



INTERNATIONAL
CAMPUS OF
EXCELLENCE

COORDINATION PROCESS OF
LEARNING ACTIVITIES
PR/CL/001



E.T.S. de Ingenieros
Informáticos

ANX-PR/CL/001-01

LEARNING GUIDE

SUBJECT

105001069 - Developing Open, Interoperable Semantic Resources

DEGREE PROGRAMME

10II - Grado En Ingenieria Informatica

ACADEMIC YEAR & SEMESTER

2025/26 - Semester 2

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Learning guide

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1. Description

1.1. Subject details

| | |
|---------------------------------------|---|
| Name of the subject | 105001069 - Developing Open, Interoperable Semantic Resources |
| No of credits | 3 ECTS |
| Type | Optional/elective |
| Academic year of the programme | Fourth year |
| Semester of tuition | Semester 8 |
| Tuition period | February-June |
| Tuition languages | English |
| Degree programme | 10II - Grado en Ingeniería Informática |
| Centre | 10 - E.T.S. De Ingenieros Informáticos |
| Academic year | 2025-26 |

2. Faculty

2.1. Faculty members with subject teaching role

| Name and surname | Office/Room | Email | Tutoring hours * |
|--|--------------------|----------------------|-------------------------|
| Maria Poveda Villalon (Subject coordinator) | | m.poveda@upm.es | -- |
| Daniel Garijo Verdejo | D3205 | daniel.garijo@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. Skills and learning outcomes *

3.1. Skills to be learned

CG-24/25/26/27 - Capacidad para trabajar en el contexto internacional, comunicándose en lengua inglesa y adaptándose a un nuevo entorno.

Ce 53/54 - Capacidad para trabajar de forma efectiva como individuo, organizando y planificando su propio trabajo, de forma independiente o como miembro de un equipo.

3.2. Learning outcomes

RA245 - Aplicar técnicas para representar conocimientos.

RA246 - Aplicar técnicas de inferencia.

RA580 - Capacidad para identificar distintos tipos de recursos semánticos adecuados para representación del conocimiento en distintos escenarios.

RA582 - Capacidad para crear grafos de conocimiento de recursos semánticos y resultados de investigación.

RA574 - Capacidad para aplicar los principios FAIR a los recursos semánticos

RA581 - Ser capaz de utilizar los diferentes lenguajes, técnicas, métodos y metodologías que permiten la construcción de ontologías y de datos de la Web Semántica

RA571 - Capacidad para leer, comprender e implementar recomendaciones y estándares (por ejemplo, del consorcio de. World Wide Web (W3C))

RA572 - Comprender los principios de los datos FAIR

RA573 - Comprender la relación entre los principios FAIR y la publicación de recursos semánticos en la web semántica

RA575 - Capacidad para describir metadatos y provenance para recursos semánticos en formatos estructurados.

RA576 - Ser capaz de generar datos en el formato utilizado en la Web Semántica y en la Web de Linked Data, y de publicarlos para su uso por terceros

RA577 - Comprender los conceptos de web semántica y recursos semánticos

RA578 - Capacidad para describir e identificar distintos tipos de recursos semánticos

RA579 - Capacidad para leer, comprender e implementar artículos científicos

* 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.

4. Brief description of the subject and syllabus

4.1. Brief description of the subject

The objective of this course is for students to learn the fundamentals of open science, specifically the principles of FAIR data publishing (Findability, Accessibility, Interoperability, and Reusability) and their application to semantic resources. The course will include theoretical and methodological knowledge on techniques for generating, publishing, and validating semantic resources, selecting, generating, and validating metadata, and reusing semantic resources. Additionally, the course will address the importance of reproducibility in data semantization processes and knowledge graph generation.

This course will build upon knowledge acquired in the subjects "Artificial Intelligence," "Semantic Web, Linked Data, and Knowledge Graphs," and "Intelligent Systems."

El objetivo de esta asignatura es que los estudiantes aprendan los fundamentos de la ciencia abierta y en concreto los principios de publicación de datos FAIR (Findability, Accessibility, Interoperability, and Reusability) y su aplicación a los recursos semánticos. El curso incluirá conocimientos teóricos y metodológicos sobre técnicas de generación, publicación y validación de recursos semánticos, selección, generación y validación de metadatos y reutilización de recursos semánticos. Además, el curso abordará la importancia de la reproducibilidad en procesos de semantización de datos y generación de grafos de conocimiento.

Este curso ampliará el conocimiento aprendido en las asignaturas "Inteligencia artificial", "Web semántica, datos enlazados y grafos de conocimiento" y "Sistemas Inteligentes".

4.2. Syllabus

1. Introduction to Ontology Engineering and Semantic Resources
 - 1.1. Course presentation
 - 1.2. Motivation and fundamentals
2. Semantic resources
 - 2.1. Terminologies, Taxonomies, and Knowledge Organization Systems
 - 2.2. Ontologies and vocabularies
3. Ontology implementation languages
 - 3.1. RDF(S)
 - 3.2. OWL
 - 3.3. SKOS
 - 3.4. Generation of Semantic Resources: Methods and Tools
 - 3.5. Semantic artifact registries and indexes
 - 3.6. Semantic resources selection
4. FAIR principles
 - 4.1. Ciencia abierta y principios FAIR
 - 4.2. Adaptación de principios FAIR a recursos semánticos
 - 4.3. Vocabularios existentes para la anotación de recursos semánticos
 - 4.4. Buenas prácticas para la documentación y publicación de vocabularios
5. Knowledge graphs over semantic resources
 - 5.1. Knowledge graphs over semantic resources generation
 - 5.2. Transforming, Integrating, and Exploiting Knowledge Graph Data

5. Schedule

5.1. Subject schedule*

| Week | Type 1 activities | Type 2 activities | Distant / On-line | Assessment activities |
|------|--|-------------------|-------------------|-----------------------|
| 1 | Lesson about topic 1 Duration: 02:00 Lecture | | | |
| 2 | Lesson about topic 2 Duration: 00:00 Lecture | | | |
| 3 | Lesson about topic 3 (RDFS) Duration: 02:00 Inverted classroom | | | |
| 4 | Lesson about topic 3 (OWL y SKOS) Duration: 02:00 Lecture | | | |
| 5 | Lesson about topic 3 (Generación y herramientas) Duration: 02:00 Lecture | | | |
| 6 | Lesson about topic 3 (Herramientas y selección) Duration: 02:00 Lecture | | | |
| 7 | Hands-on lesson about topic 3 Duration: 02:00 Laboratory assignments | | | |
| 8 | Lesson about topic 4 (FAIR principles) Duration: 02:00 Inverted classroom | | | |
| 9 | Lesson about topic 4 (FAIR y recursos semánticos) Duration: 02:00 Lecture | | | |
| 10 | Clase del tema 4 (FAIR y uso de vocabularios) Duration: 02:00 Lecture | | | |
| 11 | Hands-on about 5: knowledge graph (práctico I) Duration: 02:00 Laboratory assignments | | | |
| 12 | Hands-on about 5: knowledge graph (práctico I) Duration: 02:00 Laboratory assignments | | | |

| | | | | |
|----|--|--|--|---|
| 13 | Problems and doubts resolution Duration: 02:00 Laboratory assignments | | | |
| 14 | Problems and doubts resolution Duration: 02:00 Laboratory assignments | | | |
| 15 | Problems and doubts resolution Duration: 02:00 Laboratory assignments | | | |
| 16 | | | | <p>Email submission of the FAIR semantic resources assignment with examples of linked data. + Final project presentation (if done in groups, each student?s presentation may be graded individually). Group presentation Progressive assessment Presential Duration: 02:00</p> <p>Partial assignment average (minimum 2) Group work Progressive assessment Not Presential Duration: 00:00</p> |
| 17 | | | | <p>Submission of a written final project and presentation describing the development of a semantic resource, the application of FAIR principles to it, and the associated knowledge graph. Individual presentation Global examination Presential Duration: 00:00</p> |

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.

6. Activities and assessment criteria

6.1. Assessment activities

6.1.1. Assessment

| Week | Description | Modality | Type | Duration | Weight | Minimum grade | Evaluated skills |
|------|--|--------------------|---------------|----------|--------|---------------|----------------------------|
| 16 | Email submission of the FAIR semantic resources assignment with examples of linked data. + Final project presentation (if done in groups, each student's presentation may be graded individually). | Group presentation | Face-to-face | 02:00 | 60% | 5 / 10 | CG-24/25/26/27 Ce 53/54 |
| 16 | Partial assignment average (minimum 2) | Group work | No Presential | 00:00 | 40% | 5 / 10 | Ce 53/54 |

6.1.2. Global examination

| Week | Description | Modality | Type | Duration | Weight | Minimum grade | Evaluated skills |
|------|---|-------------------------|--------------|----------|--------|---------------|----------------------------|
| 17 | Submission of a written final project and presentation describing the development of a semantic resource, the application of FAIR principles to it, and the associated knowledge graph. | Individual presentation | Face-to-face | 00:00 | 100% | 5 / 10 | CG-24/25/26/27 Ce 53/54 |

6.1.3. Referred (re-sit) examination

No se ha definido la evaluación extraordinaria.

6.2. Assessment criteria

Assessment will be based on the completion of intermediate assignments (both individual and group-based) and a final project either as a group (for progressive assessment) or individually (for global assessment) related to the course content and presented in class for evaluation.

The project will consist of the development of a semantic resource and the application of FAIR principles to it, as well as the generation of a knowledge graph describing the resource.

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La evaluación se basará en el desarrollo de prácticas intermedias (individuales y en grupo) y un proyecto en grupo (para evaluación progresiva) o individual (para evaluación global) relacionado con los contenidos de la asignatura y su presentación en clase, para su evaluación.

El trabajo consistirá en el desarrollo de un recurso semántico y la aplicación de principios FAIR sobre el mismo así como la generación del grafo de conocimiento describiendo el recurso.

7. Teaching resources

7.1. Teaching resources for the subject

| Name | Type | Notes |
|--|--------------|---|
| Wilkinson, M., Dumontier, M., Aalbersberg, I. et al. The FAIR Guiding Principles for scientific data management and stewardship. Sci Data 3, 160018 (2016) | Bibliography | https://doi.org/10.1038/sdata.2016.18 |
| Poveda-Villalón, M., Fernández-Izquierdo, A., Fernández-López, M., & García-Castro, R. (2022). LOT: An industrial oriented ontology engineering framework. Engineering | Bibliography | https://doi.org/10.1016/j.engappai.2022.104755 |

| | | |
|--|--------------|---|
| Applications of Artificial Intelligence, 111, 104755. | | |
| RDF(S) | Web resource | http://www.w3.org/TR/rdf-schema/ |
| OWL | Web resource | http://www.w3.org/2004/OWL/ |
| SKOS Simple Knowledge Organization System Reference | Web resource | http://www.w3.org/TR/skos-reference |
| Poveda-Villalón, M., Espinoza-Arias, P., Garijo, D., Corcho, O. (2020). Coming to Terms with FAIR Ontologies. In: Keet, C.M., Dumontier, M. (eds) Knowledge Engineering and Knowledge Management. EKAW 2020. | Bibliography | https://doi.org/10.1007/978-3-030-61244-3_18 |
| Best Practices for Implementing FAIR Vocabularies and Ontologies on the Web Daniel Garijo, María Poveda-Villalón | Bibliography | https://arxiv.org/abs/2003.13084 |

8. Other information

8.1. Other information about the subject

Course activities will be organized on the Moodle platform. All materials will be made available through this platform.

Emails will be answered and questions will be addressed via teleconferencing systems or in person during scheduled tutorial hours.

The specific topics of the semantic resources developed may vary across different editions of the course, depending on students' interests. However, the most common topics are often related to quality education (SDG 4),

industry, innovation and infrastructure (SDG 9), sustainable cities and communities (SDG 11), among others.

Educational innovation techniques such as "learning by doing" and selected "flipped classroom" sessions will be used.

Las actividades del curso se organizarán en la plataforma moodle. Todos los materiales se pondrán disponibles en dicha plataforma.

Se responderán emails y se resolverán dudas, usando sistemas de teleconferencia o presencial, en los horarios de tutorías.

La temática concreta de los recursos semánticos generados puede variar en las distintas ediciones de la asignatura, dependiendo del interés de los estudiantes, pero los temas más comunes podrían estar relacionados con educación de calidad (ODS4), industria, innovación e infraestructura (ODS9), ciudades y comunidades sostenibles (ODS10), entre otros.

Se utilizarán técnicas de innovación educativa como "learning by doing" y algunas sesiones de "flipped classroom"