480075 - Intelligent Sustainability Decision Support Systems

Coordinating unit: 250 - ETSECCPB - Barcelona School of Civil Engineering
Teaching unit: 715 - EIO - Department of Statistics and Operations Research
723 - CS - Department of Computer Science

Academic year: 2019
Degree: MASTER'S DEGREE IN SUSTAINABILITY SCIENCE AND TECHNOLOGY (Syllabus 2013). (Teaching unit Optional)
ECTS credits: 5

Teaching languages: English

Teaching staff

Coordinator: MIQUEL SÀNCHEZ MARRÈ
Others: Gibert Oliveras, Carina
Sanchez Marre, Miquel

Opening hours

Timetable: Send an email to the corresponding lecturer to set an appointment: miquel@cs.upc.edu, karina.gibert@upc.edu

Prior skills

Fundamentals of Statistics

Requirements

Fundamentals of Applied Statistics
Measure of Sustainability and Development

Degree competences to which the subject contributes

Specific:
CE29. The ability to design, develop, apply and assess conceptual frameworks, methods and techniques for modelling, simulating and assessing socio-environmental systems using complex networks, intelligent decision-making support systems and continuous models, for the promotion of sustainable development and sustainability.

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.
CT5. FOREIGN LANGUAGE: Achieving a level of spoken and written proficiency in a foreign language, preferably English, that meets the needs of the profession and the labour market.

Teaching methodology

MD1. Master class or conference (EXP): exposition of knowledge by teachers through master classes or by external people through invited conferences.
MD4. Guided Theoretical-practical work (TD): performing in the classroom an activity or exercise of a theoretical or practical nature, individually or in small groups, with the advice of the teacher.

Learning objectives of the subject
Decision making is a particularly complex activity in systems related with sustainability, including environmental systems, energy systems or sustainability policy making. A main issue of the course is to provide students with the basics to identify which kind of complexities are involved in the domain and which is the nature of the associated decisions. Intelligent decision support systems are complex software tools encompassing data and knowledge management to provide support to decision making, by combining analytics with artificial intelligence and visualization. The course is a perfect complement of the Socioenvironmental Data Science course as it permits to see data science processes inserted in a wider perspective of more complex systems that considers also expert knowledge and economical information to establish recommendations. However, the course is also suitable for students that do not have followed the Socioenvironmental Data Science course. Several ISDSS and recommenders will be explored related with different sustainability issues and global discussion on strengths and weaknesses of these systems will be followed along the course.

### Study load

<table>
<thead>
<tr>
<th>Total learning time: 125h</th>
<th>Hours large group:</th>
<th>19h 30m</th>
<th>15.60%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hours medium group:</td>
<td>9h 45m</td>
<td>7.80%</td>
</tr>
<tr>
<td></td>
<td>Hours small group:</td>
<td>9h 45m</td>
<td>7.80%</td>
</tr>
<tr>
<td></td>
<td>Guided activities:</td>
<td>6h</td>
<td>4.80%</td>
</tr>
<tr>
<td></td>
<td>Self study:</td>
<td>80h</td>
<td>64.00%</td>
</tr>
</tbody>
</table>
# 480075 - Intelligent Sustainability Decision Support Systems

## Content

| 1. Introduction and Decision Theory | Learning time: 9h  
Theory classes: 9h |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong></td>
<td></td>
</tr>
<tr>
<td>1.1. Introduction to Intelligent Decision Support Systems in Sustainability (ISDSS). Complexity of systems and need for decision support tools</td>
<td></td>
</tr>
<tr>
<td>1.2. Theory of the decision. Types of decisions. Modeling the decision process. Influence diagrams, decision trees.</td>
<td></td>
</tr>
</tbody>
</table>

| 2. Introduction of the Practical Works | Learning time: 2h  
Theory classes: 2h |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong></td>
<td></td>
</tr>
<tr>
<td>The 3 practical assignments to be done during the course will be presented, giving the needed information and the basic data for each of them.</td>
<td></td>
</tr>
</tbody>
</table>

| 3. Decision Support Systems (DSS) and Intelligent Decision Support Systems (IDSS) | Learning time: 4h  
Theory classes: 4h |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong></td>
<td></td>
</tr>
<tr>
<td>3.1 Historical Perspective of Decision Support Systems (DSS)</td>
<td></td>
</tr>
<tr>
<td>3.2 Intelligent Decision Support Systems (IDSS)</td>
<td></td>
</tr>
<tr>
<td>3.2.1 Typology</td>
<td></td>
</tr>
<tr>
<td>3.2.2 Conceptual components</td>
<td></td>
</tr>
<tr>
<td>3.2.3 Requirements and support provided</td>
<td></td>
</tr>
<tr>
<td>3.2.4 Validation</td>
<td></td>
</tr>
</tbody>
</table>

| 4. General IDSS Architectures | Learning time: 4h  
Theory classes: 4h |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong></td>
<td></td>
</tr>
<tr>
<td>4.1. Integrated hybrid framework (Poch et al., 2004)</td>
<td></td>
</tr>
<tr>
<td>4.2. Knowledge Modelling Framework (Oprea, 2018)</td>
<td></td>
</tr>
<tr>
<td>4.3. Spatio/Temporal phenomena Treatment</td>
<td></td>
</tr>
</tbody>
</table>
### 5. Presentation of illustrative ISDSS

**Description:**
- 5.1. MEDIU
- 5.2. GESCONDA
- 5.3. Other Systems

**Learning time:** 6h  
Theory classes: 6h

### 6. Comparative analysis of IDSS systems: strong and weak points in sustainability

**Description:**  
Critical analysis of the different architectures and systems studied in the previous topics regarding their suitability to support different types of decisions in sustainability

**Learning time:** 2h  
Theory classes: 2h

### 7. Design and analysis of cases

**Description:**  
Identify decisions in sustainability, susceptible to receive support through any of the systems seen throughout the course. Designing what use of the system would be necessary to obtain the required support information

**Learning time:** 2h  
Theory classes: 2h
480075 - Intelligent Sustainability Decision Support Systems

**Qualification system**

AV2. Oral proof of knowledge control (PO).
AV3. Work done individually or in group throughout the course (TR). It includes both the evaluation of results and reports, and the oral presentation of them.
AV4. Attendance and participation in classes and laboratories (AP).
AV5. Quality and performance of group work (TG).

The assessment will be done taking into account the qualifications of 3 practical works:

**PRAC1:** Practical Work 1 (individual) on the Decision Modelling Process in Sustainability
**PRAC2:** Practical Work 2 (individual) on Research on Intelligent Sustainability Decision Support Systems (ISDSS)
**PRAC3:** Practical Work 3 (in groups) on Identification of sustainability decisions that can be supported with an ISDSS system seen, planning the system's use to obtain the necessary support and analyze the results

Final Grade = 0.3 * NPR1 + 0.3 * NPR2 + 0.4 * alpha * NPR3

on

NPR1 = Grade from the PRAC1 = 0.4 * interest in the sustainability decision selected + 0.6 * quality of the decision model developed

NPR2 = Grade from PRAC2 = 0.3 * Identified system interest + 0.3 * Interest on the sustainability problem that is supported + 0.4 * Quality of the synthesis presented by the system

NPR3 = Grade from the PRAC3 = 0.4 * quality of the written document + 0.3 * quality of the oral presentation and discussion + 0.2 * individual performance shown in the laboratory sessions and participation in class

Alpha: Result of the cross-evaluation process of teamwork

**Regulations for carrying out activities**

PRAC1: Practical Work 1 will be done individually
PRAC2: Practical Work 2 will be done individually
PRAC3: Practical Work 3 will be done in teams
480075 - Intelligent Sustainability Decision Support Systems

Bibliography

Basic:


Complementary:


