Course guide
270721 - IDSS - Intelligent Decision Support Systems

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

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours large group</td>
<td>27,0</td>
<td>24.00</td>
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<tr>
<td>Hours small group</td>
<td>13,5</td>
<td>12.00</td>
</tr>
<tr>
<td>Self study</td>
<td>72,0</td>
<td>64.00</td>
</tr>
</tbody>
</table>

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:**
- Introduction
- 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:**
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.

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.

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:** 2h
Theory classes: 2h

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**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.

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

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.

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

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.

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.

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

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

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.
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.
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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.

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.
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.
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.

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

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.
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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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.
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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.

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.
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.
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.

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.
CEP3. Capacity for applying Artificial Intelligence techniques in technological and industrial environments to improve quality and productivity.
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.
CEP8. Capability to respect the surrounding environment and design and develop sustainable intelligent systems.
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.
CT7. ANALYSIS Y SYNTHESIS: 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.
CB7. Ability to integrate knowledge 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.
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: 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.

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.

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.

**Full-or-part-time:** 2h

Theory classes: 2h

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## 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.

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.

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:** 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.
CEP3. Capacity for applying Artificial Intelligence techniques in technological and industrial environments to improve quality and productivity.
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.
CEP8. Capability to respect the surrounding environment and design and develop sustainable intelligent systems.
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.

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.

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.
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: 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.
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.
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.

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:

\[ \text{FinalGr} = 0.25 \times \text{PW1Gr} + 0.25 \times \text{PW2Gr} + 0.5 \times \text{PW3Gr} \times \text{WFst}, \]

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:

\[ \text{PW3Gr} = 0.4 \times \text{MetGr} + 0.2 \times \text{DocGr} + 0.2 \times \text{OrEGr} + 0.05 \times \text{TManGr} + 0.15 \times \text{IGr} \]

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,

\[ \text{IGr} = 0.5 \times \text{TeachA} + 0.5 \times \text{SelfA} \]

BIBLIOGRAPHY

Basic: