ANX-PR/CL/001-01

LEARNING GUIDE

SUBJECT

103000366 - Multi-agent Systems

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	103000366 - Multi-agent Systems
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 *
Josefa Zuleide Hernandez Diego	2205	josefaz.hernandez@upm.es	Sin horario. http://www.dia.fi.upm.es/es/tutorias
Nikolaus Guyon Swoboda (Subject coordinator)	2205	nik.swoboda@upm.es	Sin horario. http://www.dia.fi.upm.es/es/tutorias

Javier Bajo Perez	2101	javier.bajo@upm.es	Sin horario. http://www.dia.fi.upm.es/es/tutorias

* 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.

CB7 - Que los estudiantes sepan aplicar los conocimientos adquiridos y su capacidad de resolución de problemas en entornos nuevos o poco conocidos dentro de contextos más amplios (o multidisciplinares) relacionados con su área de estudio

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

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.

CG10 - Capacidad de pensamiento creativo con el objetivo de desarrollar enfoques y métodos nuevos y originales.

CG11 - Integración del conocimiento a partir de disciplinas diferentes, así como el manejo de la complejidad.

CG18 - Capacidad de trabajar y comunicarse también en contextos internacionales

CG9 - Aplicación de los métodos de resolución de problemas más recientes o innovadores y que puedan implicar el uso de otras disciplinas.

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.

3.2. Learning outcomes

RA56 - Ser capaz de entender el comportamiento y auto-organización de sistemas complejos compuestos de múltiples agentes

RA57 - Ser capaz de analizar y diseñar sociedades de agentes que simulen comportamientos inteligentes

RA58 - Ser capaz de analizar y evaluar la aportación de publicaciones científicas.

* 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

This course has two main objectives:

(i) to acquire a general familiarity with multi-agent systems from the perspective of collective intelligence (CI) and then to pursue a deeper understanding of a number of speci fic areas of research related to CI.

(ii) to give each student some \hands-on" experience doing research and reporting the results of that research activity in the format normally required for submission to an international conference.

Esta asignatura tiene dos objetivos principales:

(i) adquirir una familiaridad general con los sistemas multiagente desde la perspectiva de la inteligencia colectiva al tiempo que se estudian con más profundidad algunas áreas de investigación concretas relacionadas con la inteligencia colectiva.

(ii) proporcionar a los alumnos alguna experiencia práctica sobre cómo investigar y comunicar los resultados de la actividad investigadora, empleando un formato habitualmente requerido en conferencias internacionales.

4.2. Syllabus

1. Introduction
    1.1. What is collective intelligence?
    1.2. Basic concepts of collective intelligence
2. Case studies - Analysis and modeling of collective intelligence
    2.1. Collaborative sorting
    2.2. Distributed task allocation
    2.3. Collective construction
    2.4. Ant foraging
    2.5. Flocking
    2.6. Collaborative transport
    2.7. Applications
3. Put it into practice
    3.1. Platforms for simulating collective intelligence systems
    3.2. Implementation of a collective intelligence system

5. Schedule

5.1. Subject schedule*

Week	Face-to-face classroom activities	Face-to-face laboratory activities	Distant / On-line	Assessment activities
1			**Topic 1 - Introduction** Duration: 02:00 Lecture	**Class participation** Other assessment Continuous assessment and final examination Not Presential Duration: 02:00
2			**Topic 1 - Introduction** Duration: 01:00 Lecture **Topic 1 - Introduction** Duration: 01:00 Additional activities **Group Questions and Answers Session** Duration: 00:30 Additional activities	**Class participation** Other assessment Continuous assessment and final examination Not Presential Duration: 02:00
3			**Topic 3 - Put it into practice** Duration: 02:00 Laboratory assignments **Group Questions and Answers Session** Duration: 00:30 Additional activities	**Class participation** Other assessment Continuous assessment and final examination Not Presential Duration: 02:00
4			**Topic 2 - Case studies** Duration: 02:00 Lecture **Group Questions and Answers Session** Duration: 00:30 Additional activities	**Class participation** Other assessment Continuous assessment and final examination Not Presential Duration: 02:00
5			**Topic 2 - Case studies** Duration: 01:30 Additional activities **Topic 3 - Put it into practice** Duration: 00:30 Cooperative activities **Group Questions and Answers Session** Duration: 00:30 Additional activities	**Class participation** Other assessment Continuous assessment and final examination Not Presential Duration: 02:00 **Peer evaluation (1) of the presentations** Other assessment Continuous assessment and final examination Not Presential Duration: 01:00

6			**Topic 2 - Case studies** Duration: 02:00 Lecture **Group Questions and Answers Session** Duration: 00:30 Additional activities	**Class participation** Other assessment Continuous assessment and final examination Not Presential Duration: 02:00
7			**Topic 2 - Case studies** Duration: 01:30 Additional activities **Topic 3 - Put it into practice** Duration: 00:30 Cooperative activities **Group Questions and Answers Session** Duration: 00:30 Additional activities	**Class participation** Other assessment Continuous assessment and final examination Not Presential Duration: 02:00 **Peer evaluation (2) of the presentations** Other assessment Continuous assessment and final examination Not Presential Duration: 01:00
8			**Topic 2 - Case studies** Duration: 02:00 Lecture **Group Questions and Answers Session** Duration: 00:30 Additional activities	**Class participation** Other assessment Continuous assessment and final examination Not Presential Duration: 02:00
9			**Topics 2 - Case studies** Duration: 01:30 Additional activities **Topic 3 - Put it into practice** Duration: 00:30 Cooperative activities **Group Questions and Answers Session** Duration: 00:30 Additional activities	**Class participation** Other assessment Continuous assessment and final examination Not Presential Duration: 02:00 **Peer evaluation (3) of the presentations** Other assessment Continuous assessment and final examination Not Presential Duration: 01:00
10			**Topic 2 - Case studies** Duration: 02:00 Lecture **Group Questions and Answers Session** Duration: 01:00 Additional activities	**Class participation** Other assessment Continuous assessment and final examination Not Presential Duration: 02:00
11			**Topic 2 - Case studies** Duration: 01:30 Additional activities **Topic 3 - Put it into practice** Duration: 00:30 Cooperative activities **Group Questions and Answers Session** Duration: 01:00 Additional activities	**Class participation** Other assessment Continuous assessment and final examination Not Presential Duration: 02:00 **Peer evaluation (4) of the presentations** Other assessment Continuous assessment and final examination Not Presential Duration: 01:00

12			**Topic 2 - Case studies** Duration: 02:00 Lecture **Group Questions and Answers Session** Duration: 01:00 Additional activities	**Class participation** Other assessment Continuous assessment and final examination Not Presential Duration: 02:00
13			**Topic 2 - Case studies** Duration: 01:30 Additional activities **Topic 3 - Put it into practice** Duration: 00:30 Cooperative activities **Group Questions and Answers Session** Duration: 01:00 Additional activities	**Class participation** Other assessment Continuous assessment and final examination Not Presential Duration: 02:00 **Peer evaluation (5) of the presentations** Other assessment Continuous assessment and final examination Not Presential Duration: 01:00
14			**Topic 2 - Case studies** Duration: 02:00 Lecture **Group Questions and Answers Session** Duration: 01:00 Additional activities	**Class participation** Other assessment Continuous assessment and final examination Not Presential Duration: 02:00
15			**Topic 2 - Case studies** Duration: 01:30 Additional activities **Topic 3 - Put it into practice** Duration: 00:30 Cooperative activities **Group Questions and Answers Session** Duration: 01:00 Additional activities	**Class participation** Other assessment Continuous assessment and final examination Not Presential Duration: 02:00 **Peer evaluation (6) of the presentations** Other assessment Continuous assessment and final examination Not Presential Duration: 01:00
16				
17				**Presentation of a scientific paper** Individual presentation Continuous assessment and final examination Not Presential Duration: 00:30 **Implementation of a collective intelligence system and final report** Individual work Continuous assessment and final examination Not Presential Duration: 40:00 **Demonstration of the collective intelilgence system developed** Individual presentation Continuous assessment and final examination Not Presential

				Duration: 00:15

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
1	Class participation	Other assessment	No Presential	02:00	.34%	0 / 10	
2	Class participation	Other assessment	No Presential	02:00	.34%	0 / 10	
3	Class participation	Other assessment	No Presential	02:00	.34%	0 / 10	
4	Class participation	Other assessment	No Presential	02:00	.34%	0 / 10	
5	Class participation	Other assessment	No Presential	02:00	.34%	0 / 10	
5	Peer evaluation (1) of the presentations	Other assessment	No Presential	01:00	3.34%	0 / 10	
6	Class participation	Other assessment	No Presential	02:00	.34%	0 / 10	
7	Class participation	Other assessment	No Presential	02:00	.33%	0 / 10	
7	Peer evaluation (2) of the presentations	Other assessment	No Presential	01:00	3.34%	0 / 10	
8	Class participation	Other assessment	No Presential	02:00	.33%	0 / 10	
9	Class participation	Other assessment	No Presential	02:00	.31%	0 / 10	
9	Peer evaluation (3) of the presentations	Other assessment	No Presential	01:00	3.34%	0 / 10	
10	Class participation	Other assessment	No Presential	02:00	.33%	0 / 10	
11	Class participation	Other assessment	No Presential	02:00	.33%	0 / 10	
11	Peer evaluation (4) of the presentations	Other assessment	No Presential	01:00	3.33%	0 / 10	
12	Class participation	Other assessment	No Presential	02:00	.33%	0 / 10	

13	Class participation	Other assessment	No Presential	02:00	.33%	0 / 10	
13	Peer evaluation (5) of the presentations	Other assessment	No Presential	01:00	3.33%	0 / 10	
14	Class participation	Other assessment	No Presential	02:00	.33%	0 / 10	
15	Class participation	Other assessment	No Presential	02:00	.33%	0 / 10	
15	Peer evaluation (6) of the presentations	Other assessment	No Presential	01:00	3.33%	0 / 10	
17	Presentation of a scientific paper	Individual presentation	No Presential	00:30	15%	0 / 10	CB9 CG10 CG11 CG18 CGI4 CGI3
17	Implementation of a collective intelligence system and final report	Individual work	No Presential	40:00	50%	0 / 10	CG11 CB7 CG9 CGI1 CGI2 CEIA7 CB10
17	Demonstration of the collective intelilgence system developed	Individual presentation	No Presential	00:15	10%	0 / 10	CB9 CG18 CB7

6.1.2. Final examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
1	Class participation	Other assessment	No Presential	02:00	.34%	0 / 10	
2	Class participation	Other assessment	No Presential	02:00	.34%	0 / 10	
3	Class participation	Other assessment	No Presential	02:00	.34%	0 / 10	
4	Class participation	Other assessment	No Presential	02:00	.34%	0 / 10	
5	Class participation	Other assessment	No Presential	02:00	.34%	0 / 10	
5	Peer evaluation (1) of the presentations	Other assessment	No Presential	01:00	3.34%	0 / 10	
6	Class participation	Other assessment	No Presential	02:00	.34%	0 / 10	

7	Class participation	Other assessment	No Presential	02:00	.33%	0 / 10	
7	Peer evaluation (2) of the presentations	Other assessment	No Presential	01:00	3.34%	0 / 10	
8	Class participation	Other assessment	No Presential	02:00	.33%	0 / 10	
9	Class participation	Other assessment	No Presential	02:00	.31%	0 / 10	
9	Peer evaluation (3) of the presentations	Other assessment	No Presential	01:00	3.34%	0 / 10	
10	Class participation	Other assessment	No Presential	02:00	.33%	0 / 10	
11	Class participation	Other assessment	No Presential	02:00	.33%	0 / 10	
11	Peer evaluation (4) of the presentations	Other assessment	No Presential	01:00	3.33%	0 / 10	
12	Class participation	Other assessment	No Presential	02:00	.33%	0 / 10	
13	Class participation	Other assessment	No Presential	02:00	.33%	0 / 10	
13	Peer evaluation (5) of the presentations	Other assessment	No Presential	01:00	3.33%	0 / 10	
14	Class participation	Other assessment	No Presential	02:00	.33%	0 / 10	
15	Class participation	Other assessment	No Presential	02:00	.33%	0 / 10	
15	Peer evaluation (6) of the presentations	Other assessment	No Presential	01:00	3.33%	0 / 10	
17	Presentation of a scientific paper	Individual presentation	No Presential	00:30	15%	0 / 10	CB9 CG10 CG11 CG18 CGI4 CGI3
17	Implementation of a collective intelligence system and final report	Individual work	No Presential	40:00	50%	0 / 10	CG11 CB7 CG9 CGI1 CGI2 CEIA7 CB10
17	Demonstration of the collective intelilgence system developed	Individual presentation	No Presential	00:15	10%	0 / 10	CB9 CG18 CB7

6.1.3. Referred (re-sit) examination

No se ha definido la evaluación extraordinaria.

6.2. Assessment criteria

Evaluation in the ordinary session: Continuous evaluation

Each student's final grade will be calculated using the following items and weights:

5% - Class participation

Prior to class meetings, assigned readings for that day will be announced and all students are expected to come to class prepared to actively participate in the discussion of those articles.

15% - In class presentation

During the semester, each student will be expected to make one in class presentation/discussion.

20% - Peer evaluations of the presentations

In the week following a paper presentation class, each student is required to submit a brief commentary on each of the presentations made by the other students.

50% - Project implementation and final report

At the end of the semester each student will be expected to submit the implementation of a simulation of a CI system along with a short report describing this project.

10% - Demonstration of the implemented system

Evaluation in the extraordinary period

The final grade in this period will be obtained using the same items and weights described before. Note: the following activities can not be re-evaluated in the extraordinary period: class participation, in class presentation and the peer evaluations of the presentations. The student has to submit the implementation of a simulation of a CI system along with a short report describing this project, in the date officially assigned for this evaluation. Shortly

after the submission of the report, the student must algo give a short demo of the implemented system.

Evaluación en convocatoria ordinaria: Evaluación continua

La calificación final en este curso se obtendrá a partir de los resultados alcanzados en las actividades realizadas en clase, una práctica y la demo correspondiente, y un informe de la misma.

5% - Participación en clase

A lo largo del semestre, especialmente tras la presentación de nuevos temas, los alumnos deben prepararse el/los artículos seleccionados por los profesores con el objetivo de extraer los contenidos más relevantes y aportar su valoración personal sobre los mismos, así como otros aspectos a comentar o discutir. Durante la clase los profesores guiarán la discusión y evaluarán los comentarios de los alumnos. Se espera que todos los alumnos estén preparados para participar en la discusión, por lo que los profesores, u otros alumnos, podrán interpelar directamente a sus compañeros.

15% - Presentación

Todos los alumnos deben hacer al menos una presentación/discusión de un artículo a lo largo del semestre.

20% - Evaluaciones por pares

Adicionalmente, durante las clases de presentación de artículos por parte de los alumnos, se pedirá a los alumnos presentes que elaboren una breve evaluación de las presentaciones realizadas por sus compañeros. Posteriormente, los profesores valorarán la calidad de estas evaluaciones y las tendrán en cuenta en la calificación de la presentación.

50% - Práctica y informe

Al final del curso, cada alumno debe entregar una práctica que implemente un modelo de inteligencia colectiva, así como realizar una breve demo. La entrega de la práctica irá acompañada de un informe sobre la misma.

10% - Demonstración

Cada alumno debe realizar una demo breve del sistema implementado.

Evaluación en convocatoria extraordinaria

La calificación en convocatoria extraordinaria se obtendrá por los mismos conceptos y porcentajes detallados anteriormente. No será posible re-evaluar las siguientes actividades para la convocatoria extraordinaria: participación en clase, la presentación y las evaluaciones por pares. El alumno debe realizar una práctica que implemente un modelo de inteligencia colectiva, así como un breve informe sobre la misma. Esta práctica, y el informe correspondiente, deberán entregarse en la fecha prevista para dicha evaluación, en la que además se realizarán una demo breve de la práctica desarrollada por el alumno.

7. Teaching resources

7.1. Teaching resources for the subject

Name	Type	Notes
Bonabeau, E., Dorigo, M. and Theraulaz, G., Swarm Intelligence: From Natural to Artificial Systems, 1999.	Bibliography	
Camazine, S. et al., Self-organization in Biological Systems, 2001.	Bibliography	
Floreano, D. and Mattiussi, C., Bio-Inspired Artificial Intelligence: Theories, Methods and Technologies, 2008.	Bibliography	

Artículos relevantes y otra documentación on-line se proporcionarán a lo largo del curso	Others	
Asignatura disponible en la plataforma institucional de teleenseñanza de la UPM	Web resource	

8. Other information

8.1. Other information about the subject

Both the classes and the oral presentations will be held online using Blackboard Collaborate. A link to these classes will be provided in Moodle.

Group and individual help sessions will be held online via Microsoft Teams.

All of these activities will take place according to the degree's timetable.

This course will use Moodle to distribute information and documentation, to announce and submit assignments, and to publish grades.

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Las clases magistrales y las presentaciones orales por parte de los alumnos se realizarán de forma telemática a través de la herramienta institucional Blackboard Collaborate (con enlace en Moodle).

Las tutorías individuales y en grupo se realizarán de forma telemática a través de la herramienta institucional Microsoft Teams.

Todas estas actividades tendrán lugar en los horarios establecidos.

La asignatura se apoya en la herramienta Moodle para proporcionar información y documentación a los alumnos, así como para la asignación de enunciados y entregas de las prácticas, y la comunicación de las calificaciones de

los alumnos.