

Course guide

230329 - MLR - Machine Learning Through Reinforcement

Last modified: 11/05/2022

Unit in charge: Barcelona School of Telecommunications Engineering
Teaching unit: 739 - TSC - Department of Signal Theory and Communications.

Degree: BACHELOR'S DEGREE IN TELECOMMUNICATIONS TECHNOLOGIES AND SERVICES ENGINEERING (Syllabus 2015). (Optional subject).

Academic year: 2022 **ECTS Credits:** 2.0 **Languages:** Catalan, English

LECTURER

Coordinating lecturer: Vidal Manzano, Jose

Others: Cabrera Bean, Margarita Asuncion

Giró Nieto, Xavier

PRIOR SKILLS

Algebra, Probability and stochastic processes, Signals and systems

REQUIREMENTS

Algebra, Probability and stochastic processes, Signals and systems

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Generical:

08 CRPE. ABILITY TO IDENTIFY, FORMULATE AND SOLVE ENGINEERING PROBLEMS. To plan and solve engineering problems in the ICT with initiative, making decisions and with creativity. To develop a method of analysis and problem solving in a systematic and creative way.

Transversal:

04 COE N2. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 2. Using strategies for preparing and giving oral presentations. Writing texts and documents whose content is coherent, well structured and free of spelling and grammatical errors.

06 URI N1. EFFECTIVE USE OF INFORMATION RESOURCES - Level 1. Identifying information needs. Using collections, premises and services that are available for designing and executing simple searches that are suited to the topic.

06 URI N2. EFFECTIVE USE OF INFORMATION RESOURCES - Level 2. Designing and executing a good strategy for advanced searches using specialized information resources, once the various parts of an academic document have been identified and bibliographical references provided. Choosing suitable information based on its relevance and quality.

06 URI N3. EFFECTIVE USE OF INFORMATION RESOURCES - Level 3. Planning and using the information necessary for an academic assignment (a final thesis, for example) based on a critical appraisal of the information resources used.

TEACHING METHODOLOGY

Classroom lectures and labs

LEARNING OBJECTIVES OF THE SUBJECT

Master the principles of learning for reinforcement as an artificial intelligence tool based on the interaction of the machine with its environment, and which is at the base of systems such as autonomous vehicles, software that plays chess or go, or the organization of complex communication systems. We will work on its practical implementation and the evaluation in specific cases.

STUDY LOAD

Type	Hours	Percentage
Self study	30,0	60.00
Hours large group	20,0	40.00

Total learning time: 50 h

CONTENTS

1. Introduction to reinforcement learning

Description:

Describe with examples the fundamental concepts and the problems that can be solved.

Full-or-part-time: 2h 30m

Theory classes: 2h 30m

2. Markov decision processes

Description:

- The agent-environment interface
- Goals and rewards
- Markov Decision Processes
- Value functions and optimality: Bellman equation

Full-or-part-time: 2h 30m

Theory classes: 2h 30m

3. Dynamic programming

Description:

- Policy evaluation, improvement and iteration
- Dynamic programming based on MDP

Full-or-part-time: 2h 30m

Theory classes: 2h 30m

4. Monte-Carlo methods

Description:

- First-visit Monte-Carlo methods
- Every-visit Monte-Carlo methods
- Exploration and exploitation
- On-policy and off-policy methods

Full-or-part-time: 2h 30m

Theory classes: 2h 30m

5. Temporal-difference and Q-learning

Description:

- Model-free learning using time differences
- Q-learning and discrete actions
- Games

Full-or-part-time: 2h 30m

Theory classes: 2h 30m

6. Policy gradient methods

Description:

- Policy gradient

Full-or-part-time: 2h 30m

Theory classes: 2h 30m

7. Deep reinforcement learning

Description:

Modeling of Q functions with deep neural networks

Full-or-part-time: 2h 30m

Theory classes: 2h 30m

8. Laboratory and applications

Description:

Labs in Matlab and/or Python distributed through the lectures

- Dynamic channel allocation
- Blackjack
- Job-shop scheduling

Full-or-part-time: 2h 30m

Theory classes: 2h 30m

GRADING SYSTEM

Exam and evaluation of labs

BIBLIOGRAPHY

Basic:

- Sutton, R.S.; Barto, A.G. Reinforcement learning: an introduction [on line]. 2nd ed. Cambridge, Mass.: MIT Press, 2018 [Consultation: 14/09/2020]. Available on: <https://ebookcentral.proquest.com/lib/upcatalunya-ebooks/detail.action?docID=6260249>. ISBN 9780262039246.