

# ANX-PR/CL/001-01

## LEARNING GUIDE

### SUBJECT

**103000367 - Ontological Engineering**

### DEGREE PROGRAMME

**10AJ - Master Universitario En Inteligencia Artificial**

### ACADEMIC YEAR & SEMESTER

**2023/24 - Semester 1**

## Index

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### Learning guide

|                                                         |    |
|---------------------------------------------------------|----|
| 1. Description.....                                     | 1  |
| 2. Faculty.....                                         | 1  |
| 3. Prior knowledge recommended to take the subject..... | 2  |
| 4. Skills and learning outcomes .....                   | 2  |
| 5. Brief description of the subject and syllabus.....   | 4  |
| 6. Schedule.....                                        | 6  |
| 7. Activities and assessment criteria.....              | 8  |
| 8. Teaching resources.....                              | 10 |
| 9. Other information.....                               | 11 |

## 1. Description

### 1.1. Subject details

|                                       |                                                          |
|---------------------------------------|----------------------------------------------------------|
| <b>Name of the subject</b>            | 103000367 - Ontological Engineering                      |
| <b>No of credits</b>                  | 5 ECTS                                                   |
| <b>Type</b>                           | Optional                                                 |
| <b>Academic year of the programme</b> | First year                                               |
| <b>Semester of tuition</b>            | Semester 1                                               |
| <b>Tuition period</b>                 | September-January                                        |
| <b>Tuition languages</b>              | English                                                  |
| <b>Degree programme</b>               | 10AJ - Master Universitario en Inteligencia Artificial   |
| <b>Centre</b>                         | 10 - Escuela Técnica Superior De Ingenieros Informáticos |
| <b>Academic year</b>                  | 2023-24                                                  |

## 2. Faculty

### 2.1. Faculty members with subject teaching role

| <b>Name and surname</b>                      | <b>Office/Room</b> | <b>Email</b>                 | <b>Tutoring hours *</b> |
|----------------------------------------------|--------------------|------------------------------|-------------------------|
| Maria Poveda Villalon                        |                    | m.poveda@upm.es              | Sin horario.            |
| Oscar Corcho Garcia<br>(Subject coordinator) | 2209               | oscar.corcho@upm.es          | Tu - 10:00 - 20:00      |
| Asuncion De Maria Gomez<br>Perez             | 2211               | asunciondemaria.gomez@upm.es | Sin horario.            |

\* The tutoring schedule is indicative and subject to possible changes. Please check tutoring times with the faculty member in charge.

### 3. Prior knowledge recommended to take the subject

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#### 3.1. Recommended (passed) subjects

The subject - recommended (passed), are not defined.

#### 3.2. Other recommended learning outcomes

- Web technologies
- First order logic
- Basic knowledge representation

### 4. Skills and learning outcomes \*

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#### 4.1. Skills to be learned

CB10 - Que los estudiantes posean las habilidades de aprendizaje que les permitan continuar estudiando de un modo que habrá de ser en gran medida autodirigido o autónomo.

CEIA1 - Capacidad de integrar tecnologías y sistemas propios de la Inteligencia Artificial, con carácter generalista, y en contextos más amplios y multidisciplinares

CEIA2 - Capacidad de conectar la tecnología puntera en Inteligencia Artificial con las necesidades de los clientes

CG13 - Apreciación de los límites del conocimiento actual y de la aplicación práctica de la tecnología más reciente.

CG18 - Capacidad de trabajar y comunicarse también en contextos internacionales

CGI1 - Adquirir conocimientos científicos avanzados del campo de la informática que le permitan generar nuevas ideas dentro de una línea de investigación.

CGI2 - Comprender el procedimiento, valor y límites del método científico en el campo de la Informática, siendo capaz de identificar, localizar y obtener datos requeridos en un trabajo de investigación, de diseñar y guiar investigaciones analíticas, de modelado y experimentales, así como de evaluar datos de una manera crítica y extraer conclusiones.

CGI3 - Capacidad para valorar la importancia de las fuentes documentales, manejarlas y buscar la información para el desarrollo de cualquier trabajo de investigación.

CGI4 - Capacidad de leer y comprender publicaciones dentro de su ámbito de estudio/investigación, así como su catalogación y valor científico.

## 4.2. Learning outcomes

RA60 - Ser capaz de construir ontologías consensuadas reutilizando recursos ontológicos y no ontológicos en entornos colaborativos

RA64 - Ser capaz de manejar fuentes bibliográficas y valorar su importancia para desarrollar trabajos escritos innovadores o que reflejen el estado del arte en ontologías

RA59 - Ser capaz de identificar y resolver tipos de problemas en el mundo real a los que se pueda aplicar con éxito las ontologías

RA62 - Ser capaz de identificar las limitaciones de los lenguajes, técnicas, métodos y metodologías identificando posibles áreas de mejora

RA63 - Ser capaz de integrar ontologías en otros sistemas software

RA61 - Ser capaz de conocer los diferentes lenguajes, técnicas, métodos y metodologías que permiten la construcción de ontologías de forma colaborativa en entornos distribuidos

\* The Learning Guides should reflect the Skills and Learning Outcomes in the same way as indicated in the Degree Verification Memory. For this reason, they have not been translated into English and appear in Spanish.

## 5. Brief description of the subject and syllabus

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### 5.1. Brief description of the subject

The aim of this course is to discuss on the scientific, methodological and technological foundations that need to be considered when building ontologies. In particular, sessions in this course will cover:

- The concepts of ontologies and ontology-based annotations in the context of the Semantic Web, the Web of Linked Data and Knowledge Graphs
- Theoretical foundations in ontology development
- Descriptions of some of the most widely-known ontologies and ontology catalogues
- Ontology languages, such as RDF Schema and OWL, as well as vocabularies to represent taxonomies, such as SKOS
- Methodologies, methods, techniques and tools used in ontology development, including requirements specification, planning, conceptualisation, reuse, reengineering, etc.
- Ontology governance processes inside and across organisations
- Relevant applications of ontologies.

Throughout the entire course open research problems will be presented and discussed collaboratively for each subtopic.

### 5.2. Syllabus

#### 1. Introducción a la ingeniería ontológica - Introduction to Ontological Engineering

##### 1.1. Presentación de la asignatura - General introduction to the course

##### 1.2. Fundamentos - Foundations

#### 2. Lenguajes básicos de representación de ontologías y taxonomías - Basic ontology and taxonomy representation languages

##### 2.1. RDF Schema

##### 2.2. SKOS

#### 3. Metodología de desarrollo y lenguajes más ricos de representación de ontologías - Ontology development methodologies and richer languages

##### 3.1. Fundamentos teóricos - Theoretical foundations

##### 3.2. Metodología y técnicas para el desarrollo de ontologías - Ontology development methods and techniques

3.3. Ontologías y lógica descriptiva: OWL - Ontologies and Description Logics: OWL

3.4. Herramientas para el desarrollo, documentación y evaluación de ontologías - Ontology development, documentation and evaluation tools

4. Gobernanza de Ontologías - Ontology Governance

## 6. Schedule

### 6.1. Subject schedule\*

| Week | Classroom activities                                                                                                                                                           | Laboratory activities                                                                                | Distant / On-line | Assessment activities                                                                                                                                                                                                |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | <b>Clases teóricas del tema 1 - Lectures lesson 1</b><br>Duration: 02:00<br>Lecture<br><br><b>Clases teóricas del tema 2 - Lectures lesson 2</b><br>Duration: 02:00<br>Lecture |                                                                                                      |                   |                                                                                                                                                                                                                      |
| 2    | <b>Clases teóricas del tema 2 - Lectures lesson 2</b><br>Duration: 02:00<br>Lecture<br><br><b>Clases teóricas del tema 2 - Lectures lesson 2</b><br>Duration: 02:00<br>Lecture |                                                                                                      |                   |                                                                                                                                                                                                                      |
| 3    | <b>Clases teóricas del tema 3 - Lectures lesson 3</b><br>Duration: 02:00<br>Lecture                                                                                            | <b>Clases prácticas del tema 3 - Hands-on session 3</b><br>Duration: 02:00<br>Laboratory assignments |                   | <b>Entrega del trabajo de RDF Schema y SKOS Submission of the RDF Schema and SKOS assignment</b><br>Individual work<br>Continuous assessment<br>Not Presential<br>Duration: 00:00                                    |
| 4    | <b>Clases teóricas del tema 3 - Lectures lesson 3</b><br>Duration: 02:00<br>Lecture                                                                                            | <b>Clases prácticas del tema 3 - Hands-on session 3</b><br>Duration: 02:00<br>Laboratory assignments |                   |                                                                                                                                                                                                                      |
| 5    | <b>Clases teóricas del tema 3 - Lectures lesson 3</b><br>Duration: 02:00<br>Lecture                                                                                            | <b>Clases prácticas del tema 3 - Hands-on session 3</b><br>Duration: 02:00<br>Laboratory assignments |                   |                                                                                                                                                                                                                      |
| 6    | <b>Clases teóricas del tema 3 - Lectures lesson 3</b><br>Duration: 02:00<br>Lecture                                                                                            | <b>Clases prácticas del tema 3 - Hands-on session 3</b><br>Duration: 02:00<br>Laboratory assignments |                   | <b>Entrega del trabajo sobre el estado del arte o trabajo de investigación. Submission on the state of the art or research work</b><br>Individual work<br>Continuous assessment<br>Not Presential<br>Duration: 00:00 |
| 7    | <b>Clases teóricas del tema 3 - Lectures lesson 3</b><br>Duration: 02:00<br>Lecture                                                                                            | <b>Clases prácticas del tema 4 - Hands-on session 4</b><br>Duration: 02:00<br>Laboratory assignments |                   |                                                                                                                                                                                                                      |

|    |                                                                                                                                                                                             |  |  |                                                                                                                                                                                                                                                                                  |
|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8  | <b>Clases teóricas del tema 3 - Lectures lesson 3</b><br>Duration: 02:00<br>Lecture<br><br><b>Tutorías en grupo / Group-based help sessions</b><br>Duration: 10:00<br>Additional activities |  |  | <b>Entrega y presentación oral del trabajo de Ontologías. Submission and oral presentation of the Ontology Engineering assignment</b><br>Group presentation<br>Continuous assessment<br>Presential<br>Duration: 02:00                                                            |
| 9  |                                                                                                                                                                                             |  |  |                                                                                                                                                                                                                                                                                  |
| 10 |                                                                                                                                                                                             |  |  |                                                                                                                                                                                                                                                                                  |
| 11 |                                                                                                                                                                                             |  |  |                                                                                                                                                                                                                                                                                  |
| 12 |                                                                                                                                                                                             |  |  |                                                                                                                                                                                                                                                                                  |
| 13 |                                                                                                                                                                                             |  |  |                                                                                                                                                                                                                                                                                  |
| 14 |                                                                                                                                                                                             |  |  |                                                                                                                                                                                                                                                                                  |
| 15 |                                                                                                                                                                                             |  |  |                                                                                                                                                                                                                                                                                  |
| 16 |                                                                                                                                                                                             |  |  |                                                                                                                                                                                                                                                                                  |
| 17 |                                                                                                                                                                                             |  |  | <b>Trabajo individual: ontología (60% de la nota) y trabajo individual de estado del arte o de investigación (40%). Individual work: ontology (60%) and state-of-the-art or research work (40%)</b><br>Individual work<br>Final examination<br>Not Presential<br>Duration: 00:00 |

Depending on the programme study plan, total values will be calculated according to the ECTS credit unit as 26/27 hours of student face-to-face contact and independent study time.

\* The schedule is based on an a priori planning of the subject; it might be modified during the academic year, especially considering the COVID19 evolution.

## 7. Activities and assessment criteria

### 7.1. Assessment activities

#### 7.1.1. Assessment

| Week | Description                                                                                                                       | Modality           | Type          | Duration | Weight | Minimum grade | Evaluated skills                     |
|------|-----------------------------------------------------------------------------------------------------------------------------------|--------------------|---------------|----------|--------|---------------|--------------------------------------|
| 3    | Entrega del trabajo de RDF Schema y SKOS<br>Submission of the RDF Schema and SKOS assignment                                      | Individual work    | No Presential | 00:00    | 20%    | 5 / 10        | CGI2                                 |
| 6    | Entrega del trabajo sobre el estado del arte o trabajo de investigación.<br>Submission on the state of the art or research work   | Individual work    | No Presential | 00:00    | 35%    | 0 / 10        | CB10<br>CG13<br>CGI1<br>CGI3<br>CGI4 |
| 8    | Entrega y presentación oral del trabajo de Ontologías.<br>Submission and oral presentation of the Ontology Engineering assignment | Group presentation | Face-to-face  | 02:00    | 45%    | 5 / 10        | CG18<br>CGI1<br>CEIA1<br>CEIA2       |

#### 7.1.2. Global examination

| Week | Description                                                                                                                                                                                     | Modality        | Type          | Duration | Weight | Minimum grade | Evaluated skills                                                       |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|---------------|----------|--------|---------------|------------------------------------------------------------------------|
| 17   | Trabajo individual: ontología (60% de la nota) y trabajo individual de estado del arte o de investigación (40%).<br>Individual work: ontology (60%) and state-of-the-art or research work (40%) | Individual work | No Presential | 00:00    | 100%   | 5 / 10        | CG18<br>CB10<br>CG13<br>CGI1<br>CGI2<br>CEIA1<br>CEIA2<br>CGI3<br>CGI4 |

#### 7.1.3. Referred (re-sit) examination

| Description                                                                                                                                                                                  | Modality        | Type         | Duration | Weight | Minimum grade | Evaluated skills                                                       |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|--------------|----------|--------|---------------|------------------------------------------------------------------------|
| Trabajo individual: ontología (60% de la nota) y trabajo individual de estado del arte o de investigación (40%). Individual work: ontology (60%) and state-of-the-art or research work (40%) | Individual work | Face-to-face | 00:00    | 100%   | 5 / 10        | CG18<br>CB10<br>CG13<br>CGI1<br>CGI2<br>CEIA1<br>CEIA2<br>CGI3<br>CGI4 |

## 7.2. Assessment criteria

The final mark will be calculated as a weighted sum of the following items:

- The result of the assignment about RDF Schema and SKOS. This work will have a weight of 20%.
- The written documentation and oral presentation of the work on ontologies. This work will have a weight of 45%.
- The written documentation of the individual work on the state of the art or a research topic related to the topics of the course. Research and/or innovation aspects will be especially taken into account. This work will have a weight of 35%.

If the student opts out the continuous evaluation, the mark will be calculated as a weighted sum of the written documentation on the work of ontologies (60%) and the state-of-the-art/research work (40%).

La calificación vendrá dada a partir de la evaluación de:

- El resultado de la entrega del trabajo de RDF Schema y SKOS. Este trabajo tendrá un peso del 20%.
- La documentación escrita y presentación oral del trabajo de Ontologías. Este trabajo tendrá un peso del 45%.
- La documentación escrita, presentada de forma individual, sobre un estado del arte o algún tema de investigación relacionado con la asignatura. Se valorará especialmente el aspecto investigador o innovador. Este trabajo tendrá un peso del 35%.

Si el estudiante opta por la evaluación final, la calificación vendrá determinada por la evaluación del trabajo escrito sobre ontologías (60%) y el trabajo sobre el estado del arte o tópico de investigación (40%)

## 8. Teaching resources

### 8.1. Teaching resources for the subject

| Name                                                                                                                                                    | Type         | Notes                                         |
|---------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-----------------------------------------------|
| A.Gómez-Pérez, M. Fernández, O. Corcho. Ontological Engineering. Ed Springer, 2003                                                                      | Bibliography |                                               |
| Allemang D, Hendler J. Semantic Web for the Working Ontologist: Effective Modeling in RDFS and OWL. Morgan Kaufmann. 2008                               | Bibliography |                                               |
| MC. Suarez-Figueroa, A. Gómez-Pérez, E. Motta, A. Gangemi. Ontology Engineering in a Networked World?. Springer 2012.                                   | Bibliography |                                               |
| <a href="http://moodle.upm.es/titulaciones/ofic_iales/course/view.php?id=4897">http://moodle.upm.es/titulaciones/ofic_iales/course/view.php?id=4897</a> | Web resource |                                               |
| <a href="http://www.neon-project.org/">http://www.neon-project.org/</a>                                                                                 | Web resource | NeOn EU project, which contains the NeOn book |
| <a href="http://www.w3.org/TR/rdf-schema/">http://www.w3.org/TR/rdf-schema/</a>                                                                         | Bibliography | W3C RDF Schema Recommendation                 |
| <a href="https://www.w3.org/TR/owl2-syntax/">https://www.w3.org/TR/owl2-syntax/</a>                                                                     | Bibliography | W3C OWL2 Recommendation                       |
| <a href="https://www.w3.org/TR/skos-reference/">https://www.w3.org/TR/skos-reference/</a>                                                               | Web resource | W3C SKOS Recommendation                       |

## 9. Other information

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### 9.1. Other information about the subject

The activities in the course will be organised on the moodle platform. All materials will be made available in this platform, and all assignments and other submissions will need to be done there.

The topics in which ontologies will be developed vary from edition to edition of the course, depending on the interests of students, but the most common ones are related to open data and transparency for cities (ODS11 and ODS16) and open data and transparency for universities (ODS4 and ODS16).