Course guides
270703 - IML - Introduction to Machine Learning

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

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

Academic year: 2020 **ECTS Credits:** 5.0 **Languages:** English

LECTURER

Coordinating lecturer: SALVADOR TORRA PORRAS

Others:

PRIOR SKILLS

It is necessary to have knowledge in programming: Python and Java languages

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
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.
CEP2. Capability to solve the decision making problems from different organizations, integrating intelligent tools.
CEP7. Capability to respect the legal rules and deontology in professional practice.

Generical:
CG2. Capability to lead, plan and supervise multidisciplinary teams.
CG4. Capacity for general management, technical management and research projects management, development and innovation in companies and technology centers in the area of Artificial Intelligence.

Transversal:
CT3. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.

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.

TEACHING METHODOLOGY

The class is divided in two parts:

-Theory (2 hours): introduce the contents of the course
-Laboratory (1 hour) which includes:

*Practical exercises related to work deliveries
*Participatory class where students talk about the readings suggested to go deeper into a subject
Note: These readings will be included as theory in the final exam

LEARNING OBJECTIVES OF THE SUBJECT

1.Learn and understand the most common machine learning techniques for unsupervised and supervised tasks.
2.Learn how to solve a problem using machine learning techniques

STUDY LOAD

Type	Hours	Percentage
Hours small group	8,0	6.40
Guided activities	5,0	4.00
Self study	80,0	64.00
Hours large group	16,0	12.80
Hours medium group	16,0	12.80

Total learning time: 125 h

CONTENTS

1. Introduction to machine learning

Description:
-What is learning?
-Definition of learning
-Elements of machine learning
-Paradigms of machine learning
-Applications of machine learning
-Nuts and bolts of machine learning theory

Unsupervised learning

Description:
-Introduction to unsupervised learning
-Clustering
-Classification of clustering algorithms: K-Means and EM
-Factor Analysis : PCA (Principal Components Analysis) and ICA (Independent Component Analysis)
-Self-Organized Maps (SOM) and Multi-dimensional Scaling
-Recommender Systems

Supervised learning

Description:
- Introduction and perspectives
- Lazy Learning
- Introduction to feature selection
- Model selection
- Supervised learning taxonomy
- Linear decision
- Non-linear decision learning: Kernel methods
- Non-linear decision learning: Ensemble Learning
- Bayesian Learning

ACTIVITIES

Work 1 - (W1) Unsupervised exercise

Description:
Unsupervised exercise related to the techniques studied in this course

Specific objectives:
2

Related competencies :
CG2. Capability to lead, plan and supervise multidisciplinary teams.
CG4. Capacity for general management, technical management and research projects management, development and innovation in companies and technology centers in the area of Artificial Intelligence.
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.
CEP7. Capability to respect the legal rules and deontology in professional practice.
CEP2. Capability to solve the decision making problems from different organizations, integrating intelligent tools.
CT7. ANALISIS Y SINTESIS: Capability to analyze and solve complex technical problems.
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CT3. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.

Full-or-part-time: 15h
Self study: 15h

Work 2 - (W2) Lazy learning exercise

Description:
implement a lazy learning exercise for a particular problem

Specific objectives:
2

Related competencies :
CG2. Capability to lead, plan and supervise multidisciplinary teams.
CG4. Capacity for general management, technical management and research projects management, development and innovation in companies and technology centers in the area of Artificial Intelligence.
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.
CEP7. Capability to respect the legal rules and deontology in professional practice.
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CT3. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.

Full-or-part-time: 15h
Self study: 15h

Work 3 - (W3) Kernel Learning exercise

Description:
This exercise is devoted to implement or analyse a Kernel Learning

Specific objectives:
2

Related competencies :
CG2. Capability to lead, plan and supervise multidisciplinary teams.
CG4. Capacity for general management, technical management and research projects management, development and innovation in companies and technology centers in the area of Artificial Intelligence.
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.
CEP7. Capability to respect the legal rules and deontology in professional practice.
CEP2. Capability to solve the decision making problems from different organizations, integrating intelligent tools.
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CT3. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.

Full-or-part-time: 15h
Self study: 15h

Work 4 - (W4) Non Linear Decision exercise

Description:
This exercise is devoted to implement or analyse Ensemble Learning algorithms

Specific objectives:
2

Related competencies :
CG2. Capability to lead, plan and supervise multidisciplinary teams.
CG4. Capacity for general management, technical management and research projects management, development and innovation in companies and technology centers in the area of Artificial Intelligence.
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.
CEP7. Capability to respect the legal rules and deontology in professional practice.
CEP2. Capability to solve the decision making problems from different organizations, integrating intelligent tools.
CT7. ANALISIS Y SINTESIS: Capability to analyze and solve complex technical problems.
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..
CT3. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.

Full-or-part-time: 15h
Self study: 15h

Work 5 - (W5) Readings of different research papers

Description:
Read and analyse different research papers during the course

Specific objectives:
1

Related competencies :
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.
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..
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.

Full-or-part-time: 10h
Self study: 10h

Introduction to ML

Description:
Introduction to ML

Full-or-part-time: 4h
Theory classes: 4h

Cluster Analysis

Description:
Cluster Analysis, study of the most common techniques used in machine learning

Full-or-part-time: 7h
Theory classes: 3h
Laboratory classes: 3h
Self study: 1h

Factor analysis

Description:
Factor analysis: study of the most common techniques

Full-or-part-time: 5h
Theory classes: 4h
Laboratory classes: 1h

Visualization

Description:
Study of self-organized maps and multi-dimensional scaling techniques

Full-or-part-time: 4h
Theory classes: 3h
Laboratory classes: 1h

Introduction to supervised learning

Description:
Introduction to supervised learning

Full-or-part-time: 4h
Theory classes: 3h
Laboratory classes: 1h

Lazy Learning

Description:
Study of different Lazy Learning techniques

Full-or-part-time: 3h
Theory classes: 2h
Laboratory classes: 1h

Feature Selection

Description:
Study of Feature Selection techniques applied in machine learning

Full-or-part-time: 5h
Theory classes: 2h
Laboratory classes: 2h
Self study: 1h

Model selection and taxonomy

Description:
Model selection and taxonomy

Full-or-part-time: 3h
Theory classes: 2h
Laboratory classes: 1h

Linear Decision

Description:
Linear Decision: Algorithms

Full-or-part-time: 5h
Theory classes: 4h
Laboratory classes: 1h

Kernel Learning

Description:
Kernel Learning

Full-or-part-time: 5h
Theory classes: 3h
Laboratory classes: 2h

Ensemble Learning

Description:
Ensemble Learning

Full-or-part-time: 5h
Theory classes: 3h
Laboratory classes: 2h

Recommender Systems

Description:
Recommender Systems. Objectius. Taxonomy. Elements of the recommendation process. Basic algorithms.

Full-or-part-time: 5h
Theory classes: 3h
Laboratory classes: 2h

GRADING SYSTEM

The course is divided into two parts:

Exam: an exam at the end of the term
Work: Work deliveries during the semester (from W1 to W5)

Mark = a x Exam + b x Work

Each course a and b will be stablished in the following ranges: 0,35 <= a <= 0,5 and 0,3 <= b <= 0,6

Work = c x W1 + d x W2 + e x W3 + f x W4

Each course c, d, e, and f will be stablished in the following ranges: 0,2 <= {c,e} <= 0,4 and 0,1 <= {d, f} <= 0,2

BIBLIOGRAPHY

Basic:
- Bishop, C.M. Pattern recognition and machine learning. New York: Springer, 2006. ISBN 0387310738.
- Duda, .R.O.; Hart, P.E.; Stork, D.G. Pattern classification. 2nd ed. John Wiley & Sons, 2001. ISBN 0471056693.
- Mitchell, T.M. Machine learning. The McGraw-Hill Companies, 1997. ISBN 0070428077.