270090 - SIM - Simulation

Coordinating unit: 270 - FIB - Barcelona School of Informatics
Teaching unit: 715 - EIO - Department of Statistics and Operations Research
Academic year: 2016
Degree: BACHELOR'S DEGREE IN INFORMatics ENGINEERING (Syllabus 2010). (Teaching unit Optional)
ECTS credits: 6
Teaching languages: Catalan

Teaching staff

Coordinator: - Josep Casanovas Garcia (josep@fib.upc.edu)
- Pau Fonseca Casas (pau@fib.upc.edu)
Others: - Cristina Montañola Sales (cristina.montanola@upc.edu)

Prior skills

Statistics.

Requirements

- Prerequisite PE

Degree competences to which the subject contributes

Specific:

CES1.1. To develop, maintain and evaluate complex and/or critical software systems and services.

CES2.2. To design adequate solutions in one or more application domains, using software engineering methods which integrate ethical, social, legal and economical aspects.

CT2.1. To demonstrate knowledge and capacity to apply the principles, methodologies and life cycles of software engineering.

CT2.4. To demonstrate knowledge and capacity to apply the needed tools for storage, processing and access to the information system, even if they are web-based systems.

Generical:

G2. SUSTAINABILITY AND SOCIAL COMPROMISE: to know and understand the complexity of the economic and social phenomena typical of the welfare society. To be capable of analyse and evaluate the social and environmental impact.

G3. THIRD LANGUAGE: to know the English language in a correct oral and written level, and accordingly to the needs of the graduates in Informatics Engineering. Capacity to work in a multidisciplinary group and in a multi-language environment and to communicate, orally and in a written way, knowledge, procedures, results and ideas related to the technical informatics engineer profession.

G9. PROPER THINKING HABITS: capacity of critical, logical and mathematical reasoning. Capacity to solve problems in her study area. Abstraction capacity: capacity to create and use models that reflect real situations. Capacity to design and perform simple experiments and analyse and interpret its results. Analysis, synthesis and evaluation capacity.

Teaching methodology

The course is practical and that students want, from a set of deliverables that are developed in the laboratory is able, at the end of the course to conduct a simulation project.

Learning objectives of the subject

The course is practical and that students want, from a set of deliverables that are developed in the laboratory is able, at the end of the course to conduct a simulation project.
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1. Being able to write a technical article in English.
2. Ability to lead a consulting project.
3. Ability to develop a system of discrete simulation.

**Study load**

<table>
<thead>
<tr>
<th></th>
<th>Total learning time: 150h</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours large group:</td>
<td>30h</td>
</tr>
<tr>
<td>Hours medium group:</td>
<td>0h</td>
</tr>
<tr>
<td>Hours small group:</td>
<td>30h</td>
</tr>
<tr>
<td>Guided activities:</td>
<td>3h</td>
</tr>
<tr>
<td>Self study:</td>
<td>87h</td>
</tr>
</tbody>
</table>

**Percentage Breakdown:**

- Hours large group: 20.00%
- Hours medium group: 0.00%
- Hours small group: 20.00%
- Guided activities: 2.00%
- Self study: 58.00%
## Content

### Introduction

**Degree competences to which the content contributes:**

**Description:**
Examples of systems, which is a model?. Relationship between the different technological and economic sectors, especially in the field of computing, services, production and logistics.

### Methodologies

**Degree competences to which the content contributes:**

**Description:**
Methodologies for the construction of discrete simulation models

### Simulation languages for discrete systems

**Degree competences to which the content contributes:**

**Description:**
Typology of Languages for the construction of discrete simulation models. Adjustment of the languages to the models. Examples of simulation systems (GPSs, JGPSS, Arena, Simi, Witness, SDLPS).

### The data in the simulation.

**Degree competences to which the content contributes:**

**Description:**
Analysis of the data input of the simulation. Information available. Level of detail. Criteria for the credibility of the data.

### Design of experiments and analysis of simulation results.

**Degree competences to which the content contributes:**

**Description:**

### Verification and validation of simulation models.

**Degree competences to which the content contributes:**
New paradigms in simulation.

Degree competences to which the content contributes:

Description:

The simulation of continuous processes.

Degree competences to which the content contributes:

Description:

Formal Languages

Degree competences to which the content contributes:

Description:
Advantages of the separation between the model and the model implementation. Presentation of different formal languages used to define simulation models.

Monte Carlo methods and sampling process in simulation.

Degree competences to which the content contributes:

Description:
# Planning of activities

<table>
<thead>
<tr>
<th>Activity</th>
<th>Hours</th>
<th>Description</th>
<th>Specific objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Theory session, introduction.</strong></td>
<td>10h</td>
<td>Introduction to the course, examples of systems and models. History review.</td>
<td>3</td>
</tr>
<tr>
<td><strong>Basics of simulation.</strong></td>
<td>16h</td>
<td>This activity works the fundamental concepts of the subject. It is essential to achieve the objectives of the course.</td>
<td>2, 3</td>
</tr>
<tr>
<td><strong>Formalization of simulation models</strong></td>
<td>36h</td>
<td>In this activity you will learn how to formally represent simulation models.</td>
<td>2, 3</td>
</tr>
<tr>
<td><strong>Writing an article on the simulation Wiki</strong></td>
<td>11h</td>
<td>Write an article in English on the course Wiki.</td>
<td></td>
</tr>
</tbody>
</table>
## Design of experiments

**Specific objectives:**

1.

**Description:**

Once we have successfully implemented the simulator model and it is validated by the client we must establish a protocol to use it. Here we will try the more general aspects of how to develop this operation.

**Specific objectives:**

2.

**Hours:** 7h  
- Theory classes: 2h  
- Practical classes: 0h  
- Laboratory classes: 2h  
- Guided activities: 0h  
- Self study: 3h

### Validation and verification of simulation models

**Specific objectives:**

2, 3

**Description:**

This activity will describe the most common techniques to verify and validate simulation models.

**Hours:** 7h  
- Theory classes: 2h  
- Practical classes: 0h  
- Laboratory classes: 2h  
- Guided activities: 0h  
- Self study: 3h

### Discrete simulation languages

**Specific objectives:**

2

**Description:**

Giving an overview of the major languages of discrete simulation on the market.

**Hours:** 19h  
- Theory classes: 2h  
- Practical classes: 0h  
- Laboratory classes: 2h  
- Guided activities: 0h  
- Self study: 15h
### The random from the viewpoint of the simulation

**Description:**
The main mechanisms to represent randomness are proposed in order to generate probability distributions required to represent the simulation models.

**Specific objectives:**
3

<table>
<thead>
<tr>
<th>Hours</th>
<th>Theory classes</th>
<th>Practical classes</th>
<th>Laboratory classes</th>
<th>Guided activities</th>
<th>Self study</th>
</tr>
</thead>
<tbody>
<tr>
<td>7h</td>
<td>2h</td>
<td>0h</td>
<td>2h</td>
<td>0h</td>
<td>3h</td>
</tr>
</tbody>
</table>

### Social and environmental simulation

**Description:**
This activity describes the main mechanisms that exist in order to define social and environmental simulation models.

**Specific objectives:**
3

<table>
<thead>
<tr>
<th>Hours</th>
<th>Theory classes</th>
<th>Practical classes</th>
<th>Laboratory classes</th>
<th>Guided activities</th>
<th>Self study</th>
</tr>
</thead>
<tbody>
<tr>
<td>11h</td>
<td>4h</td>
<td>0h</td>
<td>4h</td>
<td>0h</td>
<td>3h</td>
</tr>
</tbody>
</table>

### New paradigms for discrete simulation

**Description:**
This activity emphasizes the techniques that can be used in order to implement simulation models (industrial, social or environmental) in distributed systems architectures or high performance.

<table>
<thead>
<tr>
<th>Hours</th>
<th>Theory classes</th>
<th>Practical classes</th>
<th>Laboratory classes</th>
<th>Guided activities</th>
<th>Self study</th>
</tr>
</thead>
<tbody>
<tr>
<td>5h</td>
<td>2h</td>
<td>0h</td>
<td>0h</td>
<td>0h</td>
<td>3h</td>
</tr>
</tbody>
</table>

### Writing the final report

<table>
<thead>
<tr>
<th>Hours</th>
<th>Theory classes</th>
<th>Practical classes</th>
<th>Laboratory classes</th>
<th>Guided activities</th>
<th>Self study</th>
</tr>
</thead>
<tbody>
<tr>
<td>7h 30m</td>
<td>0h</td>
<td>0h</td>
<td>0h</td>
<td>1h 30m</td>
<td>6h</td>
</tr>
</tbody>
</table>
Final Exam

**Description:**
Final exam for the course.

**Specific objectives:**
2, 3

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**Qualification system**

Final mark: $0.3 \times 0.5 \times T1 + T2 + 0.2 \times \text{Test}$.

T1: average of two practical works that assessed the ability of model with a simulation tool.

T2: average of different practical works related to a single simulation project.

Test: At the end of the course.

The qualification of "not presented" is awarded when the student participated in a number of acts of evaluation that have as a whole, no more weigh than 20% of the final grade.
Bibliography

Basic:


Others resources:

Hyperlink

http://www.wintersim.org/  

http://www.modelingforeveryone.com/  

http://www.acm-sigsim-mskr.org/  

http://creative-automata.com/  

https://plus.google.com/communities/101706154509075557846  

http://www.simuleng.com/