomously, becoming learning and adapting systems that require little supervision. By the end of the course, each student should have a solid grasp of different techniques to train robots to accomplish tasks in the real world. These techniques that will be covered in the course include but are not limited to reinforcement learning, batch RL, multi-task RL, model-based RL, Sim2Real, hierarchical RL, goal conditioned RL, Multi-Agent RL, Fragility of RL, Metalevel Decision Making and learning reward functions.

2. TARGET OBJECTIVES AND COMPETENCIES

Learn the fundamental concepts of machine learning for robotics applications. Such concepts are considered advanced and require a good foundation in machine learning, deep learning and reinforcement learning. This involves:

becoming familiar with the main types of machine learning models for a control policy (from model-based to model-free)
developing the ability to read research articles, contextualize them and develop a critical mind;
develop presentation skills;
develop their research autonomy in machine learning.
Develop skills related to the strengths and weaknesses of current machine learning methods when being applied to real-world problems.

3. MAIN TEACHING METHODS

Lectures covering topics related to learning robots as well as programming assignments and a final project. The objectives of the assignments and final projects will be:

- **Software knowledge:** Learning about the available software that is used for deep reinforcement learning.
- **Analysis skills:** Collecting proper statistics of results and using server computers and docker to reproduce experiments and validate results.
- proposal of a new idea to explore for the final project based on the lectures;

- Learn how to understand the potential of a method in the real world (positive or negative, social and environmental);
- **Exploration with final project:** More free-form investigation of advanced topics from class that produces reusable code, reproducible results and a written report.
- estimation of the impact that the new idea could have in an industrial context;

The final project will be achieved as a team. Research in academia and industry involves working with others to achieve research goals. This project will evaluate the students' ideas, research process understanding, teamwork, and presentation.

Regarding the lectures, the instructor will provide live lectures on the topics each week with a focus on their understanding, application, and limitations.

4. EVALUATIVE APPROACH AND WEIGHTING *(indicative only)*

40%: Programming assignments (2). (This is needed to provide skills necessary to perform a good final project in the class)

20%: Class participation and discussing readings.

40%: Final project