Master's Department of Engineering Sciences

MSc in Automation Engineering and Robotics

Name of the unit: AI for Robotics

Lecturer: Stéphane Doncieux (stephane.doncieux@sorbonne-universite.fr)
Course code: UM5RBI34
Student workload: 16 h of lectures, 12 h of labs
Credits: 3 ECTS
Specialization tracks: ☐ ROBOT ☒ SI (elective) ☐ MeDH
Semester offered: ☐ S1 ☐ S2 ☒ S3 ☐ S4
Language of instruction: ☐ French ☒ English
Targeted audience: ☒ Engineering Sciences students ☐ Other (specify):
Localization : ☒ PMC Campus ☐ Other (specify):

Course Overview

This course unit introduces students to the issues involved in applying AI methods, particularly learning methods, to real robots. It presents different AI approaches to robotics, focusing on two complementary reinforcement-learning methods (with and without gradients) and on planning in robotics.
Keywords: Artificial intelligence, robotics, learning, motion planning

Prerequisites

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

- Machine learning, deep learning

Intended Learning Outcomes

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

1. Situate the different artificial-intelligence approaches used in robotics;
2. Understand the principles of evolutionary algorithms;
3. Implement and apply evolutionary algorithms such as NSGA-II;
4. Understand the principles of quality-diversity algorithms;
5. Choose a deep reinforcement-learning algorithm suited to a given problem
6. Implement and apply DQN and DDPG
7. Implement and apply policy-gradient methods
8. Identify a planning problem and choose a suitable algorithm
9. Implement and apply motion-planning algorithms (RRT, RRT*)
10. Understand the principles of alternative AI approaches for robotics

Indicative Teaching Sequence and Methods

Week	C/TD/TP*	Content	Preparation	Learn. outc.
S1	C	AI and robotics: introduction / Evolutionary robotics		AAV1-4
S2	TP	Evolutionary robotics		AAV2-4
S3	C	Deep RL and robotics		AAV5
S4	TP	Deep RL and robotics		AAV6-7
S5	C	Planning and robotics / introductory lecture 1		AAV8, AAV12
S6	TP	Planning and robotics		AAV9
S7	C	Introductory lectures 2 and 3		AAV12

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

Sequence of the unit:
The course unit consists of three lecture/practical sessions and three introductory lectures.

Indicative Assessment of Intended Learning Outcomes (1st session)

Week	Individ./group	In-person/remote	Type of exam	Evaluated outcomes	Scale %
S2	Individual	In-person	TP	AAV2-4	20 %
S4	Individual	In-person	TP	AAV5-7	20 %
S6	Individual	In-person	TP	AAV8-11	20 %
S15	Individual	In-person	Other	AAV 1-12	40 %

2nde session of exam

Session	Individ./group	In-person/remote	Type of exam	Evaluated outcomes	Scale %
2	Individual	In-person	Other	AAV 1-12	100 %

Bibliographic references

- 1. Russel, S. Norvig, P. (2016). Artificial Intelligence: A modern approach.
- 2. Vernon, D. (2014). Artificial cognitive systems: A primer.
- 3. Floreano, D. Mattiussi, C. (2008). Bio-inspired artificial intelligence
- 4. LaValle, S. M. (2006) Planning algorithms http://planning.cs.uiuc.edu/

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