ANX-PR/CL/001-01

LEARNING GUIDE

SUBJECT

103000881 - Adaptive Systems

DEGREE PROGRAMME

10AZ - Master Universitario En Innovación Digital

ACADEMIC YEAR & SEMESTER

2025/26 - Semester 1

Index

Learning guide

1. Description

1.1. Subject details

Name of the subject	103000881 - Adaptive Systems
No of credits	4.5 ECTS
Type	Optional/elective
Academic year ot the programme	Second year
Semester of tuition	Semester 3
Tuition period	September-January
Tuition languages	English
Degree programme	10AZ - Master Universitario en Innovación Digital
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 *
Jaime Ramirez Rodriguez (Subject coordinator)	5112	jaime.ramirez@upm.es	Sin horario. The tutoring table can be found at: https://upm365-my.sharepoint.com/:x:/g/personal/m_jimenez_upm_es/EUOWGvHaU4JLmXdlpIxt2eQBQZ_wNYlFNXFGLzdiSm0Nqw?e=7Vfgai

Angelica De Antonio Jimenez	5108	angelica.deantonio@upm.es	Tu - 10:30 - 14:00 Th - 09:30 - 12:00 The tutoring table can be found at: https://upm365-my.sharepoint.com/:x:/g/personal/m_jimenez_upm_es/EUOWGvHaU4JLmXdlpIxt2eQBQZ_wNYlFNXFGLzdiSm0Nqw?e=7Vfgai

* The tutoring schedule is indicative and subject to possible changes. Please check tutoring times with the faculty member in charge.

3. Prior knowledge recommended to take the subject

3.1. Recommended (passed) subjects

The subject - recommended (passed), are not defined.

3.2. Other recommended learning outcomes

- Computer programming

4. Skills and learning outcomes *

4.1. Skills to be learned

CB06 - Poseer y comprender conocimientos que aporten una base u oportunidad de ser originales en el desarrollo y/o aplicación de ideas, a menudo en un contexto de investigación

CB07 - 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

CE-DIPO01 - Capacidad para conceptualizar, diseñar y desarrollar la interacción persona-ordenador de productos y servicios innovadores

CG02 - Que los estudiantes desarrollen la autonomía suficiente para participar en proyectos de investigación y colaboraciones científicas o tecnológicas dentro su ámbito temático explorando y generando nuevas ideas sistemáticamente, en contextos interdisciplinares y, en su caso, con una alta componente de transferencia del conocimiento.

CG03 - La capacidad de usar la lengua inglesa de manera competente, es decir, con capacitación para tareas complejas de trabajo y estudio.

CG06 - Capacidad para gestionar la información.

4.2. Learning outcomes

RA51 - Knowledge of Methods for student modelling and individualized and adapted interaction with learning systems

RA12 - Model the user and to design adaptive user interfaces based on the user

* 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.

5. Brief description of the subject and syllabus

5.1. Brief description of the subject

Interaction design methods focused on providing the same content to all users offer limited possibilities in addressing the specific needs and requirements of different types of users. Therefore, an essential feature of certain interactive applications should be their ability to provide some form of automatic adaptation and customization. The main objective of this course is to achieve an understanding of the models, techniques and architectures necessary to make a computer application dynamically adapt to the specific needs and requirements of different types of users at all times.

Adaptive systems maintain a model of the interests, preferences and / or knowledge of each individual user, and use this model to adapt the behavior of the systems to the needs of that user.

This course will cover the main components of the user model in the context of adaptive systems. And within the adaptive systems, the personalized search systems on the Web will be addressed first and it will be explained how these systems are supported by the user model.

Recommendation systems have become essential tools in many areas of application, because they help alleviate information overload as they select the most appropriate content for each user based on their preferences and / or interests. In this sense, these types of systems help users in decision-making by providing personalized services and help information providers and companies to serve customers more effectively.

In this course, the general characteristics of the recommendation systems will be explained and a classification of these systems will be presented according to the type of techniques they use to generate the recommendations. According to this classification, we will distinguish between content-based, collaborative filtering, and hybrid recommenders. Following this, an introduction will be given to the main techniques on which each of these groups of recommenders are based, highlighting the strengths and weaknesses of each group.

E-learning is a traditional domain for the application of personalization and adaptation technologies. One of the main objectives of these applications is to improve the effectiveness and efficiency of learning experiences. The

last topic of the course will be about adaptive e-learning systems paying special attention to intelligent tutoring systems.

5.2. Syllabus

1. User Modeling for Adaptive Systems and Adaptive Web
2. Recommender Systems
   - 2.1. Content based recommender systems
   - 2.2. Collaborative Filter recommender systems
   - 2.3. Context aware recommender systems
   - 2.4. Deep learning applied to Recommender Systems
3. Technology-enhanced adaptive learning

6. Schedule

6.1. Subject schedule*

Week	Type 1 activities	Type 2 activities	Distant / On-line	Assessment activities
1	**Presentation of the subject** Duration: 02:00 Lecture			**Classroom Participation grade** Other assessment Progressive assessment Presential Duration: 02:00
2	**User modeling for Adaptive Systems and Adaptive Web** Duration: 02:00 Lecture			**Classroom Participation grade** Other assessment Progressive assessment Presential Duration: 02:00
3	**Recommender Systems** Duration: 02:00 Lecture			**Classroom Participation grade** Other assessment Progressive assessment Presential Duration: 02:00
4	**Recommender Systems** Duration: 02:00 Lecture			**Classroom Participation grade** Other assessment Progressive assessment Presential Duration: 02:00
5	**Recommender Systems** Duration: 02:00 Lecture			**Exam 1** Online test Progressive assessment and Global Examination Not Presential Duration: 01:00 **Classroom Participation grade** Other assessment Progressive assessment Presential Duration: 02:00
6	**Workshop associated with practical exercise 1** Duration: 02:00 Laboratory assignments			**Practical exercise 1** Group work Progressive assessment and Global Examination Not Presential Duration: 07:00 **Classroom Participation grade** Other assessment Progressive assessment Presential Duration: 02:00

7	**Recommender Systems** Duration: 02:00 Lecture			**Practical exercise 1** Group work Progressive assessment and Global Examination Not Presential Duration: 07:00 **Classroom Participation grade** Other assessment Progressive assessment Presential Duration: 02:00
8	**Recommender Systems** Duration: 02:00 Lecture			**Practical exercise 1** Group work Progressive assessment and Global Examination Not Presential Duration: 20:00 **Classroom Participation grade** Other assessment Progressive assessment Presential Duration: 02:00
9	**Workshop associated with practical exercise 2** Duration: 02:00 Laboratory assignments			**Practical exercise 2** Group work Progressive assessment and Global Examination Not Presential Duration: 20:00 **Classroom Participation grade** Other assessment Progressive assessment Presential Duration: 02:00
10	**Recommender systems** Duration: 02:00 Lecture			**Practical exercise 2** Group work Progressive assessment and Global Examination Not Presential Duration: 20:00 **Classroom Participation grade** Other assessment Progressive assessment Presential Duration: 02:00
11	**Recommender Systems** Duration: 02:00 Lecture			**Practical exercise 2** Group work Progressive assessment and Global Examination Not Presential Duration: 10:00 **Classroom Participation grade** Other assessment Progressive assessment Presential Duration: 02:00

12	**Technology-enhanced adaptive learning** Duration: 02:00 Lecture			**Classroom Participation grade** Other assessment Progressive assessment Presential Duration: 02:00 **Exam 2** Online test Progressive assessment and Global Examination Not Presential Duration: 01:00
13	**Technology-enhanced adaptive learning** Duration: 02:00 Lecture			**Classroom Participation grade** Other assessment Progressive assessment Presential Duration: 02:00
14	**Technology-enhanced adaptive learning** Duration: 01:00 Lecture **Technology-enhanced adaptive learning** Duration: 01:00 Problem-solving class			**Classroom Participation grade** Other assessment Progressive assessment Presential Duration: 02:00
15	**Technology-enhanced adaptive learning (student presentations)** Duration: 01:30 Additional activities **Technology-enhanced adaptive learning** Duration: 00:30 Problem-solving class			**Design of Adaptive Tutoring System** Group presentation Progressive assessment Not Presential Duration: 00:00 **Classroom Participation grade** Other assessment Progressive assessment Presential Duration: 00:00 **Technology-enhanced adaptive learning (student presentations)** Group work Progressive assessment Presential Duration: 01:30
16				
17				

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.

7. Activities and assessment criteria

7.1. Assessment activities

7.1.1. Assessment

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
1	Classroom Participation grade	Other assessment	Face-to-face	02:00	.33%	0 / 10	
2	Classroom Participation grade	Other assessment	Face-to-face	02:00	.33%	0 / 10	CB06 CB07 CG02 CG03 CG06 CE-DIPO01
3	Classroom Participation grade	Other assessment	Face-to-face	02:00	.33%	0 / 10	CB06 CB07 CG02 CG03 CG06 CE-DIPO01
4	Classroom Participation grade	Other assessment	Face-to-face	02:00	.33%	0 / 10	CB06 CB07 CG02 CG03 CG06 CE-DIPO01
5	Exam 1	Online test	No Presential	01:00	5%	0 / 10	CB06 CG03 CG06 CE-DIPO01
5	Classroom Participation grade	Other assessment	Face-to-face	02:00	.33%	0 / 10	CB06 CB07 CG02 CG03 CG06 CE-DIPO01
6	Practical exercise 1	Group work	No Presential	07:00	5%	5 / 10	CB06 CG03 CG06 CE-DIPO01

6	Classroom Participation grade	Other assessment	Face-to-face	02:00	.33%	0 / 10	CB06 CB07 CG02 CG03 CG06 CE-DIPO01
7	Practical exercise 1	Group work	No Presential	07:00	5%	5 / 10	CB06 CG03 CG06 CE-DIPO01
7	Classroom Participation grade	Other assessment	Face-to-face	02:00	.33%	0 / 10	CB06 CB07 CG02 CG03 CG06 CE-DIPO01
8	Practical exercise 1	Group work	No Presential	20:00	15%	5 / 10	CB06 CG03 CG06 CE-DIPO01
8	Classroom Participation grade	Other assessment	Face-to-face	02:00	.33%	0 / 10	CB06 CB07 CG02 CG03 CG06 CE-DIPO01
9	Practical exercise 2	Group work	No Presential	20:00	20%	5 / 10	CB06 CB07 CG02 CG03 CG06 CE-DIPO01
9	Classroom Participation grade	Other assessment	Face-to-face	02:00	.33%	0 / 10	CB06 CB07 CG02 CG03 CG06 CE-DIPO01
10	Practical exercise 2	Group work	No Presential	20:00	10%	5 / 10	CB06 CB07 CG02 CG03 CG06 CE-DIPO01
10	Classroom Participation grade	Other assessment	Face-to-face	02:00	.33%	0 / 10	CB06 CB07 CG02 CG03 CG06 CE-DIPO01

11	Practical exercise 2	Group work	No Presential	10:00	5%	5 / 10	CB06 CB07 CG02 CG03 CG06 CE-DIPO01
11	Classroom Participation grade	Other assessment	Face-to-face	02:00	.33%	0 / 10	CB06 CB07 CG02 CG03 CG06 CE-DIPO01
12	Classroom Participation grade	Other assessment	Face-to-face	02:00	.33%	0 / 10	CB06 CB07 CG02 CG03 CG06 CE-DIPO01
12	Exam 2	Online test	No Presential	01:00	5%	0 / 10	CB06 CG02 CG06
13	Classroom Participation grade	Other assessment	Face-to-face	02:00	.33%	0 / 10	CB06 CB07 CG02 CG03 CG06 CE-DIPO01
14	Classroom Participation grade	Other assessment	Face-to-face	02:00	.33%	0 / 10	CB06 CB07 CG02 CG03 CG06 CE-DIPO01
15	Design of Adaptive Tutoring System	Group presentation	No Presential	00:00	12.5%	5 / 10	CB06 CB07 CG02 CG03 CG06 CE-DIPO01
15	Classroom Participation grade	Other assessment	Face-to-face	00:00	.38%	0 / 10	
15	Technology-enhanced adaptive learning (student presentations)	Group work	Face-to-face	01:30	12.5%	5 / 10	CB06 CG03 CG06 CE-DIPO01

7.1.2. Global examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
5	Exam 1	Online test	No Presential	01:00	5%	0 / 10	CB06 CG03 CG06 CE-DIPO01
6	Practical exercise 1	Group work	No Presential	07:00	5%	5 / 10	CB06 CG03 CG06 CE-DIPO01
7	Practical exercise 1	Group work	No Presential	07:00	5%	5 / 10	CB06 CG03 CG06 CE-DIPO01
8	Practical exercise 1	Group work	No Presential	20:00	15%	5 / 10	CB06 CG03 CG06 CE-DIPO01
9	Practical exercise 2	Group work	No Presential	20:00	20%	5 / 10	CB06 CB07 CG02 CG03 CG06 CE-DIPO01
10	Practical exercise 2	Group work	No Presential	20:00	10%	5 / 10	CB06 CB07 CG02 CG03 CG06 CE-DIPO01
11	Practical exercise 2	Group work	No Presential	10:00	5%	5 / 10	CB06 CB07 CG02 CG03 CG06 CE-DIPO01
12	Exam 2	Online test	No Presential	01:00	5%	0 / 10	CB06 CG02 CG06

7.1.3. Referred (re-sit) examination

Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills

Practical exercise 1	Individual work	Face-to-face	20:00	30%	5 / 10	CB06 CB07 CG02 CG03 CG06 CE-DIPO01
Research topic analysis	Individual work	Face-to-face	20:00	12.5%	5 / 10	CB06 CG03 CG06 CE-DIPO01
Practical exercise 2	Individual work	Face-to-face	40:00	45%	5 / 10	CB06 CB07 CG02 CG03 CG06 CE-DIPO01
Design of Adaptive Tutoring System	Individual work	Face-to-face	20:00	12.5%	5 / 10	CB06 CB07 CG02 CG03 CG06 CE-DIPO01

7.2. Assessment criteria

1. Regular Period

1.1. Distributed evaluation

The final grade (FG) will be calculated from the grades of the Practical Exercises (PEG1, PE2G), the Exam grade (EG), the Classroom Participation grade (CPG), the grade of the Design of Adaptive Tutoring System (DTG), and the Research Topic Analysis grade (RTG) by means of the following formula:

FG=0.25*PEG1+ 0.35*PEG2 + 0.10*EG + 0.125*RTG + 0.125*DTG + 0.05CPG

Where all the grades take values between 0 and 10.

The Exam grade is the average of the grades obtained in the two exams.

The classroom participation grade stands for the ratio of attendance multiplied by 10. Additionally, **students will have to attend some prefixed classes associated with evaluation activities, which will be reported at least 15 days prior to the day of the evaluation activity**.

The grades obtained in the passed parts of the subject will be recorded for the global evaluation and the Extraordinary period if needed.

1.2. Global evaluation

If the student fails to pass the exam grade of the distributed evaluation, he/she will have a second chance in the global evaluation by doing a remedial exam, which will determine the exam grade (EG) of the regular period.

If the student fails to pass some of the practical exercises, he/she will have a second chance in the global evaluation to submit the failed practical exercises.

However, given the proximity of the deadline of the research topic analysis and the Design of the Adaptive Tutoring to the global evaluation, it does not make sense that students can submit these assignments in the global evaluation.

2. Extraordinary Period

When failed, in the extraordinary period the final grade will be obtained from the grades of the Practical Exercises (30% + 45%), the grade of the Design of Adaptive Tutoring System (12.5%), and the Research Topic Analysis grade (12.5%).

8. Teaching resources

8.1. Teaching resources for the subject

Name	Type	Notes
Article	Bibliography	Brusilovsky, Peter, and Eva Millán. 2007. "User Models for Adaptive Hypermedia and Adaptive Educational Systems". The Adaptive Web, 3-53. doi:10.1007/978-3-540-72079-9_1.
book	Bibliography	Ricci, Francesco, Lior Rokach, and Bracha Shapira. 2015. Recommender Systems Handbook. Springer-Verlag. Vol. 54. doi:10.1007/978-0-387-85820-3.
book 2	Bibliography	Brusilovsky, Peter, Alfred Kobsa, and Wolfgang Nejdl. 2007. The Adaptive Web: Methods and Strategies of Web Personalization. The Adaptive Web. Vol. 4321. doi:10.1007/978-3-540-72079-9.
Article 2	Bibliography	O'Donnell, E., Lawless, S., Sharp, M., Wade, V. (2015) A Review of Personalised E-Learning: Towards Supporting Learner Diversity. International Journal of Distance Education Technologies, 13(1), 22-47, January-March 2015

book 3	Bibliography	K. Falk. Practical Recommender Systems. 2019. Publisher: Manning Publications

9. Other information

9.1. Other information about the subject

All the evaluation activities will allow the student to develop also the following skills:

CE-DIPO02: Ability to evaluate the human computer interaction and design of innovative products and services.

CE-DIPO03: Ability to make connections between the wishes and needs of the consumer or client and what technology can offer.

To contact professors, students can use their email addresses included in this document or a Moodle message.

Professors will publish the teaching materials (slides, assignments, etc.) they use throughout the course on the Moodle site of the subject. Additionally, professors will use the Moodle forum to announce key events and provide relevant information on the subject.

Several innovative teaching methodologies are implemented in this course (https://innovacioneducativa.upm.es/guias-pdi) with the goal of motivating and reinforcing student learning:

- Project-Based Learning: This is a learning methodology in which students, working in small groups, are asked to plan, create, and evaluate a project that addresses the needs presented in a given situation.
- Learning by Doing: This is an approach that gives students an active role in the tasks to be carried out, granting them autonomy to resolve the given situation or problem.
- Problem-Based Learning: Students, working in teams, are required to complete two programming assignments based on real-world problems. They must apply the knowledge acquired in the course to solve these problems under the supervision of the instructors. Both assignments begin with two workshops in the classroom, respectively, in which the professor clarifies the goals of the assignments and provides support with technical issues.