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230329 - MLR - Machine Learning Through Reinforcement

Coordinating unit: 230 - ETSETB - Barcelona School of Telecommunications Engineering

Teaching unit: 739 - TSC - Department of Signal Theory and Communications

Academic year: 2019

Degree: BACHELOR'S DEGREE IN TELECOMMUNICATIONS SCIENCE AND TECHNOLOGY (Syllabus 2010). (Teaching unit Optional)
BACHELOR'S DEGREE IN AUDIOVISUAL SYSTEMS ENGINEERING (Syllabus 2009). (Teaching unit Optional)
BACHELOR'S DEGREE IN ELECTRONIC SYSTEMS ENGINEERING (Syllabus 2009). (Teaching unit Optional)
BACHELOR'S DEGREE IN TELECOMMUNICATIONS SYSTEMS ENGINEERING (Syllabus 2010). (Teaching unit Optional)
BACHELOR'S DEGREE IN NETWORK ENGINEERING (Syllabus 2010). (Teaching unit Optional)
BACHELOR'S DEGREE IN TELECOMMUNICATIONS TECHNOLOGIES AND SERVICES ENGINEERING (Syllabus 2015). (Teaching unit Optional)

ECTS credits: 2 Teaching languages: Catalan, English

Teaching staff

Coordinator: 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.

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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

Total learning time: 50h	Hours large group:	20h	40.00%
	Self study:	30h	60.00%

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Content

1. Introduction to reinforcement learning

Learning time: 2h 30m
Theory classes: 2h 30m

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

2. Markov decision processes

Learning time: 2h 30m
Theory classes: 2h 30m

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

3. Dynamic programming

Learning time: 2h 30m
Theory classes: 2h 30m

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

4. Monte-Carlo methods

Learning time: 2h 30m
Theory classes: 2h 30m

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

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5. Temporal-difference and Q-learning	Learning time: 2h 30m Theory classes: 2h 30m

Description:
- Model-free learning using time diferences
- Q-learning and discrete actions
- Games

6. Policy gradient methods	Learning time: 2h 30m Theory classes: 2h 30m

Description:
- Policy gradient

7. Deep reinforcement learning	Learning time: 2h 30m Theory classes: 2h 30m

Description:
Modeling of Q functions with deep neural networks

8. Laboratory and applications	Learning time: 2h 30m Theory classes: 2h 30m

Description:
Labs in Matlab and/or Python distributed throught the lectures
- Dynamic channel allocation
- Blackjack
- Job-shop scheduling

Qualification system

Exam and evaluation of labs

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Bibliography

Basic:

Sutton, R.S.; Barto, A. G. Reinforcement learning: an introduction. 2nd ed. Bradford Books, 2018. ISBN 9780262039246.