240IBI32 - Medical Images

**Coordinating unit:** 240 - ETSEIB - Barcelona School of Industrial Engineering  
**Teaching unit:** 723 - CS - Department of Computer Science  
**Academic year:** 2017  
**Degree:** MASTER'S DEGREE IN INDUSTRIAL ENGINEERING (Syllabus 2014). (Teaching unit Optional)  
**ECTS credits:** 4,5  
**Teaching languages:** English

**Teaching staff**

**Coordinator:** DANIELA TOST PARDELL

**Opening hours**

**Timetable:** On appointment by e-mail (dani@cs.upc.edu) o in-person

**Prior skills**

Capacity of searching bibliography  
Initiative to carry on projects  
Skills in ICT  
Hability to schedule and plan work

**Requirements**

Skills in computer science, specifically programming (python)

**Degree competences to which the subject contributes**

**Specific:**

CEMEI16. Ability for the research management, development and technological innovation.

CEEAUT4. Apply vision techniques by computer, shape recognition and merging of multi-sensorial data in automated production systems.

CEEBI03. Identify and extract information of interest in the biomedical signs.

CEEBI04. Know how to apply the main methods which most of the treatment projects offer, analysis and visualization of medical images.

**Teaching methodology**

In this subject, a strong component of personal work is expected from students. In the theoretical sessions, the teacher will expose the needed concepts, give bibliographic references and present the corresponding works. In the lab sessions students will develop their requested work.

**Learning objectives of the subject**

To introduce students into the representation, visualisation and analysis of 2D ans 3D biomedical images: images characteristics, representation models image file formats, visualisation through surface extraction and direct volume visualization, and image analysis and processing.

At the end of the curs, we expect students to be able to construct a volumetric model, to visualise it, to extract and visualise selected iso-surfaces and to apply analysis methodologies. Therefore, they have to learn images characteristics.
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and file formats; the fundamentals of volume visualization including the ray-tracing method as well as to edit transfer functions in order to obtain illustrative images; methods for surface extraction as Marching Cubes and for visualising the corresponding surfaces.

Students are also expected to work with existing applications such as Slicer and/or Paraview and also to devise their own applications using VTK and ITK libraries.

<table>
<thead>
<tr>
<th>Study load</th>
<th>Total learning time: 112h 30m</th>
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</thead>
<tbody>
<tr>
<td>Hours large group:</td>
<td>27h</td>
</tr>
<tr>
<td>Hours small group:</td>
<td>13h 30m</td>
</tr>
<tr>
<td>Guided activities:</td>
<td>0h</td>
</tr>
<tr>
<td>Self study:</td>
<td>72h</td>
</tr>
</tbody>
</table>

- Hours large group: 27h (24.00%)
- Hours small group: 13h 30m (12.00%)
- Guided activities: 0h (0.00%)
- Self study: 72h (64.00%)
## Content

### Introduction

<table>
<thead>
<tr>
<th>Description:</th>
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</table>
| 1) Origins  
2) Acquisition methods  
3) Perspective  
4) 2D images  
5) 3D images  
6) Data and applications |

**Learning time:** 3h  
Theory classes: 3h

### Graphical interfaces

<table>
<thead>
<tr>
<th>Description:</th>
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<tbody>
<tr>
<td>Introduction to graphical user interfaces. Graphic area, menu, panel.</td>
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**Related activities:**  
Implementation of the project's GUI

<table>
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<tr>
<th>Learning time: 26h</th>
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</table>
| Theory classes: 5h  
Laboratory classes: 3h  
Self study: 18h |

### Medical Images

<table>
<thead>
<tr>
<th>Description:</th>
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| Medical Image Representation  
Creation of a medical image  
Reading of a medical image  
Filtering processing  
Analysis  
Segmentation |

<table>
<thead>
<tr>
<th>Specific objectives:</th>
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| Learn to create a medical image, read it and know how to interpret its content  
Know the basics of image processing and know how to apply filtering techniques using high-level libraries and applications  
Know the basics of image analysis and know how to apply segmentation techniques using high-level libraries and applications |

<table>
<thead>
<tr>
<th>Learning time: 25h 30m</th>
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</table>
| Theory classes: 5h  
Laboratory classes: 3h 30m  
Self study: 17h |

For each topic a test will be requested during the next theoretic session and a lab work will be delivered. There will be 3 tests (NTi, i= 1...3) and 3 lab works (NLi, i= 1...3). Besides, each student will have to realize a work of integration and extension of the lab work, and present it orally (NP). The final mark will be computed as: 
\[ NF = \sum (NTi \times 0.15 + NLi \times 0.1) + NP \times 0.25 \] for i= 1...3
Students who have obtained a score of less than 5 may attend the final exam of January 25, which will be theoretical and practical and will cover all the subjects of the course.


Bibliography

Complementary:


Others resources:

Papers of the following jounals (to spacificy):
- IEEE Transactions on Visualization and Computer Graphics
- ACM Computer Graphics
- Computer Graphics Forum
- Computers & Graphics

Computer applications:
- 3D Slicer: www.slicer.org/
- itk: www.itk.org
- vtk: www.vtk.org

Audiovisual material

Nom recurs

Resource