ANX-PR/CL/001-01

LEARNING GUIDE

SUBJECT

103000368 - Models Of Reasoning

DEGREE PROGRAMME

10AJ - Master Universitario en Inteligencia Artificial

ACADEMIC YEAR & SEMESTER

2020/21 - Semester 1

Index

Learning guide

1. Description

1.1. Subject details

Name of the subject	103000368 - Models Of Reasoning
No of credits	5 ECTS
Type	Optional
Academic year ot the programme	First year
Semester of tuition	Semester 1
Tuition period	September-January
Tuition languages	English
Degree programme	10AJ - Master Universitario en Inteligencia Artificial
Centre	10 - Escuela Tecnica Superior de Ingenieros Informaticos
Academic year	2020-21

2. Faculty

2.1. Faculty members with subject teaching role

Name and surname	Office/Room	Email	Tutoring hours *
Martin Molina Gonzalez (Subject coordinator)	2111	martin.molina@upm.es	W - 12:00 - 14:00

* 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

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.

CB9 - Que los estudiantes sepan comunicar sus conclusiones y los conocimientos y razones últimas que las sustentan a públicos especializados y no especializados de un modo claro y sin ambigüedades

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

CEIA10 - Identificación de áreas de aplicación en las que se pueda utilizar las técnicas y métodos de la Inteligencia Artificial.

CEIA7 - Conocimiento de las técnicas de representación del conocimiento reutilizables y modelos de razonamiento en entornos centralizados y distribuidos a utilizar en la resolución de problemas que impliquen conducta inteligente.

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.

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.

3.2. Learning outcomes

RA94 - Conocer las técnicas existentes para simular modos de razonamiento, entendiendo su alcance y limitaciones

RA96 - Ser capaz de buscar y manejar fuentes bibliográficas para analizar el estado del arte en el área de modelos de razonamiento

RA93 - Conocer cuáles son los principales retos y logros sobre modos de razonamiento y su formalización mediante modelos computacionales

RA95 - Ser capaz de identificar áreas de aplicación en las que se puedan utilizar modelos computacionales de razonamiento

RA97 - Ser capaz de comunicar resultados de investigación sobre modelos de razonamiento, realizando exposiciones y manejando terminología adecuada

* 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 course "models of reasoning" presents computational models of reasoning proposed in artificial intelligence, which have applicability to the design and construction of intelligent systems. Initially, the course presents a general characterization of intelligent systems together with basic concepts and foundations of knowledge representation and reasoning. In this part, the symbolic approach of artificial intelligence is explained and illustrated with common methods (e.g. logic, rules, frameworks, etc.) and software tools.

Next, the course describes cognitive abilities associated to deliberative reasoning. In this part, we discuss approaches related to world modeling, reflective action control with cognizant failure, and integrated reactive and deliberative behaviors, which is important for an autonomous intelligent system to make safe and efficient decisions in complex dynamic environments.

Finally, the course describes artificial intelligence challenges in models of reasoning. For example, common sense reasoning is presented as one of the important problems, showing difficulties and partial achievements such as logical-based methods (e.g., event calculus) and qualitative reasoning.

The course gives mainly a theoretical description of a number of methods, illustrated in some cases with tools and applications related to practical domains (e.g., autonomous aerial robots). As a general learning objective, students are expected to develop a comprehensive understanding of reasoning methods that may complement other more specific areas in artificial intelligence that make use of symbolic approaches (e.g., autonomous robots, multi-agent systems, automated planning, ontology engineering, etc.). In the course, students will develop research skills in artificial intelligence through the realization of a project that explores a topic of their interest, related to models of reasoning. In this project, students will analyze bibliographic sources and will present the results in class.

4.2. Syllabus

1. Intelligent systems
    1.1. Properties of intelligent systems (intelligence, rationality, autonomy)
    1.2. Functional components of intelligent systems (deliberation, perception, actuation, communication)
    1.3. System categories (assistant systems, autonomous systems, expert systems, cognitive systems)
2. Knowledge representation and reasoning
    2.1. Symbolism and connectionism in artificial intelligence
    2.2. Terminology review (knowledge, representation, data, symbol grounding)
    2.3. Reasoning as symbol manipulation
    2.4. Review of methods and tools for knowledge representation (rules, frames, logic, constraints, etc.)
3. Cognitive abilities related to deliberative reasoning
    3.1. World modeling (environment mapping, perceptual anchoring)
    3.2. Action execution control with cognizant failure
    3.3. Reactive behaviors and deliberative reasoning
    3.4. Goal reasoning (belief-desire-intention model)
    3.5. Software architectures and frameworks
4. Artificial intelligence challenges related to models of reasoning
    4.1. Common sense reasoning (cause-effect reasoning, physical reasoning, knowledge bases)
    4.2. Other challenges related to models of reasoning

5. Schedule

5.1. Subject schedule*

Week	Face-to-face classroom activities	Face-to-face laboratory activities	Distant / On-line	Assessment activities
1			**Course introduction** Duration: 02:00 Lecture	
2			**Lecture on Unit 1** Duration: 02:00 Lecture	
3			**Lecture on Unit 1** Duration: 02:00 Lecture	
4			**Lecture on Unit 2** Duration: 02:00 Lecture	
5			**Lecture on Unit 2** Duration: 02:00 Lecture	
6			**Lecture on Unit 2** Duration: 02:00 Lecture	
7			**Lecture on Unit 3** Duration: 02:00 Lecture **Group tutoring session** Duration: 02:00 Additional activities	
8			**Lecture on Unit 3** Duration: 02:00 Lecture **Group tutoring session** Duration: 02:00 Additional activities	
9			**Lecture on Unit 3** Duration: 02:00 Lecture **Group tutoring session** Duration: 02:00 Additional activities	
10			**Lecture on Unit 4** Duration: 02:00 Lecture **Group tutoring session** Duration: 02:00 Additional activities	**Week assignments. Students will be assessed whether they answer correctly week assignments.** Other assessment Continuous assessment Not Presential Duration: 00:00

11			**Lecture on Unit 4** Duration: 02:00 Lecture **Group tutoring session** Duration: 02:00 Additional activities	
12			**Oral presentation by the students. Discussion topics in group. Answers by the professor to student questions.** Duration: 02:00 Additional activities	
13			**Oral presentation by the students. Discussion topics in group. Answers by the professor to student questions.** Duration: 02:00 Additional activities	
14			**Oral presentation by the students. Discussion topics in group. Answers by the professor to student questions.** Duration: 02:00 Additional activities	
15			**Oral presentation by the students. Discussion topics in group. Answers by the professor to student questions.** Duration: 02:00 Additional activities	
16				**Attendance and participation in class.** Other assessment Continuous assessment Not Presential Duration: 00:00 **Student project. The student project will be assessed regarding relevance, organization, terminology, argumentation and clarity.** Group work Continuous assessment Not Presential Duration: 00:00 **Written test. Students will be assessed whether they answer correctly on questions regarding techniques and applications.** Online test Continuous assessment Not Presential Duration: 02:00
17				**Student project. The student project will be assessed regarding relevance, organization, terminology, argumentation and clarity.** Group work Final examination Not Presential Duration: 00:00 **Written test. Students will be assessed whether they answer correctly on questions regarding techniques and**

				applications. Written test Final examination Not Presential Duration: 02:00

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.

6. Activities and assessment criteria

6.1. Assessment activities

6.1.1. Continuous assessment

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
10	Week assignments. Students will be assessed whether they answer correctly week assignments.	Other assessment	No Presential	00:00	10%	/ 10	CEIA1 CEIA7 CGI1
16	Attendance and participation in class.	Other assessment	No Presential	00:00	10%	7 / 10	CEIA7 CGI1 CEIA1
16	Student project. The student project will be assessed regarding relevance, organization, terminology, argumentation and clarity.	Group work	No Presential	00:00	50%	5 / 10	CG18 CGI4 CB10 CGI3 CEIA10 CB9 CG13
16	Written test. Students will be assessed whether they answer correctly on questions regarding techniques and applications.	Online test	No Presential	02:00	30%	5 / 10	CGI1 CEIA1 CEIA7

6.1.2. Final examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
17	Written test. Students will be assessed whether they answer correctly on questions regarding techniques and applications.	Written test	No Presential	02:00	50%	5 / 10	CGI1 CEIA1 CEIA7
17	Student project. The student project will be assessed regarding relevance, organization, terminology, argumentation and clarity.	Group work	No Presential	00:00	50%	5 / 10	CB9 CG13 CG18 CGI4 CB10 CGI3 CEIA10

6.1.3. Referred (re-sit) examination

Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
Written test. The student will be assessed whether they answer correctly on questions regarding techniques and applications.	Written test	Face-to-face	02:00	50%	5 / 10	CGI1 CEIA1 CEIA7
Student project. The student project will be assessed regarding relevance, organization, terminology, argumentation and clarity.	Group work	Face-to-face	00:00	50%	5 / 10	CB9 CG13 CG18 CGI4 CB10 CGI3 CEIA10

6.2. Assessment criteria

Partial and final grades are on the scale of 0 to 10. To pass the course it is required that the final grade G must be G >= 5.

"Continuous" assessment and "final examination" are mutually exclusive. Students who want to follow "final examination" must inform the coordinator (email address: martin.molina@upm.es) at the beginning of the course, in the first two weeks of the course. Otherwise, continuous assessment is followed.

Students who have chosen "continuous" assessment may be affected during the course by problems related to Covid-19 or by the need to enter working life due to the socio-economic situation. In this case, students can apply for admission to the "final examination". This request must be sent to the coordinator (martin.molina@upm.es) and duly justified with the appropriate documentation.

Students who follow "final examination" or "referred (re-sit) examination" must submit to the coordinator (martin.molina@upm.es) the practical project at least one week before the day established for the written examination. The student will be allowed to take the written examination if the student has submitted in advance the practical project.

7. Teaching resources

7.1. Teaching resources for the subject

Name	Type	Notes
Moodle UPM	Web resource	Support to on-line education
Microsoft Teams	Others	Support to on-line education
Blackboard Collaborate	Others	Support to on-line education
Bibliography	Bibliography	Selected bibliography (papers and text books)

8. Other information

8.1. Other information about the subject

Online education is planned to be performed in the following way:

- UPM Moodle will be used by instructors, for example, to communicate general messages to students, to provide course material (e.g. lecture slides), to propose assignments and to communicate grades. Students will use UPM Moodle, for example, to take online exams and to submit the results of assignments.
- Microsoft Teams or Blackboard Collaborate will be used for online lectures by instructors, student presentations, support to online exams and meetings with students.

This course is related to the "Sustainable Development Goal 9" (Build resilient infrastructure, promote sustainable industrialization and foster innovation), defined by the United Nations Development Programme (www.undp.org).