



## Teaching Guide

| Teaching Guide           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |        |                                    |           |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|------------------------------------|-----------|
| Identifying Data         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |        | 2020/21                            |           |
| Subject (*)              | Advanced Machine Learning for Computer Vision                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Code   |                                    | 614535008 |
| Study programme          | Máster Universitario en Visión por Computador                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |        |                                    |           |
| Descriptors              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |        |                                    |           |
| Cycle                    | Period                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Year   | Type                               | Credits   |
| Official Master's Degree | 2nd four-month period                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | First  | Obligatory                         | 6         |
| Language                 | English                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |        |                                    |           |
| Teaching method          | Hybrid                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |        |                                    |           |
| Prerequisites            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |        |                                    |           |
| Department               | Ciencias da Computación e Tecnoloxías da Información                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |        |                                    |           |
| Coordinador              | Rouco Maseda, Jose                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | E-mail | jose.rouco@udc.es                  |           |
| Lecturers                | Novo Bujan, Jorge<br>Rouco Maseda, Jose                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | E-mail | j.novo@udc.es<br>jose.rouco@udc.es |           |
| Web                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |        |                                    |           |
| General description      | The objective of this subject is to know and apply advanced neural models, to know the techniques of the state of the art of deep learning, with end-to-end training approaches, and minimizing the use of tagged data, to solve computer vision applications using the methodologies covered in the subject.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |        |                                    |           |
| Contingency plan         | <p>1. Modifications to the contents</p> <p>No change</p> <p>2. Methodologies</p> <p>All activities are maintained. The teaching will be online and the lessons will take place synchronously in the official schedule of classes. It may be that, for reasons of inconvenience, some of the classes will be held asynchronously, which will be communicated to the students in advance.</p> <p>3. Mechanisms for personalized attention to students</p> <p>The tutorials will be telematic and will require an appointment.</p> <p>4. Modifications in the evaluation</p> <p>No change in the evaluation. Evaluation activities that cannot be carried out in person will be carried out telematically through the institutional tools in Office 365 and Moodle. In this case, a series of validation measures will be required, which will require the students to have a device with a microphone and a camera, while appropriate validation software is not available. An interview may be arranged with each student to comment on or explain part or all of the tests carried out. In these scenarios, some of the activities under each heading may be modified, adapting them to the situation, but not their overall contribution to the final grade (the weighting percentage)</p> <p>5. Modifications to the bibliography or webgraphy</p> <p>No change</p> |        |                                    |           |

## Study programme competences

| Code | Study programme competences                                                                            |
|------|--------------------------------------------------------------------------------------------------------|
| A2   | CE2 - To know and apply machine learning and pattern recognition techniques applied to computer vision |



|     |                                                                                                                                                                                                           |
|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| B1  | CB6 - To possess and understand knowledge that provides a basis or opportunity to be original in the development and/or application of ideas, often in a research context                                 |
| B2  | CB7 - That students are able to apply their acquired knowledge and problem-solving skills in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their area of study |
| B5  | CB10 - That students possess the learning skills to enable them to continue studying in a largely self-directed or autonomous manner                                                                      |
| B6  | CG1 - Ability to analyze and synthesize knowledge                                                                                                                                                         |
| B8  | CG3 - Ability to develop computer vision systems depending on existing needs and apply the most appropriate technological tools                                                                           |
| B10 | CG5 - Ability to identify unsolved problems and provide innovative solutions                                                                                                                              |
| B11 | CG6 - Ability to identify theoretical results or new technologies with innovative potential and convert them into products and services useful to society                                                 |
| C1  | CT1 - Practice the profession with a clear awareness of its human, economic, legal and ethical dimensions and with a clear commitment to quality and continuous improvement                               |
| C2  | CT2 - Ability to work as a team, organize and plan                                                                                                                                                        |

| Learning outcomes                                                                                             |                             |                                                 |            |
|---------------------------------------------------------------------------------------------------------------|-----------------------------|-------------------------------------------------|------------|
| Learning outcomes                                                                                             | Study programme competences |                                                 |            |
| To know, apply and evaluate advanced neural models.                                                           | AC2                         | BC1<br>BC2<br>BC5<br>BC6<br>BC8<br>BC10<br>BC11 | CC1<br>CC2 |
| To know deep learning techniques, with end-to-end training approaches, and minimizing the use of tagged data. | AC2                         | BC1<br>BC2<br>BC5<br>BC6<br>BC8<br>BC10<br>BC11 | CC1<br>CC2 |
| To solve computer vision applications using advanced machine learning methods.                                | AC2                         | BC1<br>BC2<br>BC5<br>BC6<br>BC8<br>BC10<br>BC11 | CC1<br>CC2 |

| Contents                                                |           |
|---------------------------------------------------------|-----------|
| Topic                                                   | Sub-topic |
| Multilayer perception and backpropagation.              |           |
| Convolutional and recurrent networks                    |           |
| Principles of deep learning                             |           |
| Self-supervised learning and autoencoders               |           |
| Advanced neural models for computer vision.             |           |
| Advanced supervised learning paradigms                  |           |
| Selected topics in machine learning for computer vision |           |
| Advanced applications in computer vision.               |           |



## Planning

| Methodologies / tests          | Competencies                       | Ordinary class hours | Student?s personal work hours | Total hours |
|--------------------------------|------------------------------------|----------------------|-------------------------------|-------------|
| Guest lecture / keynote speech | A2 B1 B2 B5 B6 B8<br>B10 B11 C2 C1 | 10                   | 20                            | 30          |
| Case study                     | A2 B1 B2 B5 B6 B8<br>B10 B11 C1 C2 | 4                    | 16                            | 20          |
| Objective test                 | A2 B1 B2 B5 B6 B8<br>B10 B11 C1 C2 | 2                    | 0                             | 2           |
| Laboratory practice            | A2 B1 B2 B5 B6 B8<br>B10 B11 C1 C2 | 16                   | 32                            | 48          |
| Research (Research project)    | A2 B1 B2 B5 B6 B8<br>B10 B11 C2 C1 | 10                   | 40                            | 50          |
| Personalized attention         |                                    | 0                    | 0                             | 0           |

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

## Methodologies

| Methodologies                  | Description                                                                                                                                                                                                                                                                                                          |
|--------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Guest lecture / keynote speech | Participatory lessons with the aim of learning the theoretical content of the subject                                                                                                                                                                                                                                |
| Case study                     | Elaboration and presentation of selected state-of-the-art methodologies related to the subject.                                                                                                                                                                                                                      |
| Objective test                 | Continuous evaluation tests during the course. Evaluation by examination at the end of the course as an alternative.                                                                                                                                                                                                 |
| Laboratory practice            | Analysis and resolution of practical cases with the aim of strengthening the practical application of the theoretical content. Practice in computer classrooms, learning based on the resolution of practical cases, autonomous work and independent study of the students, and group work and cooperative learning. |
| Research (Research project)    | Learning based on the resolution of practical cases, autonomous work and independent study of the students, and group work and cooperative learning.                                                                                                                                                                 |

## Personalized attention

| Methodologies                                                    | Description                                                                                                             |
|------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| Research (Research project)<br>Case study<br>Laboratory practice | < br>Resolution of doubts during laboratory practices. Individualized advice during research projects and case studies. |

## Assessment

| Methodologies               | Competencies                       | Description                                                                                                                                            | Qualification |
|-----------------------------|------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| Research (Research project) | A2 B1 B2 B5 B6 B8<br>B10 B11 C2 C1 | Resolution of practical cases of application of the subject through autonomous work of the student, and using the techniques learned during the course | 20            |
| Case study                  | A2 B1 B2 B5 B6 B8<br>B10 B11 C1 C2 | Elaboration and presentation of works on selected state-of-the-art methodologies                                                                       | 15            |
| Laboratory practice         | A2 B1 B2 B5 B6 B8<br>B10 B11 C1 C2 | Analysis and resolution of practical cases with the aim of strengthening the practical application of theoretical content                              | 40            |
| Objective test              | A2 B1 B2 B5 B6 B8<br>B10 B11 C1 C2 | Continuous evaluation tests during the course. Evaluation by examination at the end of the course as an alternative                                    | 25            |

## Assessment comments

The evaluation corresponding to the objective test may be passed by means of the tests scheduled during the course or by means of the final exam.



## Sources of information

|               |                                                                                                                                                                                                                           |
|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Basic         |                                                                                                                                                                                                                           |
| Complementary | Ian Goodfellow, Yoshua Bengio, Aaron Courville. Deep Learning. MIT Press. 2017. Artigos recentes en revistas e conferencias científicas relevantes: NIPS, ICML, IJCAI, AAAI, ECML, CVPR, ICDM, IEEE PAMI, IEEE TKDE, etc. |

## Recommendations

### Subjects that it is recommended to have taken before

Fundamentals of Machine Learning for Computer Vision /614535007

Image Description and Modeling/614535004

### Subjects that are recommended to be taken simultaneously

Visual Recognition/614535005

### Subjects that continue the syllabus

### Other comments

(\*)The teaching guide is the document in which the URV publishes the information about all its courses. It is a public document and cannot be modified. Only in exceptional cases can it be revised by the competent agent or duly revised so that it is in line with current legislation.