

Course guide

270721 - IDSS - Intelligent Decision Support Systems

Last modified: 21/07/2022

Unit in charge: Barcelona School of Informatics
Teaching unit: 715 - EIO - Department of Statistics and Operations Research.
723 - CS - Department of Computer Science.

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

Academic year: 2022 **ECTS Credits:** 4.5 **Languages:**

LECTURER

Coordinating lecturer: MIQUEL SANCHEZ MARRE

Others: Primer quadrimestre:
CARINA GIBERT OLIVERAS - 10
MIQUEL SANCHEZ MARRE - 10

PRIOR SKILLS

Fundamentals on Machine Learning and Artificial Intelligence.

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.

CEP8. Capability to respect the surrounding environment and design and develop sustainable intelligent systems.

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:

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.

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.

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.

CB7. Ability to integrate knowledges and handle the complexity of making judgments based on information which, being incomplete or limited, includes considerations on social and ethical responsibilities linked to the application of their knowledge and judgments.

TEACHING METHODOLOGY

The contents of the course will be exposed with the support of several case studies along the course. In the laboratory classes, the homework of the students (practical works) will be supervised by the teacher.



LEARNING OBJECTIVES OF THE SUBJECT

- 1.To provide students with the basic and necessary knowledge, in order that they could identify when a given domain is really a complex one
- 2.To identify how many and of which nature are the decisions involved in complex domains management
- 3.To know how to analyse, to design, to implement and to validate an Intelligent Decision Support Systems (IDSS), emphasising the integration of Artificial Intelligence models and Statistical/Numerical models, and the knowledge discovery from data.

STUDY LOAD

Type	Hours	Percentage
Hours large group	27,0	24.00
Self study	72,0	64.00
Hours small group	13,5	12.00

Total learning time: 112.5 h

CONTENTS

Introduction

Description:

Complexity of real-world systems or domains
The need of decision support tools

Decisions

Description:

Decision Theory
Modelling of Decision Process

Evolution of Decision Support Systems

Description:

Historical perspective of Management Information Systems
Decision Support Systems (DSS)
Advanced Decision Support Systems (ADSS)
Intelligent Decision Support Systems (IDSS)

Intelligent Decision Support Systems (IDSS)

Description:

IDSS Architecture
IDSS Analysis and Design
Requirements, advantages and drawbacks of IDSS
IDSS Validation
Implementation of an IDSS in a computer



Knowledge Discovery in a IDSS: from Data to Models

Description:

Introduccion
Data Structure
Data Filtering
Knowledge Models
- Descriptive models
- Associative models
- Discriminant Models
- Predictive models
Uncertainty Models
- Probabilistic models
- Fuzzy models

Post-Processing and Model Validation

Description:

Post-processing techniques
Validation
Statistical Methods for Hypotheses Verification

Tools and Applications

Description:

Software Tools for IDSS Development
Application of IDSS to real-world problems

Future Trends in IDSS and Conclusions

ACTIVITIES

INTRODUCTION TO THE COURSE: General view, Contents, Web page, Racó, Evaluation, Practical works, etc.

Full-or-part-time: 1h

Theory classes: 1h



INTRODUCTION TO THE IDSS: Complexity of Real-world Systems, Decision Theory.

Specific objectives:

1, 2

Related competencies :

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

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.

CB7. Ability to integrate knowledges and handle the complexity of making judgments based on information which, being incomplete or limited, includes considerations on social and ethical responsibilities linked to the application of their knowledge and judgments.

Full-or-part-time: 2h

Theory classes: 2h

PRESENTATION OF INDIVIDUAL PRACTICAL WORK 1 (PW1) and OF INDIVIDUAL PRACTICAL WORK 2 (PW2)

Specific objectives:

2, 3

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.

CEP8. Capability to respect the surrounding environment and design and develop sustainable intelligent systems.

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.

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.

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.

CB7. Ability to integrate knowledges and handle the complexity of making judgments based on information which, being incomplete or limited, includes considerations on social and ethical responsibilities linked to the application of their knowledge and judgments.

Full-or-part-time: 1h

Laboratory classes: 1h



PRESENTATION OF GROUP PRACTICAL WORK 3 (PW3). INTRODUCTION TO GESCONDA TOOL.

Specific objectives:

2, 3

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.

CEP8. Capability to respect the surrounding environment and design and develop sustainable intelligent systems.

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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Full-or-part-time: 2h

Laboratory classes: 2h

EVOLUTION OF DECISION SUPPORT SYSTEMS: Decision Support Systems (DSS) and Advanced Decision Support Systems (ADSS)

Specific objectives:

3

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.

CEP8. Capability to respect the surrounding environment and design and develop sustainable intelligent 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.

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: 1h

Theory classes: 1h



INTELLIGENT DECISION SUPPORT SYSTEMS (IDSS): architecture, analysis and design, implementation

Specific objectives:

3

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.

CEP8. Capability to respect the surrounding environment and design and develop sustainable intelligent 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.

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: 1h

Theory classes: 1h

Presentation of several Case Studies showing the design and development of IDSS

Specific objectives:

1, 2, 3

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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.

CEP8. Capability to respect the surrounding environment and design and develop sustainable intelligent systems.

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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CB7. Ability to integrate knowledges and handle the complexity of making judgments based on information which, being incomplete or limited, includes considerations on social and ethical responsibilities linked to the application of their knowledge and judgments.

Full-or-part-time: 15h

Theory classes: 15h



THE USE OF INTELLIGENT MODELS: Knowledge Discovery process.

Specific objectives:

3

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.

CEP8. Capability to respect the surrounding environment and design and develop sustainable intelligent 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.

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: 4h

Theory classes: 4h

PW3 supervision

Specific objectives:

1, 2, 3

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.

CEP8. Capability to respect the surrounding environment and design and develop sustainable intelligent systems.

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.

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.

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.

CB7. Ability to integrate knowledges and handle the complexity of making judgments based on information which, being incomplete or limited, includes considerations on social and ethical responsibilities linked to the application of their knowledge and judgments.

Full-or-part-time: 8h

Laboratory classes: 8h

FUTURE TRENDS IN IDSS

Specific objectives:

3

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.

CEP8. Capability to respect the surrounding environment and design and develop sustainable intelligent 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.

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: 2h

Theory classes: 2h

PW1 public presentation & discussion

Specific objectives:

1, 2

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.

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

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.

CB7. Ability to integrate knowledges and handle the complexity of making judgments based on information which, being incomplete or limited, includes considerations on social and ethical responsibilities linked to the application of their knowledge and judgments.

Full-or-part-time: 5h

Guided activities: 1h

Self study: 4h



PW2 public presentation & discussion

Specific objectives:

2, 3

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.

CEP8. Capability to respect the surrounding environment and design and develop sustainable intelligent systems.

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.

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.

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.

CB7. Ability to integrate knowledges and handle the complexity of making judgments based on information which, being incomplete or limited, includes considerations on social and ethical responsibilities linked to the application of their knowledge and judgments.

Full-or-part-time: 9h

Guided activities: 1h

Self study: 8h

PW3 public presentation & discussion

Specific objectives:

3

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.

CEP8. Capability to respect the surrounding environment and design and develop sustainable intelligent 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.

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: 61h 30m

Guided activities: 1h 30m

Self study: 60h

GRADING SYSTEM

Evaluation of the knowledge and skills obtained by the students will be assessed through the 3 practical Works. The final grade will be the weighted mean of the grade of each practical work:

$$\text{FinalGr} = 0.25*\text{PW1Gr} + 0.25*\text{PW2Gr} + 0.5*\text{PW3Gr} * \text{WFst}, \text{ where } 0 \leq \text{WFst} \leq 1.2$$

where WFst is a Working Factor evaluating the work of a particular student within his/her teamwork in PW3. It will be obtained by observing and assessing the load of work and degree of participation of each student throughout the PW3. In normal conditions, the WFst = 1

The PW1 will be evaluated by means of its quality and its justified explanation in the document. The PW2 will be evaluated according to its accuracy and completeness. The PW3 will be evaluated through the following formula:

$$\text{PW3Gr} = 0.4*\text{MetGr} + 0.2*\text{DocGr} + 0.2*\text{OrEGr} + 0.05*\text{TManGr} + 0.15*\text{IGr}$$

Where:

- MetGr: Grade for the quality of the methodology and work done, DocGr: Grade for the documentation delivered, OrEGr: Grade for the quality of the oral exposition (both presentation and content assessed, as well as the ability to answer questions), TManGr: Grade for the planning, coordination and management of the team, IGr: The individual evaluation of each student including her/his integration level within the team group.

This individual student grade (IGr) will be a mean between the teacher assessment of the student (TeachA) and the self-assessment of the student participation by the other members of the team (SelfA). Thus,

$$\text{IGr} = 0.5*\text{TeachA} + 0.5*\text{SelfA}$$

BIBLIOGRAPHY

Basic:

- Sánchez-Marrè, Miquel. Intelligent Decision Support Systems [on line]. Cham: Springer, 2022 [Consultation: 26/10/2022]. Available on: <https://link-springer-com.recursos.biblioteca.upc.edu/book/10.1007/978-3-030-87790-3>. ISBN 9783030877903.
- Dhar, V.; Stein, R. Intelligent decision support methods: the science of knowledge work. Prentice Hall, 1997. ISBN 0135199352.
- Marakas, G.M. Decision support systems in the 21st century. 2nd ed. Prentice-Hall, 2003. ISBN 013122848X.
- Sharda, R.; Delen, D.; Turban, E. Business intelligence and analytics: systems for decision support. Tenth edition, global edition. Pearson Education Limited, 2014. ISBN 9781292009261.
- Power, D.J. Decision support system : concepts and resources for managers. Quorum Books, 2002. ISBN 9781567204971.