COURSE TEACHING PLAN OF KNOWLEDGE ENGINEERING

Academic Year: 2024-25

Basic course details				
Code	401082		ECTS Credits	6
Name	Knowledge Engineering / Ingeniería del Conocimiento			
Degrees	Master in Computer Engineering			
Centre	School of Technology (Escuela Politécnica)			
Semester	2nd	Character	Basic studies	
Module	Computer technologies module			
Material	Advanced computer technologies			

Lectures			
Name	Office	Email	Web page
Adolfo Lozano Tello	40	alozano@unex.es	https://uex.be/mbm88
Encarna Sosa Sánchez	10	esosa@unex.es	https://uex.be/2fnwj
Óscar Mogollón Gutierrez	GIM	oscarmg@unex.es	https://uex.be/srzcs

Subject Area	Computer languages and systems
Department	Engineering of Computer and Telematic Systems
Coordinating lecturer	Adolfo Lozano Tello

Competencies

Basic competencies

CB6 - Knowledge and understanding that provide a basis or opportunity for originality in developing and / or applying ideas, often in a research context.

CB9 – Skills to communicate conclusions, and the knowledge and rationale underpinning these, to specialized and non-specialized audiences in a clear and unambiguous manner.

CB10 - Learning skills that enable to continue studying in a way that will be largely self-directed or autonomous.

General competencies

CG4 - Capacity for mathematical modeling, calculation and simulation in technological centers and engineering of company, particularly in research, development and innovation tasks in all fields related to Informatics Engineering.

CG8 - Ability to apply acquired knowledge and solve problems in new or little-known environments within broader and multi-disciplinary contexts, being able to integrate this knowledge.

Specific competencies

CETI9 - Ability to apply mathematical, statistical and artificial intelligence methods to model, design and develop applications, services, intelligent systems and systems based on knowledge.

Cross-curricular competencies

CT13 - Ability to integrate knowledge and face the complexity of formulating opinions from incomplete or limited information.

Course content

Brief description of course content

The subject includes the methods and techniques for the development of

knowledge-based systems throughout the its life cycle. This includes the methods of opportunity analysis of application of the problems where Knowledge Engineering can be used, and the formal methods to design knowledge-based systems through Knowledge Engineering. The techniques of knowledge-based systems representation are studied in linked open data formats.

Syllabus

Topic 1: Introduction to Knowledge Engineering. Knowledge acquisition techniques.
Contents of topic 1: Basic definitions and fundamental concepts of Knowledge Engineering. Methodologies of Knowledge Engineering.
Practical works: none.

Topic 2: Formalisms for the representation of knowledge.
Contents of topic 2: Methods of knowledge representation. Logic of predicates, semantic networks, frames, production systems.
Practical works: Ontologies development on Protege.

Topic 3: Knowledge Engineering Modeling in CommonKADS.
Contents of topic 3: Introduction to CommonKADS. Manual, semiautomatic, automatic techniques and on groups of experts for the extraction and acquisition of knowledge. Feasibility study and Impact study and improvements in CommonKADS Knowledge Model and Communication Model in CommonKADS. Representation of knowledge of tasks, reasoning and mastery.
Practical works: Design of a Knowledge-Based Sytem in CK.

Topic 4: Fundamentals and techniques of opend linked data.
Contents of topic 4: The Open Linked Data initiative. The representation of triplets in linked data. Models of exploitation of the data linked through the SPARQL language.
Practical works: Creating queries in SPARQL to triplet servers.

Topic 5: Techniques of data transformation to open linked data.
Contents of topic 5: Phases of the data transformation process to open linked data. Methods of selecting ontologies for the representation in open data. Cured of data. Techniques for transforming structured data to open linked data. Techniques of transformation of databases to open linked data. The R2RML language.
Practical works: Practices of transformation of structured data to open linked data using openRefine. Transformation of databases to open linked data.

Topic 6: Data analysis of knowledge-based systems.
Contents of topic 6: Data mining methods applied to knowledge-based systems. Data analysis for pattern discovery. Machine learning tools.
Practical works: Data analysis practices using data mining tools.

Topic 7: Natural Language Processing (NLP). Foundations of AI and Generative AI.
Contents of topic 7: Introduction. NLP applications. NLP components. Resources and tools used in NLP. Introduction to AI and Generative AI.
Practical works: Information extraction, syntactic and morphological analysis, and discourse labeling practices using NLP tools. Data analysis tools and visual analytics. Python libraries.

Educational activities

Student hours of work per theme		Classroom		Practical works			Monitoring activity	Non-classroom
Topic	Total	LG		SL			PT	PS
1	4	2		0			0	2
2	20	7		3			0	10
3	20	10		0			0	10
4	29	5		2			0	22
5	28	8		2			0	18

6	24	8		2			0	14
7	21	5		2			0	14
Evaluation	4	0		4			0	0
TOTAL	150	45		15			0	90

LG: Large Group (85 students).
SL: Seminar/Laboratory (computer laboratory sessions = 20, problem classes or seminars or case studies = 40).
PT: Programmed Tutorials (educational monitoring, in the form of ECTS tutorials).
PS: Personal study, individual or in groups, and literature reading.

Teaching methods

1) **Lectures** in which the theoretical content is developed and the derived methods applied in the resolution of problems that involve probability theory and the statistics.
2) **Seminars and practical classes** in which short, individual or group activities designed to promote problem solving and active student participation are performed and which require the application of probability theory and statistics.
3) **Computer laboratories** in which students will be guided by the teacher in the use of the R software to solve problems that require the application of probability theory and statistics in their resolution.
4) **Non-classroom activities, assignments and study** oriented mainly towards the acquisition of basic knowledge and the resolution of exercises, problems and assignments, individually or in groups, that require the application of probability theory and statistics.

Teaching outcomes

• Know the design methodologies of Knowledge Engineering for the development of knowledge-based systems.
• Know the techniques of knowledge acquisition and representation, and know how to apply the methodologies and techniques of Knowledge Engineering to specific problems where expert systems and knowledge-based systems are adequate.
• Know and put into practice the advanced knowledge representation techniques.
• Know how to select the most appropriate knowledge representation scheme for each intelligent agent.

Evaluation systems

Evaluation instruments

In order to evaluate the achievement of the learning objectives of this subject, the development of design projects and development of knowledge-based systems have been adequately considered.

Knowledge-based systems design and development projects
The project is an evaluation instrument that allows evaluating the ability to apply techniques to model, design and develop applications, services, intelligent systems and knowledge-based systems, being an activity very close to the one that you will have to face periodically during your working life: the design of intelligent and knowledge-based systems to solve a problem and the necessary documentation, and the application of specific techniques for the representation of knowledge.

Evaluation criteria
As contemplated in the current "Regulations for the evaluation of learning results

and the competences acquired by students in the official degrees of the University of Extremadura" (DOE October 6, 2020), this subject can be passed following the system of continuous evaluation or the global evaluation system. As indicated in this regulation, "The choice between the continuous evaluation system or the global evaluation system corresponds to the student before each call."
The student will be able to choose, through the Virtual Campus during the first quarter of the semester for the ordinary call (in the case of the extraordinary call, it will be done within the period established by the center), the modality with which he or she wants to be evaluated for each call. In case of absence of express request by the student, the modality assigned will be that of **continuous evaluation**.

For continuous evaluation, these criteria will be followed:

- To pass this course, the minimum requirements and optimal characteristics of the projects proposed in the course must be met.
- The score will be calculated out of 10. Each proposed project will have a percentage that will determine the final grade.
- It is mandatory to pass each mandatory project proposed with a minimum grade of 5 out of 10.
- The essential requirements to overcome this block are: deliver the requested system design and documentation, meeting the minimum requirements established.
- Each proposed project will be recoverable during all the calls for that course.
- The note in each project passed (meeting the minimum requirements) will be kept during all the calls for that course, provided that the student has the right to take the exam in the call.

For global evaluation, these criteria will be followed:

- To pass this course, the minimum requirements and optimal characteristics of the projects proposed in the course must be met. It is mandatory to pass each mandatory project proposed with a minimum grade of 5 out of 10.
- There will be a global evaluation test that will be scored from 1 to 10. It is mandatory to pass this test with a minimum score of 5 out of 10.

Calculation of the final grade of the subject

- Copying or plagiarism in any activity or test supposes a final grade of FAIL (0) in the call and a grade of 0 in all grades obtained so far for all those involved, in addition to the legal actions indicated according to the current regulations.
- If all the minimum requirements and success of the projects are met:
  1. For continuous evaluation: the mark will be calculated with the sum of each of the projects
  2. For global evaluation: the mark will be the average mark between the mark obtained in the projects delivered and the mark of the global evaluation test
- If a student does not hand in any project or (in global evaluation) does not take the exam or hand in the proposed blank exam in the first 5 minutes, his or her grade in that session will be “Not Presented”.
- If all the minimum delivery and requirements of the obligatory projects are not met, the final mark will be 3.

Bibliography (basic and complementary)

Basic Bibliography

- Alonso A., Guijarro B., Lozano-Tello A., Palma J. y Taboada A. *Ingeniería del Conocimiento. Aspectos metodológicos*. Ed. Pearson. 2004.
- Palma J , Marín R., Lozano-Tello A. y colaboradores. *Inteligencia Artificial: Técnicas, métodos y aplicaciones*. McGraw-Hill 2007

Complementary Bibliography

- Del Moral A, Pazos J y otros. *Gestión del Conocimiento.* Thomson 2007.
- Gómez A., Juristo N., Montes C. y Pazos J., *Ingeniería del conocimiento.* Ed. Centro Ramón Areces, 1997
- Russell S., Norvig P. *Inteligencia Artificial: un enfoque moderno.* 2ª edición. Ed. Prentice-Hall Hispanoamerica, 2004.
- Scheiber G., Akkermans H. y Anjewierden A. *Knowledge Engineering and Management. The CommonKADS Methodology*. MIT Press. 1999.
- Heath T. and Bizer C, *Linked Data: Evolving the Web into a Global Data Space*, (2011), ISBN: 9781608454310
- DuCharme B and O'Reilly C. *Learning SPARQL*, (2011), ISBN: 9781449306595

Other complementary resources and teaching materials

- Protege portal: http://protege.stanford.edu/
- Geospatial funtions for SPARQL

  http://www.opengeospatial.org/standards/geosparql#overview
- AZURE ML tool:
  https://azure.microsoft.com
- Anaconda tool:
  https://www.anaconda.com/
- Spanish Society for Natural Language Processing:

  http://www.sepln.org/sepln/la-sociedad
- OpenAI:
  https://openai.com/
- Artificial intelligence in universities: challenges and opportunities (La inteligencia artificial en las uiversidades: retos y oportunidades):

  https://andrespedreno.com/Informe-IA-Universidades.pdf

Tutorial timetable

Programmed tutorials

There are no programmed tutorials for this course.

Open access tutorials

The times of the tutorials of each lecturer are published on the doors of their offices, on the course website and on the website of the School of Technology.
Also, doubts can be addressed to lecturers by email.

Recommendations

It is recommended that students:

1) Read each topic comprehensively before and after its presentation in class.
2) Attempt to solve the exercises before and after they are considered in class.
3) Attempt to solve each computing practical before and after the practical class dedicated to it.
4) Devote at least those hours assigned to the course's personal study activities.

Class attendance is not obligatory, but it is highly recommended so as to follow the development of the course and the concepts introduced within it.