UNIVERSIDAD DE CASTILLA - LA MANCHA

GUÍA DOCENTE

1. General information

Course: KNOWLEDGE-BASED SYSTEMS
Code: 42345
Type: CORE COURSE
ECTS credits: 6
Degree: 347 - DEGREE PROGRAMME IN COMPUTER SCIENCE ENGINEERING (CR)
Academic year: 2023-24
Center: 108 - SCHOOL OF COMPUTER SCIENCE OF C. REAL
Group(s): 20
Year: 3
Duration: C2
Main language: Spanish
Second language: English
Use of additional languages:
English Friendly: Y
Web site: https://campusvirtual.uclm.es
Bilingual: N

Lecturer: **JOSE ANGEL OLIVAS VARELA** - Group(s): **20**

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2. Pre-Requisites

It is highly recommended to have previously studied the subjects of Programming Methodology and Data Structure, both in the field of programming and also as a subject from which it starts the third year of the degree course of Intelligent Systems. The subject of "knowledge based systems" is framed in the specific technology of Computing and therefore it is closely related to the subjects dedicated to the study of computer sciences and to intelligent systems or artificial intelligence. That is why it is highly recommended to have previously studied the subjects of Programming Methodology and Data Structure, as well as Logic, both in the field of programming and logical programming, and also, and as initial subject of the scope of the Artificial Intelligence, Intelligent Systems of third course of degree. In any case, it is advisable to have completed the basic training modules and the common module of the IT branch.

3. Justification in the curriculum, relation to other subjects and to the profession

There are very complex problems in the field of application of the construction of Software Systems where the step-by-step description of the solutions to them is unapproachable, either by computer time or by memory space when not in both directions.
It is in this environment where all available expert knowledge must be incorporated to solve complex problems as an expert in the domain in question would do. The subject is part of the Computer Intensification, where all the specific competences are developed in subjects of Intelligent Systems, Data Mining, Intelligent Agents and Fundamentals of Computing.

To get an idea of what we are talking about, imagine for a moment how a mining engineer decides the drilling of new oilfields, there are so many variables to take into account and possible scenarios to analyze that it is practically impossible to tackle all at once. This expert, in this field, will follow guidelines/rules that will allow him, with the accumulated experience, decide at any time the most probable scenarios to take into account and the variables to consider in their evaluations, greatly reducing the complexity of the problem and providing a cost-effective solution, in our case, decide whether to invest in a new drilling (with the consequent execution costs). In this course, paradigms that attempt to capture this type of knowledge will be approached in order to be able to reason and solve problems of this type with reasonable time and efficiency.

In the case of perforations, a model could be constructed that, faced with environmental and/or geological variables, etc., will decide whether the perforation is worthwhile or not. As main justification in the curriculum we could summarize it in that there are many real problems where you must know the rules or guidelines of how to intelligently solve this type of problems experts in their field, for us to implement appropriate data structures and programs to represent and manage this expert knowledge and thus provide an appropriate solution to these problems. This subject is closely related to others in the curriculum, perhaps the most related is Intelligent Systems, as the base subject of this, in addition to the entire programming module, data structures, programming methodology.

But in addition this subject will help to obtain the competences of others like Mutiagent Systems, when intelligent agents are designed; Algorithm Design, there are programming techniques and more sophisticated data structures that are used in both disciplines. In general, all subjects of specific computer technology are related, although those discussed above may be more closely related.

4. Degree competences achieved in this course

Course competences

Code	Description
CM04	Ability to know the fundamentals, paradigms, and techniques of intelligent systems, and analyse, design, and build systems, services, and digital, applications which could use such techniques in any application context.
CM05	Ability to acquire, formalise, and represent human knowledge in a computable form for the solution of problems throughout a digital system in any application context, especially the one linked to computational aspects, perception, and behaviour in intelligent frames.
INS01	Analysis, synthesis, and assessment skills.
INS04	Problem solving skills by the application of engineering techniques.
INS05	Argumentative skills to logically justify and explain decisions and opinions.
PER02	Ability to work in multidisciplinary teams.
PER04	Interpersonal relationship skills.
PER05	Acknowledgement of human diversity, equal rights, and cultural variety.
SIS01	Critical thinking.
SIS03	Autonomous learning.

SIS09	Care for quality.
UCLM03	Accurate speaking and writing skills.

5. Objectives or Learning Outcomes

Course learning outcomes

Description

Understanding of the paradigms of knowledge representation and inference that allow designing and implementing knowledge-based systems.

Additional outcomes

The student will be able to plan, analyze and implement computer systems based on the extensive use of knowledge of a given problem, as well as to discriminate the use of one or several techniques suitable for the resolution of such problems. The student will be able to distinguish in depth different paradigms of knowledge representation and uncertainty management, as well as to decide, argue and justify the reasons for selecting one or the other. The student will be able to decide and justify the decision to use Artificial Intelligence techniques and knowledge representation methods and inference processes to extract new knowledge for a real problem. The student should know the meaning of knowledge-based systems as systems that solve problems through an exhaustive knowledge of their patterns and rules in their resolution by an expert.

6. Units / Contents

Unit 1: Introduction and basic concepts of Knowledge Engineering.

- **Unit 1.1** Advanced concepts of Artificial Intelligence and Knowledge Engineering.
- **Unit 1.2** Types of problems propitious to be solved with Systems based on the knowledge.
- **Unit 1.3** Expert Systems Construction Methodology. Life Cycle.
- **Unit 1.4** Viability Study. Slagel test.

Unit 2: Knowledge Acquisition and Conceptualization

- **Unit 2.1** Characterization of the experts and levels of reasoning.
- **Unit 2.2** The interview. Types of interview. Preparation and conduct of interviews.
- **Unit 2.3** Other sources of information. Systematic search.
- **Unit 2.4** Conceptualization: Semantic. Linguistics.
- **Unit 2.5** Conceptualization: Hierarchical models of knowledge. Concept maps. Ontologies.
- **Unit 2.6** Conceptualization: Gratings. Automatic knowledge modeling. Hierarchical Clustering.
- **Unit 2.7** Conceptualization: Tables Object-Attribute-Value-Characteristics.
- **Unit 2.8** Pseudocode. Forms of expression.

Unit 3: Representation of knowledge.

- **Unit 3.1** Reasoning. Inference mechanisms.
- **Unit 3.2** Inference engines based on rules.
- **Unit 3.3** The CLIPS system.
- **Unit 3.4** Interfaces. Rapid prototyping method. Prototype construction.
- **Unit 3.5** Evaluation and testing.

ADDITIONAL COMMENTS, REMARKS

PRACTICES

In the practices, throughout the course, a prototype of Intelligent System will be developed (Based on rules, using CLIPS and FUZZYCLIPS). The student will propose the domain (linked to his/her work and/or research interests) or will choose it from a list of proposals.

Practices will be carried out on the CLIPS system.

The following deliveries on the Project are foreseen:

1. Introduction. Identification of the problem: Document of objectives, scope and annexes. Slagel Viability Test. State of the Art.

2. Conceptualization. Conceptualization document: Process and knowledge maps, glossaries, tables, gratings, pseudocode. Demonstration Prototype.

3. Representation of knowledge. CLIPS Code. Interface. Definitive prototype. Evaluation of the system.

7. Activities, Units/Modules and Methodology

Training Activity	Methodology	Related Competences (only degrees before RD 822/2021)	ECTS	Hours	As	Com	Description
Individual tutoring sessions [ON-SITE]	Group tutoring sessions	CM04 CM05 INS05 SIS01 SIS09 UCLM03	0.18	4.5	N	-	Individual or small group tutoring in lecturer¿s office, classroom or laboratory (TUT)
Study and Exam Preparation [OFF-SITE]	Self-study	CM04 CM05 INS01 SIS01 SIS03 SIS09	1.8	45	N	-	Self-study (EST)
Other off-site activity [OFF-SITE]	Practical or hands-on activities	CM04 CM05 INS04 PER02 PER04 PER05 SIS03 SIS09	0.9	22.5	N	-	Lab practical preparation (PLAB)
Problem solving and/or case studies [ON-SITE]	Problem solving and exercises	CM04 CM05 INS01 INS04 PER02 PER04 PER05 SIS01 SIS09	0.6	15	Y	N	Worked example problems and cases resolution by the lecturer and the students (PRO)
Writing of reports or projects [OFF-SITE]	Self-study	CM04 CM05 INS01 INS04 INS05 PER02 PER04 PER05 SIS01 SIS03	0.9	22.5	Y	N	Preparation of essays on topics proposed by lecturer (RES)
Laboratory practice or sessions [ON-SITE]	Practical or hands-on activities	CM04 CM05 INS04 PER02 PER04 PER05 SIS03 SIS09	0.72	18	Y	Y	Realization of practicals in laboratory /computing room (LAB)

Progress test [ON-SITE]	Assessment tests	CM04 CM05 INS01 INS04 INS05 PER02 SIS01 SIS09 UCLM03	0.1	2.5	Y	N	Progress test 1 of the first third of the syllabus of the subject (EVA)
Progress test [ON-SITE]	Assessment tests	CM04 CM05 INS01 INS04 INS05 PER02 SIS01 SIS09 UCLM03	0.1	2.5	Y	N	Progress test 2 of the two first thirds of the syllabus of the subject (EVA)
Progress test [ON-SITE]	Assessment tests	CM04 CM05 INS01 INS04 INS05 PER02 SIS01 SIS09 UCLM03	0.1	2.5	Y	N	Progress test 3 of the complete syllabus of the subject (EVA)
Class Attendance (theory) [ON-SITE]	Lectures	CM04 CM05	0.6	15	N	-	Teaching of the subject matter by lecturer (MAG)
		Total:	**6**	**150**			
		Total credits of in-class work: 2.4					**Total class time hours: 60**
		Total credits of out of class work: 3.6					**Total hours of out of class work: 90**

As: Assessable training activity
Com: Training activity of compulsory overcoming (It will be essential to overcome both continuous and non-continuous assessment).

8. Evaluation criteria and Grading System

Evaluation System	Continuous assessment	Non-continuous evaluation*	Description
Final test	0.00%	50.00%	Compulsory and recoverable activity to be carried out on the date scheduled for the final ordinary examination.
Progress Tests	7.50%	0.00%	Progress test 1. Non-compulsory activity that can be retaken (rescheduling). To be carried out at the end of the first third of the teaching period.
Progress Tests	15.00%	0.00%	Progress test 2. Non-compulsory activity that can be retaken. To be carried out at the end of the second third of the teaching period.
Progress Tests	27.50%	0.00%	Progress test 3. Non-compulsory activity that can be retaken. To be carried out during the non-teaching period.
Theoretical papers assessment	15.00%	15.00%	Non-compulsory activity that can be retaken. To be carried out before end of teaching period.
Laboratory sessions	25.00%	25.00%	Compulsory activity that can be retaken. To be carried out during lab sessions.
Oral presentations assessment	10.00%	10.00%	Non-compulsory activity that can be retaken. To be carried out during the theory/lab sessions for students in the continuous assessment modality. The students of non-continuous modality will be evaluated of this activity through an alternative system in the final exam call (convocatoria ordinaria)
Total:	**100.00%**	**100.00%**	

According to art. 4 of the UCLM Student Evaluation Regulations, it must be provided to students who cannot regularly attend face-to-face training activities the passing of the subject, having the right (art. 12.2) to be globally graded, in 2 annual calls per subject , an ordinary and an extraordinary one (evaluating 100% of the competences).

Evaluation criteria for the final exam:

Continuous assessment:

In compulsory activities, a minimum mark of 40% is required in order to pass that activity and have the possibility to therefore pass the entire subject. A compulsory activity cannot be divided into eliminatory parts, nor can minimum marks be established for each of its parts. In the case of the activities that may be retaken (i.e., rescheduling), an alternative activity or test will be offered in the resit/retake exam call (convocatoria extraordinaria).

The progress tests will be common for all the theory/laboratory groups of the subject and will be evaluated by the lecturers of the subject in a serial way, i.e., each part of the progress tests will be evaluated by the same lecturer for all the students.

A student is considered to pass the subject if she/he obtains a minimum of 50 points out of 100, taking into account the points obtained in all the evaluable activities, and also has passed all the compulsory activities.

For students who do not pass the subject in the final exam call (convocatoria ordinaria), the marks of activities already passed will be conserved for the resit/retake exam call (convocatoria extraordinaria). If an activity is not recoverable, its assessment will be preserved for the resit/retake exam call (convocatoria extraordinaria) even if it has not been passed. In the case of the passed recoverable activities, the student will have the opportunity to receive an alternative evaluation of those activities in the resit/retake exam call and, in that case, the final grade of the activity will correspond to the latter grade obtained.

The mark of the passed activities in any call, except for the progress tests, will be conserved for the subsequent academic year at the request of the student, provided that mark is equal or greater than 50% and that the activities and evaluation criteria of the subject remain unchanged prior to the beginning of that academic year.

The failure of a student to attend the progress test 3 will automatically result in her/him receiving a "Failure to attend" (no presentado). If the student has not passed any compulsory evaluation activity, the maximum final grade will be 40%.

Non-continuous evaluation:

Students may apply at the beginning of the semester for the non-continuous assessment mode. In the same way, the student may change to the non-continuous evaluation mode as long as she/he has not participated during the teaching period in evaluable activities that together account for at least 50% of the total mark of the subject. If a student has reached this 50% of the total obtainable mark or the teaching period is over, she/he will be considered in continuous assessment without the possibility of changing to non-continuous evaluation mode.

Students who take the non-continuous evaluation mode will be globally graded, in 2 annual calls per subject, an ordinary and an extraordinary one (evaluating 100% of the competences), through the assessment systems indicated in the column "Non-continuous evaluation".

In the "non-continuous evaluation" mode, it is not compulsory to keep the mark obtained by the student in the activities or tests (progress test or partial test) taken in the continuous assessment mode.

Specifications for the resit/retake exam:

Evaluation tests will be conducted for all recoverable activities. Due to the nature of the progress tests, in the resit/retake exam (convocatoria extraordinaria) there will be a single progress test that includes the three progress tests. The failure of a student to attend this progress test will automatically result in her/him receiving a "Failure to attend" (no presentado), except in the case that the student conserves the mark for progress tests from the final exam call (convocatoria ordinaria). In the latter case, the student's carrying out of any other evaluable activity in the resit/retake exam call (convocatoria extraordinaria) will result in a numerical mark.

Specifications for the second resit / retake exam:

Same characteristics as the resit/retake exam call.

9. Assignments, course calendar and important dates

Not related to the syllabus/contents

Hours	**hours**

General comments about the planning: The subject has 3 sessions/week of 1,5 hours.

Unit 1 (de 3): Introduction and basic concepts of Knowledge Engineering.

Activities	**Hours**
Individual tutoring sessions [PRESENCIAL][Group tutoring sessions]	1.5
Study and Exam Preparation [AUTÓNOMA][Self-study]	15
Other off-site activity [AUTÓNOMA][Practical or hands-on activities]	7.5
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	5
Writing of reports or projects [AUTÓNOMA][Self-study]	7.5
Laboratory practice or sessions [PRESENCIAL][Practical or hands-on activities]	6
Progress test [PRESENCIAL][Assessment tests]	.5
Progress test [PRESENCIAL][Assessment tests]	.5
Progress test [PRESENCIAL][Assessment tests]	.5

Unit 2 (de 3): Knowledge Acquisition and Conceptualization

Activities	**Hours**
Individual tutoring sessions [PRESENCIAL][Group tutoring sessions]	1.5
Study and Exam Preparation [AUTÓNOMA][Self-study]	15
Other off-site activity [AUTÓNOMA][Practical or hands-on activities]	7.5
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	5
Writing of reports or projects [AUTÓNOMA][Self-study]	7.5
Laboratory practice or sessions [PRESENCIAL][Practical or hands-on activities]	6
Progress test [PRESENCIAL][Assessment tests]	1
Progress test [PRESENCIAL][Assessment tests]	1
Progress test [PRESENCIAL][Assessment tests]	1

Unit 3 (de 3): Representation of knowledge.

Activities	**Hours**
Individual tutoring sessions [PRESENCIAL][Group tutoring sessions]	1.5
Study and Exam Preparation [AUTÓNOMA][Self-study]	15
Other off-site activity [AUTÓNOMA][Practical or hands-on activities]	7.5
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	5
Writing of reports or projects [AUTÓNOMA][Self-study]	7.5
Laboratory practice or sessions [PRESENCIAL][Practical or hands-on activities]	6
Progress test [PRESENCIAL][Assessment tests]	1
Progress test [PRESENCIAL][Assessment tests]	1
Progress test [PRESENCIAL][Assessment tests]	1

Global activity

Activities	**hours**
Progress test [PRESENCIAL][Assessment tests]	2.5
Progress test [PRESENCIAL][Assessment tests]	2.5
Individual tutoring sessions [PRESENCIAL][Group tutoring sessions]	4.5
Study and Exam Preparation [AUTÓNOMA][Self-study]	45
Other off-site activity [AUTÓNOMA][Practical or hands-on activities]	22.5
Problem solving and/or case studies [PRESENCIAL][Problem solving and exercises]	15
Writing of reports or projects [AUTÓNOMA][Self-study]	22.5
Laboratory practice or sessions [PRESENCIAL][Practical or hands-on activities]	18
Progress test [PRESENCIAL][Assessment tests]	2.5
Total horas:	135

10. Bibliography and Sources

Author(s)	Title/Link	Publishing house	Citv	ISBN	Year	Description
B. G. Buchanan, R. Barstow, R. Bechtal, J. Bennet, W. Clancey, C. Kulikowsky, T. Mitchel, D. A. Waterman	Building Expert Systems, Constructing an expert system.	Addison Wesley			1983	
G. Guida, C.Tasso. John	Design and development of Knowledge Based Systems. From	John Wiley and Sons Ltd			1994	

	Life Cycle to Methology		
Rafael Martínez Tomás, José Manuel Molina López, Javier Carbó Rubiera	Ingeniería del conoDesarrollo de sistemas basados en el conocimiento CLIPS y FUZZY CLIPS,	Sanz y Torres	2005
A. Gómez, N. Juristo, C. Montes, J. Pazos	Ingeniería del conocimiento	Ed. Centro de estudios Ramón Areces	1997