# Course guide
# 270227 - PE - Engineering Projects

**Last modified:** 30/01/2024

**Unit in charge:** Barcelona School of Informatics
**Teaching unit:** 709 - DEE - Department of Electrical Engineering.
701 - DAC - Department of Computer Architecture.
739 - TSC - Department of Signal Theory and Communications.
723 - CS - Department of Computer Science.
732 - OE - Department of Management.

**Degree:** BACHELOR'S DEGREE IN DATA SCIENCE AND ENGINEERING (Syllabus 2017). (Compulsory subject).

**Academic year:** 2023 **ECTS Credits:** 12.0 **Languages:** Catalan, Spanish, English

## LECTURER

**Coordinating lecturer:** ALBERTO CABELLOS APARICIO

**Others:** Segon quadrimestre:
ELISENDA BONET CARNÉ - 13
ALBERTO CABELLOS APARICIO - 11, 12, 13
ALEXANDRE GRACIA CALVO - 12
CARLOS LOPEZ MARTINEZ - 11
JOSE ADRIAN RODRIGUEZ FONOLLOSA - 13
EVA RODRIGUEZ LUNA - 11
JOAN SARDA FERRER - 11, 12, 13

## PRIOR SKILLS

Have completed Entrepreneurship and Innovation (EI)

## DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

**Specific:**
CE1. Skillfully use mathematical concepts and methods that underlie the problems of science and data engineering.
CE10. Visualization of information to facilitate the exploration and analysis of data, including the choice of adequate representation of these and the use of dimensionality reduction techniques.
CE11. Within the corporate context, understand the innovation process, be able to propose models and business plans based on data exploitation, analyze their feasibility and be able to communicate them convincingly.
CE12. Apply the project management practices in the integral management of the data exploitation engineering project that the student must carry out in the areas of scope, time, economic and risks.
CE13. (End-of-degree work) Plan and design and carry out projects of a professional nature in the field of data engineering, leading its implementation, continuous improvement and valuing its economic and social impact. Defend the project developed before a university court.
CE2. To be able to program solutions to engineering problems: Design efficient algorithmic solutions to a given computational problem, implement them in the form of a robust, structured and maintainable program, and check the validity of the solution.
CE3. Analyze complex phenomena through probability and statistics, and propose models of these types in specific situations. Formulate and solve mathematical optimization problems.
CE4. Use current computer systems, including high performance systems, for the process of large volumes of data from the knowledge of its structure, operation and particularities.
CE5. Design and apply techniques of signal processing, choosing between different technological tools, including those of Artificial vision, speech recognition and multimedia data processing.
CE6. Build or use systems of processing and comprehension of written language, integrating it into other systems driven by the data. Design systems for searching textual or hypertextual information and analysis of social networks.
CE7. Demonstrate knowledge and ability to apply the necessary tools for the storage, processing and access to data.
CE8. Ability to choose and employ techniques of statistical modeling and data analysis, evaluating the quality of the models, validating and interpreting them.
CE9. Ability to choose and employ a variety of automatic learning techniques and build systems that use them for decision making, even autonomously.

**Generical:**
CG1. To design computer systems that integrate data of provenances and very diverse forms, create with them mathematical models, reason on these models and act accordingly, learning from experience.
CG2. Choose and apply the most appropriate methods and techniques to a problem defined by data that represents a challenge for its volume, speed, variety or heterogeneity, including computer, mathematical, statistical and signal processing methods.
CG3. Work in multidisciplinary teams and projects related to the processing and exploitation of complex data, interacting fluently with engineers and professionals from other disciplines.
CG4. Identify opportunities for innovative data-driven applications in evolving technological environments.

**Transversal:**
CT1. Entrepreneurship and innovation. Know and understand the organization of a company and the sciences that govern its activity; Have the ability to understand labor standards and the relationships between planning, industrial and commercial strategies, quality and profit.
CT2. Sustainability and Social Commitment. To know and understand the complexity of economic and social phenomena typical of the welfare society; Be able to relate well-being to globalization and sustainability; Achieve skills to use in a balanced and compatible way the technique, the technology, the economy and the sustainability.
CT3. Efficient oral and written communication. Communicate in an oral and written way with other people about the results of learning, thinking and decision making; Participate in debates on topics of the specialty itself.
CT4. Teamwork. Be able to work as a member of an interdisciplinary team, either as a member or conducting management tasks, with the aim of contributing to develop projects with pragmatism and a sense of responsibility, taking commitments taking into account available resources.
CT7. Third language. Know a third language, preferably English, with an adequate oral and written level and in line with the needs of graduates.

**Basic:**
CB2. That the students know how to apply their knowledge to their work or vocation in a professional way and possess the skills that are usually demonstrated through the elaboration and defense of arguments and problem solving within their area of ??study.
CB3. That students have the ability to gather and interpret relevant data (usually within their area of ??study) to make judgments that include a reflection on relevant social, scientific or ethical issues.
CB4. That the students can transmit information, ideas, problems and solutions to a specialized and non-specialized public.
CB5. That the students have developed those learning skills necessary to undertake later studies with a high degree of autonomy

## TEACHING METHODOLOGY

In this subject the work plan designed to implement and validate the functional prototype of the product or service designed in the Entrepreneurship and Innovation (EI) subject is carried out. Therefore, most of the hours are hands-on in the lab, with faculty present to support and monitor the progress of the project (90). There are also a significant number of hours of autonomous, individual or subgroup work (180). At the same time, the concepts associated with the business plan are actively reviewed and revised and completed in a way that is consistent with the technical implementation developed. The responsibility for defining and monitoring the work plan corresponds to the team, mainly to the team leader. A follow-up meeting is held every week and there is, at least, three presentations to the external company or institution (Preliminary Design Review, Critical Design Review, Final Design Review)

## LEARNING OBJECTIVES OF THE SUBJECT

1.Complete the objectives of the Entrepreneurship and Innovation subject by improving the business plan developed on the same product or service.
2.From the technical solution developed in the project, to deepen the knowledge and methodologies acquired in the different subjects of the degree and to add value from their integration.
3.Conceive, design, implement and plan the operation and complete life cycle of a product or service, based on the challenge defined by an external company or institution. Obtain the results of learning of the transversal and generic skills from a team work context on a high complexity design challenge.

## STUDY LOAD

| Type | Hours | Percentage |
|---|---|---|
| Self study | 180,0 | 60.00 |
| Hours small group | 48,0 | 16.00 |
| Hours large group | 72,0 | 24.00 |

**Total learning time:** 300 h

## CONTENTS

**Specific technical contents.**

**Description:**
Depending on the topic of the project, it may be necessary to impart specific contents, additional to those obtained in previous subjects.

**Advanced and reinforcing content for the business plan.**

**Description:**
Although this part has been covered in the previous Entrepreneurship and Innovation subject, there will be seminars and tutorials to complete and improve the final version of the business plan as it may have modifications as you implement the technical solution. Includes: Training of work teams. Refining the Business Model. Refining the product or service design. Refining the marketing plan. Business development. Legislation and regulations. Intellectual property. Business plan. Provisional financial statements. Treasury plan. Analysis of economic, environmental and social sustainability.

## ACTIVITIES

### Seminars

**Description:**
Strengthening and mentoring the aspects associated with the business plan, the legal aspects and the sustainability of the project, applied to the specific case of the project being developed.

**Specific objectives:**
1, 3

**Related competencies :**
CG4. Identify opportunities for innovative data-driven applications in evolving technological environments.
CG3. Work in multidisciplinary teams and projects related to the processing and exploitation of complex data, interacting fluently with engineers and professionals from other disciplines.
CT7. Third language. Know a third language, preferably English, with an adequate oral and written level and in line with the needs of graduates.
CT2. Sustainability and Social Commitment. To know and understand the complexity of economic and social phenomena typical of the welfare society; Be able to relate well-being to globalization and sustainability; Achieve skills to use in a balanced and compatible way the technique, the technology, the economy and the sustainability.
CT3. Efficient oral and written communication. Communicate in an oral and written way with other people about the results of learning, thinking and decision making; Participate in debates on topics of the specialty itself.
CT1. Entrepreneurship and innovation. Know and understand the organization of a company and the sciences that govern its activity; Have the ability to understand labor standards and the relationships between planning, industrial and commercial strategies, quality and profit.
CT4. Teamwork. Be able to work as a member of an interdisciplinary team, either as a member or conducting management tasks, with the aim of contributing to develop projects with pragmatism and a sense of responsibility, taking commitments taking into account available resources.
CB4. That the students can transmit information, ideas, problems and solutions to a specialized and non-specialized public.
CB3. That students have the ability to gather and interpret relevant data (usually within their area of ??study) to make judgments that include a reflection on relevant social, scientific or ethical issues.
CB2. That the students know how to apply their knowledge to their work or vocation in a professional way and possess the skills that are usually demonstrated through the elaboration and defense of arguments and problem solving within their area of ??study.
CB5. That the students have developed those learning skills necessary to undertake later studies with a high degree of autonomy

**Full-or-part-time:** 48h
Theory classes: 28h
Self study: 20h

**Presentation of initial project planning (Preliminary Design Review)**

**Description:**
Preparation and presentation of the project plan in public for validation.

**Specific objectives:**
3

**Related competencies :**
CT7. Third language. Know a third language, preferably English, with an adequate oral and written level and in line with the needs of graduates.
CT2. Sustainability and Social Commitment. To know and understand the complexity of economic and social phenomena typical of the welfare society; Be able to relate well-being to globalization and sustainability; Achieve skills to use in a balanced and compatible way the technique, the technology, the economy and the sustainability.
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**Full-or-part-time:** 6h
Laboratory classes: 2h
Self study: 4h

**Presentation of the critical review of the progress of the project (Critical Design Review)**

**Description:**
Mid-term presentation of the critical review of the project (Critical Design Review) in order to detect malfunctions or forecasts that are difficult to fulfill and correct them.

**Specific objectives:**
3

**Related competencies :**
CT7. Third language. Know a third language, preferably English, with an adequate oral and written level and in line with the needs of graduates.
CT2. Sustainability and Social Commitment. To know and understand the complexity of economic and social phenomena typical of the welfare society; Be able to relate well-being to globalization and sustainability; Achieve skills to use in a balanced and compatible way the technique, the technology, the economy and the sustainability.
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CB5. That the students have developed those learning skills necessary to undertake later studies with a high degree of autonomy

**Full-or-part-time:** 6h
Laboratory classes: 2h
Self study: 4h

**Final presentation of the project (Final design Review)**

**Description:**
Final presentation of the project and the associated business plan (Final Design Review). Depending on the confidentiality agreement with the external institution that has proposed it, it can be done in conjunction with other projects or behind closed doors only with representatives of the institution.

**Specific objectives:**
1, 2, 3

**Related competencies :**
CG4. Identify opportunities for innovative data-driven applications in evolving technological environments.
CG2. Choose and apply the most appropriate methods and techniques to a problem defined by data that represents a challenge for its volume, speed, variety or heterogeneity, including computer, mathematical, statistical and signal processing methods.
CG1. To design computer systems that integrate data of provenances and very diverse forms, create with them mathematical models, reason on these models and act accordingly, learning from experience.
CG3. Work in multidisciplinary teams and projects related to the processing and exploitation of complex data, interacting fluently with engineers and professionals from other disciplines.
CE5. Design and apply techniques of signal processing, choosing between different technological tools, including those of Artificial vision, speech recognition and multimedia data processing.
CE7. Demonstrate knowledge and ability to apply the necessary tools for the storage, processing and access to data.
CE2. To be able to program solutions to engineering problems: Design efficient algorithmic solutions to a given computational problem, implement them in the form of a robust, structured and maintainable program, and check the validity of the solution.
CE6. Build or use systems of processing and comprehension of written language, integrating it into other systems driven by the

data. Design systems for searching textual or hypertextual information and analysis of social networks.
CE10. Visualization of information to facilitate the exploration and analysis of data, including the choice of adequate representation of these and the use of dimensionality reduction techniques.
CE13. (End-of-degree work) Plan and design and carry out projects of a professional nature in the field of data engineering, leading its implementation, continuous improvement and valuing its economic and social impact. Defend the project developed before a university court.
CE4. Use current computer systems, including high performance systems, for the process of large volumes of data from the knowledge of its structure, operation and particularities.
CE8. Ability to choose and employ techniques of statistical modeling and data analysis, evaluating the quality of the models, validating and interpreting them.
CE1. Skillfully use mathematical concepts and methods that underlie the problems of science and data engineering.
CE12. Apply the project management practices in the integral management of the data exploitation engineering project that the student must carry out in the areas of scope, time, economic and risks.
CE3. Analyze complex phenomena through probability and statistics, and propose models of these types in specific situations. Formulate and solve mathematical optimization problems.
CE9. Ability to choose and employ a variety of automatic learning techniques and build systems that use them for decision making, even autonomously.
CE11. Within the corporate context, understand the innovation process, be able to propose models and business plans based on data exploitation, analyze their feasibility and be able to communicate them convincingly.
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**Full-or-part-time:** 10h
Theory classes: 2h
Laboratory classes: 2h
Self study: 6h

**Technical realization of the project**

**Description:**
Execution of the work plan

**Specific objectives:**
2, 3

**Related competencies :**
CG2. Choose and apply the most appropriate methods and techniques to a problem defined by data that represents a challenge for its volume, speed, variety or heterogeneity, including computer, mathematical, statistical and signal processing methods.
CG1. To design computer systems that integrate data of provenances and very diverse forms, create with them mathematical models, reason on these models and act accordingly, learning from experience.
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CE12. Apply the project management practices in the integral management of the data exploitation engineering project that the student must carry out in the areas of scope, time, economic and risks.
CE3. Analyze complex phenomena through probability and statistics, and propose models of these types in specific situations. Formulate and solve mathematical optimization problems.
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CB5. That the students have developed those learning skills necessary to undertake later studies with a high degree of autonomy

**Full-or-part-time:** 183h
Laboratory classes: 84h
Self study: 99h

## GRADING SYSTEM

A global mark is assigned to the project developed by the team using a rubric that takes into account the different aspects of the process, the final result and the presentations that have been made by the team.
This mark is modulated for each component of the group with three coefficients, with a modulation rate of 20% each. One is determined from the evidences collected by the teaching staff in the in-person sessions, the other is determined by the team leader with the points-bag procedure and the other by the co-assessment carried out by all members of the team using a rubric. In the latter case, the team leader is evaluated for his or her role as a team leader.

Apart from the natural imbrication of the basic and transversal specified skills in the development of the course and on its assessment, the following transversal skills are explicitly evaluated using a qualitative scale (A, B, C, D, NA):
CT1 - Entrepreneurship and innovation. From the continuation or adaptation of the development of the business model designed in EI and the inclusion of innovative aspects in the technical solution.
CT3 - Effective oral and written communication. From the evaluation by rubrics of the reports and of the intermediate and final presentations.
CT4 - Teamwork. Based on the evidences collected by the supervisors in the team meetings and on the final rubric of peer assessment.

Although the fair fulfilment of the assigned tasks should lead to a favourable assessment, in the event that the subject is failed, students are entitled, in accordance with the academic regulations of the degree, to a re-evaluation test which would consist of an individual presentation in front of a committee of the overall project and of the individual contribution. The panel would consist of the subject coordinator, one of their teachers and an external member who is a teacher of a project subject of another degree. In this case the final mark is the maximum between the regular mark and the re-evaluation mark.

## BIBLIOGRAPHY

**Basic:**
- Ulrich, K.T.; Eppinger, S.D.; Yang, M.C. Product design and development. 7th ed. New York, NY: McGraw-Hill Education, 2019. ISBN 9781260566437.