Course guide
270728 - PGM - Probabilistic Graphical Models

Last modified: 02/02/2024

Unit in charge: Barcelona School of Informatics
Teaching unit: 1004 - UB - (ENG)Universitat de Barcelona.

Degree: MASTER'S DEGREE IN ARTIFICIAL INTELLIGENCE (Syllabus 2017). (Optional subject).

Academic year: 2023 **ECTS Credits:** 4.5 **Languages:** English

LECTURER

Coordinating lecturer:

Others:

PRIOR SKILLS

The subject requires the student to have basic knowledge of linear algebra and calculus, and be familiar with basic probability concepts.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CEA12. Capability to understand the advanced techniques of Knowledge Engineering, Machine Learning and Decision Support Systems, and to know how to design, implement and apply these techniques in the development of intelligent applications, services or systems.
CEA13. Capability to understand advanced techniques of Modeling , Reasoning and Problem Solving, and to know how to design, implement and apply these techniques in the development of intelligent applications, services or systems.
CEA3. Capability to understand the basic operation principles of Machine Learning main techniques, and to know how to use on the environment of an intelligent system or service.
CEA8. Capability to research in new techniques, methodologies, architectures, services or systems in the area of ??Artificial Intelligence.
CEP1. Capability to solve the analysis of information needs from different organizations, identifying the uncertainty and variability sources.
CEP2. Capability to solve the decision making problems from different organizations, integrating intelligent tools.
CEP3. Capacity for applying Artificial Intelligence techniques in technological and industrial environments to improve quality and productivity.
CEP5. Capability to design new tools and new techniques of Artificial Intelligence in professional practice.

Generical:
CG3. Capacity for modeling, calculation, simulation, development and implementation in technology and company engineering centers, particularly in research, development and innovation in all areas related to Artificial Intelligence.

Transversal:
CT4. EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data and information in the chosen area of specialisation and critically assessing the results obtained.

CT6. REASONING: Capability to evaluate and analyze on a reasoned and critical way about situations, projects, proposals, reports and scientific-technical surveys. Capability to argue the reasons that explain or justify such situations, proposals, etc..
CT7. ANALISIS Y SINTESIS: Capability to analyze and solve complex technical problems.

Basic:
CB6. Ability to apply the acquired knowledge and capacity for solving problems in new or unknown environments within broader (or multidisciplinary) contexts related to their area of study.
CB9. Possession of the learning skills that enable the students to continue studying in a way that will be mainly self-directed or autonomous.

TEACHING METHODOLOGY

Lectures dynamically combine master explanations and problem solving. The weekly schedule of in-person activities is distributed in three hours. Some slots may be exclusively dedicated to programming throughout directed activities or notebooks.
The students will be required to present an application of PGMs (their own or other people's) to problems of their interest, or a recently proposed PGM technique.

LEARNING OBJECTIVES OF THE SUBJECT

1.Be able to use effectively Probabilistic Graphical Models in business and research scenarios.

STUDY LOAD

Type	Hours	Percentage
Self study	72,0	64.00
Hours large group	15,0	13.33
Guided activities	3,0	2.67
Hours small group	7,5	6.67
Hours medium group	15,0	13.33

Total learning time: 112.5 h

CONTENTS

Representation

Description:
Formal description of PGMs and different types

Inference

Description:
Using PGMs to answer probabilistic queries (both exactly and approximately)

Learning

Description:
Learning PGMs from data (both parameters and graph structure)

Modern trends, applications and tools

Description:
PGMs state-of-the-art

ACTIVITIES

Development of the first subject's block: Representation

Description:
Collaborative style lectures

Specific objectives:
1

Related competencies :
CG3. Capacity for modeling, calculation, simulation, development and implementation in technology and company engineering centers, particularly in research, development and innovation in all areas related to Artificial Intelligence.
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CB6. Ability to apply the acquired knowledge and capacity for solving problems in new or unknown environments within broader (or multidisciplinary) contexts related to their area of study.
CB9. Possession of the learning skills that enable the students to continue studying in a way that will be mainly self-directed or autonomous.

Full-or-part-time: 25h
Theory classes: 4h
Practical classes: 4h
Laboratory classes: 2h
Self study: 15h

Development of the second subject's block: Inference

Full-or-part-time: 25h
Theory classes: 4h
Practical classes: 4h
Laboratory classes: 2h
Self study: 15h

Development of the third subject's block: Learning

Full-or-part-time: 25h
Theory classes: 4h
Practical classes: 4h
Laboratory classes: 2h
Self study: 15h

Test

Specific objectives:
1

Related competencies :
CG3. Capacity for modeling, calculation, simulation, development and implementation in technology and company engineering centers, particularly in research, development and innovation in all areas related to Artificial Intelligence.
CEP2. Capability to solve the decision making problems from different organizations, integrating intelligent tools.
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CB9. Possession of the learning skills that enable the students to continue studying in a way that will be mainly self-directed or autonomous.

Full-or-part-time: 17h 30m
Guided activities: 2h 30m
Self study: 15h

Development of the fourth subject's block: Trends and applications

Full-or-part-time: 2h 30m
Theory classes: 1h
Practical classes: 1h
Laboratory classes: 0h 30m

Students' presentations

Specific objectives:
1

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CEP3. Capacity for applying Artificial Intelligence techniques in technological and industrial environments to improve quality and productivity.
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CT7. ANALISIS Y SINTESIS: Capability to analyze and solve complex technical problems.
CT4. EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data and information in the chosen area of specialisation and critically assessing the results obtained.

CB6. Ability to apply the acquired knowledge and capacity for solving problems in new or unknown environments within broader (or multidisciplinary) contexts related to their area of study.
CB9. Possession of the learning skills that enable the students to continue studying in a way that will be mainly self-directed or autonomous.

Full-or-part-time: 17h 30m
Guided activities: 2h 30m
Self study: 15h

GRADING SYSTEM

The subject is expected to be evaluated based on a final exam (40%), a presentation (30%) and in-class activities (30%).

BIBLIOGRAPHY

Basic:
- Koller, D.; Friedman, N. Probabilistic graphical models: principles and techniques. MIT Press, 2009. ISBN 9780262013192.
- Lauritzen, S.L. Graphical models. Clarendon Press, 1996. ISBN 0198522193.
- Mackay, D.J.C. Information theory, inference, and learning algorithms. Cambridge University Press, 2003. ISBN 0521642981.

RESOURCES

Hyperlink:
- https://www.coursera.org/