Course guide
270673 - SV - Scientific Visualization

Unit in charge: Barcelona School of Informatics
Teaching unit: 723 - CS - Department of Computer Science.
Degree: MASTER'S DEGREE IN INNOVATION AND RESEARCH IN INFORMATICS (Syllabus 2012). (Optional subject).
Academic year: 2022  ECTS Credits: 6.0  Languages: English

LECTURER
Coordinating lecturer: PERE PAU VÁZQUEZ ALCOCER
Others: Primer quadrimestre:
IMANOL MUÑOZ PANDIELLA - 10
PERE PAU VÁZQUEZ ALCOCER - 10

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CEE1.1. Capability to understand and know how to apply current and future technologies for the design and evaluation of interactive
graphic applications in three dimensions, either when prioritizing image quality or when prioritizing interactivity and speed, and to
understand the associated commitments and the reasons that cause them.
CEE1.3. Ability to integrate the technologies mentioned in CEE1.2 and CEE1.1 skills with other digital processing information
technologies to build new applications as well as make significant contributions in multidisciplinary teams using computer graphics.

Generical:
CG3. Capacity for mathematical modeling, calculation and experimental designing in technology and companies engineering centers,
particularly in research and innovation in all areas of Computer Science.

Transversal:
CTR1. ENTREPRENEURSHIP AND INNOVATION: Capacity for knowing and understanding a business organization and the science that
rules its activity, capability to understand the labour rules and the relationships between planning, industrial and commercial
strategies, quality and profit. Capacity for developing creativity, entrepreneurship and innovation trend.
CTR4. INFORMATION LITERACY: Capability to manage the acquisition, structuring, analysis and visualization of data and information
in the area of informatics engineering, and critically assess the results of this effort.

TEACHING METHODOLOGY
The professor provides theoretical lectures where the most important concepts are introduced; moreover supplement material will be
provided.
During the laboratory class, the students will receive the guidelines for the analysis and implementation of their programming
assignments and will have time to work in their assignments with the teacher supervision when needed.

LEARNING OBJECTIVES OF THE SUBJECT
1.By the end of the course, students should be able to know the main concepts behind visualization and representation of volume
models in scientific applications (mainly in medical applications). More specifically they will be able to understand and program
algorithms for:
STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours small group</td>
<td>24,0</td>
<td>16.00</td>
</tr>
<tr>
<td>Self study</td>
<td>96,0</td>
<td>64.00</td>
</tr>
<tr>
<td>Guided activities</td>
<td>6,0</td>
<td>4.00</td>
</tr>
<tr>
<td>Hours large group</td>
<td>24,0</td>
<td>16.00</td>
</tr>
</tbody>
</table>

Total learning time: 150 h

CONTENTS

**Introduction to Visualization. Perception in Visualization**

Description:
Basic concepts of visualization: goals, tasks, users.
Elements of perception and its application in Visualization: pre-attentive variables, visual channels...

**Multi-dimensional data visualization**

Description:
Techniques for visualization of multiple-dimensional data.

**Multiple Views Visualization**

Description:
Multiple Views. Common designs, examples, analysis of advantages and inconvenients.

**Molecular visualization**

Description:
Introduction to Molecular Visualization: motivation, data, and rendering algorithms.

**GPU-based Volume Rendering**

Description:
Presentation of the main algorithms of direct volume rendering, including 3D textures and ray-casting. Transfer functions. GPU-based ray-casting.

**Advanced Scientific Visualization Techniques**

Description:
Introduction to Molecular Visualization: motivation, data, and rendering algorithms.
Introduction to DTI rendering: data, applications, measures, algorithms.
**ACTIVITIES**

**Lectures**

**Description:**
Material will be presented in lectures along the term. You are expected to conduct complementary readings to be presented at a later date or turned in.

**Full-or-part-time:** 60h  
Theory classes: 30h  
Self study: 30h

**Implementation of selected algorithms**

**Description:**
A selection of relevant algorithms will be assigned to implement in Lab sessions and on your own, in VTK and C++. You may be required to present your solution in class.

**Full-or-part-time:** 60h  
Laboratory classes: 15h  
Self study: 45h

**Lab project(s)**

**Description:**
The students will have to complete a lab project that includes two or more practical works that consist in implementing some of the techniques developed in the lectures. This project will be either be presented and discussed at a later date or turned in for grading.

**Full-or-part-time:** 23h  
Laboratory classes: 3h  
Self study: 20h

**Final Exam**

**Description:**
At the end of the term, the students will have a final exam, which may be a take-home.

**GRADING SYSTEM**

The students will be marked for their attendance and participation in class (including the presentation of papers and their discussion), yielding a mark “Paper”.

Another grade will stem from the student’s implementations of selected algorithms (which may include the presentation of their solution in a laboratory class), yielding a mark "Lab".

Finally, students will receive a third mark based on their performance in the final exam, yielding "Exam".

The final grade for the course will be computed as:

\[
\text{Final Grade} = 0.2 \text{ Paper} + 0.6 \text{ Lab} + 0.2 \text{ Exam}
\]


BIBLIOGRAPHY

Basic:

Complementary:

RESOURCES

Hyperlink: