



Course guide

270427 - PAID - Processes of Intelligent Data Analysis

Last modified: 02/02/2024

Unit in charge: Barcelona School of Informatics
Teaching unit: 715 - EIO - Department of Statistics and Operations Research.
Degree: BACHELOR'S DEGREE IN ARTIFICIAL INTELLIGENCE (Syllabus 2021). (Compulsory subject).
Academic year: 2023 **ECTS Credits:** 6.0 **Languages:** Catalan

LECTURER

Coordinating lecturer: SERGI RAMIREZ MITJANS - CARINA GIBERT OLIVERAS

Others: Segon quadrimestre:
XAVIER ANGERRI TORREDEFLOT - 11
CARINA GIBERT OLIVERAS - 11, 12
SERGI RAMIREZ MITJANS - 12

PRIOR SKILLS

In this subject the techniques seen in a large part of the subjects of the preceding subjects such as "Probability and Statistics", "Intelligent Data Analysis", "Machine Learning", "Logic, Automatic Reasoning and "Knowledge-Based Systems" and " Human language processing and perception"

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

CE09. To ideate, design and integrate intelligent data analysis systems with their application in production and service environments.
CE17. To develop and evaluate interactive systems and presentation of complex information and its application to solving human-computer and human-robot interaction design problems.
CE18. To acquire and develop computational learning techniques and to design and implement applications and systems that use them, including those dedicated to the automatic extraction of information and knowledge from large volumes of data.
CE20. To select and put to use techniques of statistical modeling and data analysis, assessing the quality of the models, validating and interpreting.

Generical:

CG1. To ideate, draft, organize, plan and develop projects in the field of artificial intelligence.

CG2. To use the fundamental knowledge and solid work methodologies acquired during the studies to adapt to the new technological scenarios of the future.

CG3. To define, evaluate and select hardware and software platforms for the development and execution of computer systems, services and applications in the field of artificial intelligence.

CG4. Reasoning, analyzing reality and designing algorithms and formulations that model it. To identify problems and construct valid algorithmic or mathematical solutions, eventually new, integrating the necessary multidisciplinary knowledge, evaluating different alternatives with a critical spirit, justifying the decisions taken, interpreting and synthesizing the results in the context of the application domain and establishing methodological generalizations based on specific applications.

CG5. Work in multidisciplinary teams and projects related to artificial intelligence and robotics, interacting fluently with engineers and professionals from other disciplines.

CG7. To interpret and apply current legislation, as well as specifications, regulations and standards in the field of artificial intelligence.

CG8. Perform an ethical exercise of the profession in all its facets, applying ethical criteria in the design of systems, algorithms, experiments, use of data, in accordance with the ethical systems recommended by national and international organizations, with special emphasis on security, robustness, privacy, transparency, traceability, prevention of bias (race, gender, religion, territory, etc.) and respect for human rights.

CG9. To face new challenges with a broad vision of the possibilities of a professional career in the field of Artificial Intelligence. Develop the activity applying quality criteria and continuous improvement, and act rigorously in professional development. Adapt to organizational or technological changes. Work in situations of lack of information and / or with time and / or resource restrictions.

Transversal:

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.

CT6. Autonomous Learning. Detect deficiencies in one's own knowledge and overcome them through critical reflection and the choice of the best action to extend this knowledge.

CT8. (ENG) Perspectiva de gènere. Conèixer i comprendre, des del propi àmbit de la titulació, les desigualtats per raó de sexe i gènere a la societat; Integrar les diferents necessitats i preferències per raó de sexe i de gènere en el disseny de solucions i resolució de problemes.

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

The 12 suggested topics will be developed in 12 theoretical class sessions (2 hours per week) with their respective practices or associated laboratory session (also 2 hours per week).

The 3 sessions that are missing from the 15 sessions per semester established in the FIB, will be used for theoretical evaluations (quiz or similar) and practical evaluations (defense of practical work in the middle of the semester and at the end of the semester), remembering also that there are a couple of non-teaching weeks to be mid-term and/or final exam week, during which advice, support and guidance can be offered to students as reinforcement or preparation for their assessments.

In the theory classes, the inverted class scheme will be practiced whenever possible.

There is a web page for the subject.

The temporary distribution of the subject's contents and the materials to be brought prepared before each class will be published on this platform(s).

The master class outline will be used on occasion when the teacher needs to clarify complex concepts that have not been clear with the materials previously distributed in class.

The theory class will be mainly devoted to the presentation of cases and the development of interactive activities with the students such as the discussion of the cases, or the completion of specific short questionnaires.

One of the activities of the theory classes of the course will be the approach of real cases with proposals for the design of the intelligent data system to support certain decisions and the open discussion in the classroom about the strengths and weaknesses of the proposed design. This activity is fundamental to train the student in designing solvent, safe, viable processes with little risk of bankruptcy when we talk about real environments. Methodological questions to be clarified by the teacher will derive from the result of the debate.

Additionally, the students will perform in groups a good number of short practical works on the design of intelligent data analysis processes in more or less mature scenarios from a technological point of view where the entire process will have to be done from the eventual collection or identification of data sources or knowledge up to the communication of results and recommendations with the user.

The analysis case can be proposed by the students themselves based on certain characteristics set by the teaching staff. Each team will carry out practice sessions, each week applying the techniques seen in the course to tackle the challenge. The teacher will monitor all the work teams weekly in the laboratory sessions. The design proposal will include a proof of concept as far as the means of the subject allow for the proposed proposal.

Twice a year the teams will present their proposals in a sharing session where all the projects will be discussed together.

Supporting material resources include:

- * Slides/Transparencies for each subject in pdf format or similar.
- * Links to articles, forums, discussions or practical cases in congruent and reliable repositories for the subject.
- * Videos or similar to show case studies or complementary topics to master classes.
- * Use of GNU software for the practical part. The use of R, RStudio and similar platforms is suggested.
- * You can use specialized software developed by research groups within the UPC such as GESCONDA and Klass, Freeling, etc.

LEARNING OBJECTIVES OF THE SUBJECT

1. Solving available open data sources in combination with private data
2. Identify what kind of preprocessing real data needs
3. Know methods of integrated analysis of data and knowledge and be able to apply them correctly to a real problem
4. Given a problem, data and perspectives for using the model, knowing how to choose the best model to apply among all those seen in the subject and in the previous ones
5. Combine the results of data-driven models with useful knowledge production methods for subsequent decision-making
6. Identify the reporting or visualization tools most suitable for a specific problem.
7. Integrate the tools and models that are known in the design of an intelligent data analysis process suitable for a specific problem.
8. Master the technologies of putting into production an intelligent data analysis process.
9. Be aware of AI's digital footprint and be able to apply strategies that reduce it in a process of intelligent data analysis.
10. Integrate intelligent data analysis processes into intelligent decision support system architectures.
11. Being able to document new methods or technologies autonomously
12. Understand the ethical principles of the current AI model and assess whether we can implement it in the debate.
13. Be able to document yourself about new methods or technologies independently and be able to self-train in the future.



STUDY LOAD

Type	Hours	Percentage
Self study	90,0	60.00
Hours large group	30,0	20.00
Hours small group	30,0	20.00

Total learning time: 150 h

CONTENTS

Introduction. The insertion of the data in the real decision processes

Description:

General outline of a data process (pre-processing, processing, post-processing, interpretation, insertion in the decision process)

Intelligent decision-making support systems

Description:

Intelligent decision-making support systems

Design of relevant data sources for a decision-making process

Description:

The relevant sources of information (data, images, videos, knowledge); static/dynamic; open, sample, experimental data
Linking the data with the objectives of the study. Data representativeness, biases and compensation policies
Best practices from design.

Integrated preprocessing design

Description:

Construction of data preprocessing organizational charts for complex projects
Role of study objectives and data models to be trained in data preprocessing processes

Choice of data modeling methods for the decision support process

Description:

- Integration of the DMMCM map in the method selection process
- The DMMT model of representation of the data-based methods
- Relation between the available methods and the objectives of the study
- Relation between the available methods and the available data
- Relation between the available method and the intended use of the model

Determination of knowledge models

Description:

Criteria for determining the knowledge representation models to integrate in the decision process (ontologies, knowledge bases, linguistic labels, etc.)

Relationship between knowledge components and data-based models in the decision support process

Knowledge representation and explainability of data models Mixed components of data and knowledge

Other components of the decision process

Description:

Display

User interface

Modes of interaction with the user (voice, text, etc etc)

Insertion of intelligent data analysis in administrative processes

Description:

Real cases related to public administration, hospital administration, large corporations, etc. will be worked on

Insertion of intelligent data analysis in industrial processes

Description:

Real industry 4.0 cases will be worked on

Insertion of intelligent data analysis in business processes

Description:

Real cases will be worked on to improve business processes through the insertion of data and intelligent analysis (retailing, negotiations, etc.)

Insertion of intelligent data analysis in strategic decision processes

Description:

Real cases in the field of defining business strategies and drafting public policies

Ethical considerations and the carbon footprint of AI

Description:

European ethical models, assessment tools Carbon footprint of AI, strategies to reduce it



ACTIVITIES

Introduction The insertion of the data in the real decision processes

Specific objectives:

2

Related competencies :

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CG4. Reasoning, analyzing reality and designing algorithms and formulations that model it. To identify problems and construct valid algorithmic or mathematical solutions, eventually new, integrating the necessary multidisciplinary knowledge, evaluating different alternatives with a critical spirit, justifying the decisions taken, interpreting and synthesizing the results in the context of the application domain and establishing methodological generalizations based on specific applications.

Full-or-part-time: 4h

Theory classes: 2h

Self study: 2h

Introduction to practices and training of work teams

Full-or-part-time: 2h

Laboratory classes: 2h



Intelligent decision-making support systems

Specific objectives:

2, 3, 4

Related competencies :

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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.

CT8. (ENG) Perspectiva de gènere. Conèixer i comprendre, des del propi àmbit de la titulació, les desigualtats per raó de sexe i gènere a la societat; Integrar les diferents necessitats i preferències per raó de sexe i de gènere en el disseny de solucions i resolució de problemes.

CB5. That the students have developed those learning skills necessary to undertake later studies with a high degree of autonomy

Full-or-part-time: 4h

Theory classes: 2h

Self study: 2h



Design of relevant data sources for a decision-making process

Specific objectives:

1, 5

Related competencies :

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CT6. Autonomous Learning. Detect deficiencies in one's own knowledge and overcome them through critical reflection and the choice of the best action to extend this knowledge.

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Full-or-part-time: 8h

Theory classes: 2h

Self study: 6h



Integrated preprocessing design

Specific objectives:

6, 7, 8

Related competencies :

CG7. To interpret and apply current legislation, as well as specifications, regulations and standards in the field of artificial intelligence.

CG2. To use the fundamental knowledge and solid work methodologies acquired during the studies to adapt to the new technological scenarios of the future.

CG3. To define, evaluate and select hardware and software platforms for the development and execution of computer systems, services and applications in the field of artificial intelligence.

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CE18. To acquire and develop computational learning techniques and to design and implement applications and systems that use them, including those dedicated to the automatic extraction of information and knowledge from large volumes of data.

CB4. That the students can transmit information, ideas, problems and solutions to a specialized and non-specialized public.

Full-or-part-time: 6h

Theory classes: 2h

Self study: 4h



Choice of data modeling methods for the decision support process

Specific objectives:

2, 3, 4

Related competencies :

CG2. To use the fundamental knowledge and solid work methodologies acquired during the studies to adapt to the new technological scenarios of the future.

CG8. Perform an ethical exercise of the profession in all its facets, applying ethical criteria in the design of systems, algorithms, experiments, use of data, in accordance with the ethical systems recommended by national and international organizations, with special emphasis on security, robustness, privacy, transparency, traceability, prevention of bias (race, gender, religion, territory, etc.) and respect for human rights.

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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

Theory classes: 2h

Self study: 4h



Determination of knowledge models

Specific objectives:

2, 4, 5, 6, 8

Related competencies :

CG7. To interpret and apply current legislation, as well as specifications, regulations and standards in the field of artificial intelligence.

CG3. To define, evaluate and select hardware and software platforms for the development and execution of computer systems, services and applications in the field of artificial intelligence.

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CB4. That the students can transmit information, ideas, problems and solutions to a specialized and non-specialized public.

Full-or-part-time: 4h

Theory classes: 2h

Self study: 2h



Other components of the decision process

Specific objectives:

11, 13

Related competencies :

CG5. Work in multidisciplinary teams and projects related to artificial intelligence and robotics, interacting fluently with engineers and professionals from other disciplines.

CT6. Autonomous Learning. Detect deficiencies in one's own knowledge and overcome them through critical reflection and the choice of the best action to extend this knowledge.

Full-or-part-time: 4h

Theory classes: 2h

Self study: 2h

Intermediate presentation of the practical works

Specific objectives:

10

Related competencies :

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Full-or-part-time: 12h

Guided activities: 3h

Self study: 9h

Design of an intelligent process to improve an administrative process

Description:

Team work on a real case applying the techniques seen in the course to the design of an intelligent data analysis process to improve an administrative process

Specific objectives:

10

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Full-or-part-time: 19h

Theory classes: 2h

Laboratory classes: 7h

Self study: 10h



Design of a decision support system for a strategic decision process

Description:

Teamwork on real data following IDSS architectures seen in class

Specific objectives:

10

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Full-or-part-time: 19h

Theory classes: 2h

Laboratory classes: 7h

Self study: 10h



Design of an intelligent data process to improve a business process

Description:

In this case, it will be a matter of teamwork to improve a business process, but the focus will be on small companies that are not yet technical and that do not have massive data or continuous monitoring

Specific objectives:

10

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CG5. Work in multidisciplinary teams and projects related to artificial intelligence and robotics, interacting fluently with engineers and professionals from other disciplines.

CG1. To ideate, draft, organize, plan and develop projects in the field of artificial intelligence.

CG4. Reasoning, analyzing reality and designing algorithms and formulations that model it. To identify problems and construct valid algorithmic or mathematical solutions, eventually new, integrating the necessary multidisciplinary knowledge, evaluating different alternatives with a critical spirit, justifying the decisions taken, interpreting and synthesizing the results in the context of the application domain and establishing methodological generalizations based on specific applications.

CG9. To face new challenges with a broad vision of the possibilities of a professional career in the field of Artificial Intelligence. Develop the activity applying quality criteria and continuous improvement, and act rigorously in professional development. Adapt to organizational or technological changes. Work in situations of lack of information and / or with time and / or resource restrictions.

CE20. To select and put to use techniques of statistical modeling and data analysis, assessing the quality of the models, validating and interpreting.

CE09. To ideate, design and integrate intelligent data analysis systems with their application in production and service environments.

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.

CT8. (ENG) Perspectiva de gènere. Conèixer i comprendre, des del propi àmbit de la titulació, les desigualtats per raó de sexe i gènere a la societat; Integrar les diferents necessitats i preferències per raó de sexe i de gènere en el disseny de solucions i resolució de problemes.

CT6. Autonomous Learning. Detect deficiencies in one's own knowledge and overcome them through critical reflection and the choice of the best action to extend this knowledge.

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.

Full-or-part-time: 19h

Theory classes: 2h

Laboratory classes: 7h

Self study: 10h



Design of an intelligent system to support an industrial process

Description:

Teamwork for a highly technical industrial production process

Specific objectives:

10

Related competencies :

CG3. To define, evaluate and select hardware and software platforms for the development and execution of computer systems, services and applications in the field of artificial intelligence.

CG8. Perform an ethical exercise of the profession in all its facets, applying ethical criteria in the design of systems, algorithms, experiments, use of data, in accordance with the ethical systems recommended by national and international organizations, with special emphasis on security, robustness , privacy, transparency, traceability, prevention of bias (race, gender, religion, territory, etc.) and respect for human rights.

CG5. Work in multidisciplinary teams and projects related to artificial intelligence and robotics, interacting fluently with engineers and professionals from other disciplines.

CG1. To ideate, draft, organize, plan and develop projects in the field of artificial intelligence.

CG4. Reasoning, analyzing reality and designing algorithms and formulations that model it. To identify problems and construct valid algorithmic or mathematical solutions, eventually new, integrating the necessary multidisciplinary knowledge, evaluating different alternatives with a critical spirit, justifying the decisions taken, interpreting and synthesizing the results in the context of the application domain and establishing methodological generalizations based on specific applications.

CG9. To face new challenges with a broad vision of the possibilities of a professional career in the field of Artificial Intelligence. Develop the activity applying quality criteria and continuous improvement, and act rigorously in professional development. Adapt to organizational or technological changes. Work in situations of lack of information and / or with time and / or resource restrictions.

CE20. To select and put to use techniques of statistical modeling and data analysis, assessing the quality of the models, validating and interpreting.

CE09. To ideate, design and integrate intelligent data analysis systems with their application in production and service environments.

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.

CT8. (ENG) Perspectiva de gènere. Conèixer i comprendre, des del propi àmbit de la titulació, les desigualtats per raó de sexe i gènere a la societat; Integar les diferents necessitats i preferències per raó de sexe i de gènere en el disseny de solucions i resolució de problemes.

CT6. Autonomous Learning. Detect deficiencies in one's own knowledge and overcome them through critical reflection and the choice of the best action to extend this knowledge.

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.

Full-or-part-time: 19h

Theory classes: 2h

Laboratory classes: 7h

Self study: 10h



Ethical considerations and the carbon footprint of AI

Specific objectives:

9, 12

Related competencies :

CG2. To use the fundamental knowledge and solid work methodologies acquired during the studies to adapt to the new technological scenarios of the future.

CG3. To define, evaluate and select hardware and software platforms for the development and execution of computer systems, services and applications in the field of artificial intelligence.

CG8. Perform an ethical exercise of the profession in all its facets, applying ethical criteria in the design of systems, algorithms, experiments, use of data, in accordance with the ethical systems recommended by national and international organizations, with special emphasis on security, robustness , privacy, transparency, traceability, prevention of bias (race, gender, religion, territory, etc.) and respect for human rights.

CG4. Reasoning, analyzing reality and designing algorithms and formulations that model it. To identify problems and construct valid algorithmic or mathematical solutions, eventually new, integrating the necessary multidisciplinary knowledge, evaluating different alternatives with a critical spirit, justifying the decisions taken, interpreting and synthesizing the results in the context of the application domain and establishing methodological generalizations based on specific applications.

CG9. To face new challenges with a broad vision of the possibilities of a professional career in the field of Artificial Intelligence. Develop the activity applying quality criteria and continuous improvement, and act rigorously in professional development. Adapt to organizational or technological changes. Work in situations of lack of information and / or with time and / or resource restrictions.

CE09. To ideate, design and integrate intelligent data analysis systems with their application in production and service environments.

CE18. To acquire and develop computational learning techniques and to design and implement applications and systems that use them, including those dedicated to the automatic extraction of information and knowledge from large volumes of data.

CT8. (ENG) Perspectiva de gènere. Conèixer i comprendre, des del propi àmbit de la titulació, les desigualtats per raó de sexe i gènere a la societat; Integrar les diferents necessitats i preferències per raó de sexe i de gènere en el disseny de solucions i resolució de problemes.

CB4. That the students can transmit information, ideas, problems and solutions to a specialized and non-specialized public.

Full-or-part-time: 12h

Theory classes: 2h

Self study: 10h

Final presentations of the practices

Full-or-part-time: 12h

Theory classes: 3h

Self study: 9h

GRADING SYSTEM

The following evaluation system is proposed:

- 4 Team works carried out throughout the course 80%.

Each team work is evaluated

- Technical quality of the proposed design and integration of knowledge involved (30%)
- Proof of concept (20%)
- Oral knowledge control test 10% (discussion with the teaching staff during the oral presentation of team work).
- Quality and performance of the work team. 10%
- Oral and written communication 10%.
- Ethics of the work team and the work itself 10%
- Gender perspective of the team and the work 10%.

- Attendance and participation in classes and laboratories. 10%
- 2 Quiz throughout the course 10% (5% each).

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