ANX-PR/CL/001-01
LEARNING GUIDE

SUBJECT
103000662 - Cognitive systems

DEGREE PROGRAMME
10AP - Eit Digital Master's Programme In Data Science

ACADEMIC YEAR & SEMESTER
2018/19 - Semester 1
Index

Learning guide

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1. Description

1.1. Subject details

<table>
<thead>
<tr>
<th>Name of the subject</th>
<th>103000662 - Cognitive systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>No of credits</td>
<td>4.5 ECTS</td>
</tr>
<tr>
<td>Type</td>
<td>Compulsory</td>
</tr>
<tr>
<td>Academic year of the programme</td>
<td>First year</td>
</tr>
<tr>
<td>Semester of tuition</td>
<td>Semester 1</td>
</tr>
<tr>
<td>Tuition period</td>
<td>September-January</td>
</tr>
<tr>
<td>Tuition languages</td>
<td>English</td>
</tr>
<tr>
<td>Degree programme</td>
<td>10AP - Eit digital master's programme in data science</td>
</tr>
<tr>
<td>Centre</td>
<td>10 - Escuela Tecnica Superior de Ingenieros Informaticos</td>
</tr>
<tr>
<td>Academic year</td>
<td>2018-19</td>
</tr>
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</table>

2. Faculty

2.1. Faculty members with subject teaching role

<table>
<thead>
<tr>
<th>Name and surname</th>
<th>Office/Room</th>
<th>Email</th>
<th>Tutoring hours *</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ernestina Menasalvas Ruiz</td>
<td>4303</td>
<td><a href="mailto:ernestina.menasalvas@upm.es">ernestina.menasalvas@upm.es</a></td>
<td>Sin horario. contact the professor</td>
</tr>
<tr>
<td>(Subject coordinator)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>María Covadonga Fernandez</td>
<td></td>
<td><a href="mailto:mariacovadonga.fernandez@upm.es">mariacovadonga.fernandez@upm.es</a></td>
<td>Sin horario. contact the professor</td>
</tr>
<tr>
<td>Baizan</td>
<td></td>
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</tr>
</tbody>
</table>

GA_10AP_103000662  
1S_2018-19  
Cognitive systems  
Eit Digital Master's Programme In Data Science  
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3. Prior knowledge recommended to take the subject

3.1. Recommended (passed) subjects

El plan de estudios Eit Digital Master's Programme In Data Science no tiene definidas asignaturas previas recomendadas para esta asignatura.

3.2. Other recommended learning outcomes

- Databases
- relational data model
- SQL

4. Skills and learning outcomes *

4.1. Skills to be learned

CE01 - Capacidad para la integración de tecnologías, aplicaciones, servicios y sistemas propios de la Ingeniería Informática, con carácter generalista, y en contextos más amplios y multidisciplinares.

CE08 - Capacidad para analizar las necesidades de información que se plantean en un entorno y llevar a cabo en todas sus etapas el proceso de construcción de un sistema de información.

CG10 - Conocimiento y comprensión de la informática necesaria para la creación de modelos de información, y de los sistemas y procesos complejos

CG14 - Capacidad de trabajar y comunicarse también en contextos internacionales
4.2. Learning outcomes

RA95 - The ability to propose a well-founded approach in any domain where big data can play a role.

RA96 - The capacity to identify and link the key issues related to the use of big data in the main economic, industrial, societal and scientific domains

* 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

In this course we will deepen on the importance of data for an organization. In fact, the course is centered on the process of extraction of knowledge from databases as a support for decision making.

Consequently the course will start with the analysis of data sources in an organization and very briefly analyzed data base management systems. Emphasis will be put on the ethical aspects regarding data management and knowledge extraction.

Later students will understand the data value chain and will go deep into the process of knowledge extraction. At this stage CRISP-Dm methodology will be used.

The course will follow on the different phases of the process: i) business understanding, ii) data understanding, iii) data preparation, iv) modeling v) evaluation and vi) deployment.

Through all the phases the main emphasis will be on students getting hands on the different steps, techiques, algorithms and tools.

The course will end with use cases in different domains.
5.2. Syllabus

1. Introduction
   1.1. Course description.
   1.2. Data Science and Data Scientist Skills.
   1.3. The Value hidden in data.

2. Operational Data bases Vs Decisional databases
   2.1. The BIG Data Value Chain.
   2.2. Data Warehouse.
   2.3. Data Lakes

3. The process of Knowledge Discovery in Databases
   3.1. CRISP-DM

4. Business Understanding
   4.1. Goal of BU.
   4.2. Planning of a DataScience project.

5. Data Understanding
   5.1. Understanding data.
   5.2. Nulls and outliers detection.
   5.3. Correlation analysis

6. Data Preparation
   6.1. Preparing data for mining: dealing with problems encountered in understanding, transforming data, discretization, data reduction, aggregation, ?.

7. Data mining/data modeling
   7.1. Type of problems. Data nature, data problems and possible algorithms.
   7.2. Classification, association and clustering
   7.3. Complex Networks

8. Evaluation and Deployment
   8.1. Evaluation of the models.
   8.2. Deployment of the models
9. Ethics

9.1. GDPR and implications in Data Science

10. Extraction of knowledge from data in different domains

10.1. Data Science in the medical domain
### 6. Schedule

#### 6.1. Subject schedule*

<table>
<thead>
<tr>
<th>Week</th>
<th>Face-to-face classroom activities</th>
<th>Face-to-face laboratory activities</th>
<th>Other face-to-face activities</th>
<th>Assessment activities</th>
</tr>
</thead>
</table>
| 1    | Unit 1  
Duration: 02:00  
Lecture |  |  |  |
| 2    | Unit 2  
Duration: 01:00  
Lecture | Unit 2  
Duration: 01:00  
Problem-solving class |  |  |
| 3    | Unit 3  
Duration: 01:00  
Lecture | Unit 3  
Duration: 01:00  
Problem-solving class |  |  |
| 4    | Unit 4  
Duration: 01:00  
Lecture | Unit 4  
Duration: 01:00  
Problem-solving class |  |  |
| 5    | Unit 5  
Duration: 01:00  
Lecture | Unit 5  
Duration: 01:00  
Problem-solving class |  |  |
| 6    | Unit 6  
Duration: 01:00  
Lecture | Unit 6  
Duration: 01:00  
Problem-solving class |  |  |
| 7    | Unit 6  
Duration: 01:00  
Lecture | Unit 6  
Duration: 01:00  
Problem-solving class |  |  |
| 8    | Unit 6  
Duration: 01:00  
Lecture | Unit 6  
Duration: 01:00  
Problem-solving class |  |  |
| 9    | Unit 7  
Duration: 01:00  
Lecture | Unit 7  
Duration: 01:00  
Problem-solving class |  |  |
| 10   | Unit 7  
Duration: 01:00  
Lecture | Unit 7  
Duration: 01:00  
Problem-solving class |  | Evaluation First Assignment  
Group presentation  
Continuous assessment  
Duration: 02:00 |
| 11   | Unit 7  
Duration: 01:00  
Lecture | Unit 7  
Duration: 01:00  
Problem-solving class |  |  |
| 12   | Unit 8  
Duration: 01:00  
Lecture | Unit 8  
Duration: 01:00  
Problem-solving class |  |  |
| 13   | Unit 8  
Duration: 01:00  
Lecture | Unit 8  
Duration: 01:00  
Problem-solving class |  |  |
The independent study hours are training activities during which students should spend time on individual study or individual assignments.

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 subject schedule is based on a previous theoretical planning of the subject plan and might go through experience some unexpected changes along throughout the academic year.
7. Activities and assessment criteria

7.1. Assessment activities

7.1.1. Continuous assessment

<table>
<thead>
<tr>
<th>Week</th>
<th>Description</th>
<th>Modality</th>
<th>Type</th>
<th>Duration</th>
<th>Weight</th>
<th>Minimum grade</th>
<th>Evaluated skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>Evaluation First Assignment</td>
<td>Group presentation</td>
<td>Face-to-face</td>
<td>02:00</td>
<td>25%</td>
<td>4 / 10</td>
<td>CE01 CE14 CG10 CE08</td>
</tr>
<tr>
<td>16</td>
<td>Evaluation Second Assignment</td>
<td>Group presentation</td>
<td>Face-to-face</td>
<td>02:00</td>
<td>25%</td>
<td>4 / 10</td>
<td>CE01 CE14 CG10 CE08</td>
</tr>
<tr>
<td>17</td>
<td>Exam</td>
<td>Written test</td>
<td>Face-to-face</td>
<td>02:00</td>
<td>50%</td>
<td>4 / 10</td>
<td>CE01 CE14 CG10 CE08</td>
</tr>
</tbody>
</table>

7.1.2. Final examination

<table>
<thead>
<tr>
<th>Week</th>
<th>Description</th>
<th>Modality</th>
<th>Type</th>
<th>Duration</th>
<th>Weight</th>
<th>Minimum grade</th>
<th>Evaluated skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
<td>Exam</td>
<td>Written test</td>
<td>Face-to-face</td>
<td>02:00</td>
<td>100%</td>
<td>5 / 10</td>
<td>CE01 CE14 CG10 CE08</td>
</tr>
</tbody>
</table>

7.1.3. Referred (re-sit) examination

<table>
<thead>
<tr>
<th>Description</th>
<th>Modality</th>
<th>Type</th>
<th>Duration</th>
<th>Weight</th>
<th>Minimum grade</th>
<th>Evaluated skills</th>
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<tr>
<td>Exam in July</td>
<td>Written test</td>
<td>Face-to-face</td>
<td>02:00</td>
<td>100%</td>
<td>5 / 10</td>
<td>CE01 CE14 CG10 CE08</td>
</tr>
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</table>
7.2. Assessment criteria

The "only final exam" evaluation will only be offered if the UPM "Normativa Reguladora de los Sistemas de Evaluación" requires so in the academic year 2015-2016, and the procedure to opt in will be as stated by the head of studies. Continuous evaluation: The course will be evaluated by:

- 2 practical assignments,
- 1 exam

Attendance is mandatory (It is allowed not to attend up to 6 hours without proper justification)

Practical assignments will be done in groups among those enrolled in the course at the beginning of the academic year (nature and number of components will be established at the beginning of the course, depending on the number of students enrolled).

In order to pass the course in the fall semester the requirements are:

- 1. To obtain a minimum of 50 points out of 100 in the added evaluation.
- 2. It is MANDATORY to do the exam and do the practical assignment.
- 3. In the exam and on the practical assignments students must obtain a minimum of 40%.

Final score will be calculated as follows:

- 45% Practical assignment (divided between the two assignments)
- 10% Oral presentation
- 45% Final exam

Final exam evaluation: Those students whose extraordinary circumstances cannot perform the continuous evaluation, and having done the final exam evaluation written petition during the first 15 days of the course, will perform the final exam evaluation without having the opportunity to do the continuous evaluation;

Those students failing to attend 85% of of the lectures will also do the final evaluation.

In these premises, the final exam evaluation will consist of an exam as stated by the head of studies.

Measures against copies and fraud Rights and duties of college students are gathered on the statues of the
Universidad Politécnica de Madrid (BOCM de 15 de noviembre de 2010) and in the statutes of the college student (RD 1791/2010 de 30 de diciembre). Article 124 a) of EUPM fixes the duty of the student... “to follow with responsibility and taking advantage of the learning process, knowledge acquisition correspondent to its condition of college student”... and the article 13 of the statutes of the college student in its point d) also specifies as duty of the college student “abstain from the use or cooperation in fraudulent procedures in the evaluation assessments, in the assignments developed or in the official documents of the university”. In the case that in the development of the evaluation assessments it is appreciated a breach in the duties as college student, the subject coordinator may communicate the headmaster as established in the article 74 (n) of EUPM to have the competences to "propose the initiation of a disciplinary procedure to any College member, by its own initiative or as instance from the "Comisión de Gobierno" to the Rector, pursuant to the statutes and rules of application.

8. Teaching resources

8.1. Teaching resources for the subject

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Notes</th>
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<tbody>
<tr>
<td>Moodle</td>
<td>Web resource</td>
<td><a href="http://moodle.upm.es">http://moodle.upm.es</a></td>
</tr>
<tr>
<td>IBM Watson - How it works</td>
<td>Web resource</td>
<td><a href="http://www.youtube.com/watch?v=_Xcmh1LQB9I">http://www.youtube.com/watch?v=_Xcmh1LQB9I</a></td>
</tr>
<tr>
<td>Database Systems: The Complete Book (DS:CB), by Hector Garcia-Molina, Jeff Ullman, and Jennifer Widom</td>
<td>Bibliography</td>
<td></td>
</tr>
<tr>
<td>&quot;MySQL Administrator´s Bible&quot;. Sheeri K. Cabral and Keith Murphy. Wiley</td>
<td>Bibliography</td>
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</table>
Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Introduction to Data Mining, Pearson Addison Wesley (May, 2005).