



## IDENTIFYING DATA

### (\*)Tecnoloxías de imaxe médica

|                     |   |           |      |            |
|---------------------|---|-----------|------|------------|
| Subject             | (*)Tecnoloxías de imaxe médica  |           |      |            |
| Code                | V04M192V01301   |           |      |            |
| Study programme     | Máster Universitario en Ingeniería Biomédica                                  |           |      |            |
| Descriptors         | ECTS Credits  | Choose    | Year | Quadmester |
|                     | 4.5   | Mandatory | 2nd  | 1st        |
| Teaching language   | #EnglishFriendly<br>Spanish<br>Galician                                       |           |      |            |
| Department          |   |           |      |            |
| Coordinator         | Martín Rodríguez, Fernando  |           |      |            |
| Lecturers           | Martín Rodríguez, Fernando  |           |      |            |
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| General description |   |           |      |            |

## Training and Learning Results

|      |  |
|------|--|
| Code |  |
| A3   | That students are able to integrate knowledge and handle complexity and formulate judgments based on information that was incomplete or limited, include reflecting on social and ethical responsibilities linked to the application of their knowledge and judgments. |
| A5   | Students must possess the learning skills that enable them to continue studying in a way that will be largely self-directed or autonomous.   |
| B3   | Knowledge in basic and technological subjects that will enable students to learn new methods and theories, and provide them the versatility to adapt to new situations.  |
| B6   | Capacity for handling specifications, regulations and mandatory standards.   |
| C7   | Knowledge and ability to apply lead generation principles radiation, radiation-matter interaction and ultrasound.  |

## Expected results from this subject

| Expected results from this subject   | Training and Learning Results                           |
|--|---|
| Specify, compare, evaluate and operate commercial systems of acquisition, storage, exchange and processed of medical images. | A3<br>B13<br>B13<br>B6<br>C15<br>C15<br>C7<br>C15<br>D4 |

|  |   |
|--|---|
| Implement simple systems for medical image processing.                                       | A3<br>A5<br>B13<br>B13<br>B3<br>B13<br>B13<br>B13<br>B13<br>C15<br>C15<br>C7<br>C15<br>D4<br>D4<br>D4 |
| Specify, direct and evaluate the development of complex systems of medical image processing. | A3<br>B6<br>C15<br>C15<br>C15<br>C15<br>C7<br>C15<br>C15<br>D4<br>D4<br>D4                            |

## Contents

| Topic                         |  |
|-------------------------------|--|
| Medical imaging fundamentals. | - Ultrasound (ultrasound), digital radiography, computed tomography, magnetic resonance, PET.<br>- Medical image formats (and medical information standards): DICOM, HL7.  |
| Medical images processing.    | - Image transforms: 2D Fourier transform (application in MRI), Radon transform (application in CT).<br>- Filtering and restoration of images.<br>- Segmentation methods and application of unsupervised learning techniques (machine learning).<br>- Other processing techniques.  |
| Practical contents.           | - Working with free tools for visualization (using real medical studies). Examples: MicroDicom, Invesalius, 3D-slicer.<br>- Practical case 1: small image processing project using classical techniques. Examples: digitalization of scanned ECG's, compression of 3D medical studies using 3D-DCT...<br>- Practical case 2: small image processing project using machine learning (ML) techniques. Examples: help in the diagnosis of breast cancer in mammographies using CNN's (deep learning), detection of pneumonia in digital chest X-rays. |

## Planning

|   | Class hours | Hours outside the classroom | Total hours |
|---|-------------|-----------------------------|-------------|
| Lecturing   | 16          | 26                          | 42          |
| Problem solving                                       | 8           | 15                          | 23          |
| Practices through ICT                                 | 14          | 26                          | 40          |
| Report of practices, practicum and external practices | 0.5         | 1                           | 1.5         |
| Report of practices, practicum and external practices | 0.5         | 4                           | 4.5         |
| Essay questions exam                                  | 1.5         | 0                           | 1.5         |

\*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

## Methodologies

|                 | Description   |
|-----------------|---|
| Lecturing       | Contents of the course are presented by lecturer, encouraging the critical discussion of the concepts. The theoretical bases of algorithms and procedures used in the practical part are established. |
| Problem solving | Working in practical cases. Discussion about decision making in real projects. Calculations.  |

Practices through ICT Small projects are presented. The student must obtain the appropriate solution in a reasoned way, correctly choosing the applicable methods and reaching a valid solution.

## Personalized assistance

| Methodologies   | Description  |
|---|--|
| Lecturing   | Answering questions in class and tutorials, if necessary.<br><a href="https://www.uvigo.gal/es/universidad/administracion-personal/pdi/fernando-martin-rodriguez">https://www.uvigo.gal/es/universidad/administracion-personal/pdi/fernando-martin-rodriguez</a>                             |
| Problem solving                                       | Answering questions in class and tutorials, if necessary.<br><a href="https://www.uvigo.gal/es/universidad/administracion-personal/pdi/fernando-martin-rodriguez">https://www.uvigo.gal/es/universidad/administracion-personal/pdi/fernando-martin-rodriguez</a>                             |
| Practices through ICT                                 |  |
| Tests   | Description  |
| Report of practices, practicum and external practices | On-site help and, if necessary, tutorial by appointment. Query and answer via e-mail.<br><a href="https://www.uvigo.gal/es/universidad/administracion-personal/pdi/fernando-martin-rodriguez">https://www.uvigo.gal/es/universidad/administracion-personal/pdi/fernando-martin-rodriguez</a> |
| Report of practices, practicum and external practices | On-site help and, if necessary, tutorial by appointment. Query and answer via e-mail.<br><a href="https://www.uvigo.gal/es/universidad/administracion-personal/pdi/fernando-martin-rodriguez">https://www.uvigo.gal/es/universidad/administracion-personal/pdi/fernando-martin-rodriguez</a> |
| Essay questions exam                                  | Clarifications during the exam, if necessary.  |

## Assessment

|   | Description  | Qualification | Training and Learning Results |          |    |
|---|--|---------------|-------------------------------|----------|----|
| Report of practices, practicum and external practices | Report of the first proposed project. Medical image processing problem of low-medium difficulty.                                 | 25            | A3<br>A5                      | B3       | C7 |
| Report of practices, practicum and external practices | Report of the second proposed project. Medical image processing problem of medium-high difficulty.                               | 35            | A3<br>A5                      | B3       | C7 |
| Essay questions exam                                  | Questions about theory and practical work done. Practical questions about the course. Practical case studies, decision making... | 40            | A5                            | B3<br>B6 | C7 |

## Other comments on the Evaluation

There is the option of global evaluation. The decision made the same day of the final exam by signing a resignation of the qualifications of the practical deliverables. In that case it is necessary to answer a set of extra questions of a practical nature.

The extraordinary call works equally as the ordinary one.

## Sources of information

### Basic Bibliography

Paul Suetens, **Fundamentals of Medical Imaging**, 9780511596803, 2, CAMBRIDGE UNIVERSITY PRESS, 2009

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### Complementary Bibliography

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R. Nick Bryan Ed., **Introduction to the Science of Medical Imaging**, 9780521747622, 1, CAMBRIDGE UNIVERSITY PRESS, 2010

Krzysztof Iniewski Ed., **MEDICAL IMAGING Principles, Detectors, and Electronics**, 9780470391648, 1, Wiley, 2009

W.R. Hendee, E.R. Ritenour, **Medical Imaging Physics**, 9780471382263, 4, Wiley, 2002

N.A. Diakides, J.D. Bronzino, **Medical Infrared Imaging**, 9780849390272, 1, CRC Press, 2007

Xujing Yao et al., **A comprehensive survey on convolutional neural network in medical image analysis**, 10.1007/s11042-020-09634-7, Vol 81 (8), Springer-Nature, 2020

D.R. Sarvamangala, Raghavendra V. Kulkarni, **Convolutional neural networks in medical image understanding: a survey**, 10.1007/s12065-020-00540-3, PubMed, 2022

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**Recommendations**