Course guide
270729 - PMCDSS - Personalized Multi-Criteria Decision Support Systems

Last modified: 04/02/2025

Unit in charge: Barcelona School of Informatics
Teaching unit: 1042 - URV - Universitat Rovira i Virgili.

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

Academic year: 2024 **ECTS Credits:** 4.5 **Languages:** English

LECTURER

Coordinating lecturer:

Others:

PRIOR SKILLS

None

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.
CEP3. Capacity for applying Artificial Intelligence techniques in technological and industrial environments to improve quality and productivity.

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.

CT7. ANALISIS Y SINTESIS: Capability to analyze and solve complex technical problems.

TEACHING METHODOLOGY

Oral exposition of the teacher
Oral presentations of the students
Practical exercices with software tools
Solving exercices in class

LEARNING OBJECTIVES OF THE SUBJECT

1.Recognize the main components of a decision making problem and decide the most appropriate modelization method.
2.Build a preference model according to the heterogeneous data types.
3.Make an appropriate selection and use of aggregation operators.
4.Study and apply methods based on the Multi-Attribute Utility Theory.
5.Study and apply methods based on Outranking models for MCDA.
6.Identify the relations between MCDA (Multi-criteria Decision Aiding) and AI (Artificial Intelligence)

STUDY LOAD

Type	Hours	Percentage
Hours large group	40,5	36.00
Self study	72,0	64.00

Total learning time: 112.5 h

CONTENTS

1 Introduction

Description:
"Multicriteria Decision Aiding" is a research field that is growing in importance recently.
The use of AI techniques in this field is quite new and opens many interesting research lines.
The first topic introduces the basic concepts and notation.

1.1 The decision making problem. Formalization.
1.2 MCDA applications

2 Preference representation models for user profiles

Description:
To build personalised decision support systems we need to know and store the preferences of the users in an appropriate model. In this chapter, we study different representation models that take into account several data formats.

2.1 Data types
2.2 Family of criteria
2.3 User profile construction and update

3 Multi-Attribute Utility Theory

Description:
The course addresses two main approaches. The first is based on merging the utility of different criteria into a single overall score. Many fusion methods for aggregation will be presented and compared.

3.1 Introduction
3.2 Steps: aggregation and exploitation.
3.3 Aggregation operators. Properties.

4 Models based on outranking relations

Description:
The second approximation is more qualitative than quantitative. It is based on building a decision model with preference relations among a set of options.

4.1 Introduction
4.2 Outranking relations
4.3 ELECTRE

5 MCDA and AI

Description:
Use of MCDA in combination with other intelligent techniques can be applied in many different fields. Each course we study different lines according to the interests of the students. For example, MCDA in intelligent recommender systems, or in geographic information systems, or in web searchers, or electronic commerce, among others.

ACTIVITIES

Exam

Description:
Final exam with questions and exercices

Specific objectives:
1, 2, 3, 4, 5

Related competencies :
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.
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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.

CT7. ANALISIS Y SINTESIS: Capability to analyze and solve complex technical problems.

Full-or-part-time: 2h
Guided activities: 2h

Research report with an oral presentation

Description:
The student will make a survey on some topic, in group.The report is delivered to the teacher.
An oral presentation will be done at class.

Specific objectives:
1, 4, 5, 6

Related competencies :
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.
CEP3. Capacity for applying Artificial Intelligence techniques in technological and industrial environments to improve quality and productivity.
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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.

CT7. ANALISIS Y SINTESIS: Capability to analyze and solve complex technical problems.

Full-or-part-time: 22h
Self study: 20h
Guided activities: 2h

Solving practical exercices with software tools

Description:
The student will use a free software to solve some exercises.
Some of them will be reported in a short document delivered to the teacher.

Specific objectives:
1, 2, 3, 4, 5, 6

Related competencies :
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.
CEP3. Capacity for applying Artificial Intelligence techniques in technological and industrial environments to improve quality and productivity.
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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.

CT7. ANALISIS Y SINTESIS: Capability to analyze and solve complex technical problems.

Full-or-part-time: 11h
Self study: 9h 30m
Guided activities: 1h 30m

Lectures

Description:
The lecturer explains the theoretical conceps of the subject with examples.
Some complementary materials will be given to the students.

Specific objectives:
1, 2, 6

Related competencies :
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.
CEP3. Capacity for applying Artificial Intelligence techniques in technological and industrial environments to improve quality and productivity.
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.
CT7. ANALISIS Y SINTESIS: Capability to analyze and solve complex technical problems.

Full-or-part-time: 49h
Self study: 26h
Theory classes: 23h

Practical exercises at the computer lab

Description:
The student will use a free software to solve some exercises.
Some of them will be reported in a short document delivered to the teacher.

Specific objectives:
2, 3, 4, 5

Related competencies :
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.
CEP3. Capacity for applying Artificial Intelligence techniques in technological and industrial environments to improve quality and productivity.
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.

CT7. ANALISIS Y SINTESIS: Capability to analyze and solve complex technical problems.

Full-or-part-time: 24h
Self study: 12h
Laboratory classes: 12h

GRADING SYSTEM

Student must solve practical exercices with software tools 30%
Student must prepare a research report and make an oral presentation 30%
There is a final exam with short questions and exercises 40%

BIBLIOGRAPHY

Basic:
- Greco, S.; Ehrgott, M.; Figueira, J.R. Multiple criteria decision analysis: state of the art surveys. 2nd ed. New York: Springer, 2016. ISBN 9781493930944.
- Torra, V.; Narukawa, Y. Modeling decisions: information fusion and aggregation operators. Berlin: Springer, 2007. ISBN 9783540687894.
- Ishizaka, A.; Nemery, P. Multi-criteria decision analysis: methods and software. Chichester, West Sussex: John Wiley & Sons, 2013. ISBN 9781118644898.
- Doumpos, M.; Grigoroudis, E. (eds.). Multicriteria decision aid and artificial intelligence: links, theory and applications. Sussex, UK: John Wiley & Sons, 2013. ISBN 9781119976394.

RESOURCES

Hyperlink:
- http://www.cs.put.poznan.pl/ewgmcda/- http://www.informs.org/Community/MCDM- http://www.mcdmsociety.org