

# Course guide

## 270419 - PLH - Human Language Processing

Last modified: 02/02/2024

**Unit in charge:** Barcelona School of Informatics  
**Teaching unit:** 723 - CS - Department of Computer Science.

**Degree:** BACHELOR'S DEGREE IN ARTIFICIAL INTELLIGENCE (Syllabus 2021). (Compulsory subject).

**Academic year:** 2023    **ECTS Credits:** 6.0    **Languages:** Catalan

### LECTURER

---

**Coordinating lecturer:** JORGE TURMO BORRÁS

**Others:** Segon quadrimestre:  
SALVADOR MEDINA HERRERA - 11, 12  
JORGE TURMO BORRÁS - 11, 12

### DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

---

#### Specific:

CE02. To master the basic concepts of discrete mathematics, logic, algorithmic and computational complexity, and its application to the automatic processing of information through computer systems . To be able to apply all these for solving problems.

CE14. To master the foundations, paradigms and techniques of intelligent systems and to analyze, designing and build computer systems, services and applications that use these techniques in any field of application, including robotics.

CE15. To acquire, formalize and represent human knowledge in a computable form for solving problems through a computer system in any field of application, particularly those related to aspects of computing, perception and performance in intelligent environments or environments.

CE16. To design and evaluate human-machine interfaces that guarantee the accessibility and usability of computer systems, services and applications.

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.

CE27. To design and apply speech processing techniques, speech recognition and human language comprehension, with application in social artificial intelligence.

#### Generical:

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.

CG6. To identify opportunities for innovative applications of artificial intelligence and robotics in constantly evolving technological environments.

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:**

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.

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**

---

**LEARNING OBJECTIVES OF THE SUBJECT**

---

1. To understand the fundamental theories and techniques associated with Natural Language Processing
2. To know the most relevant resources and applications of Natural Language Processing
3. To develop programs to solve particular tasks in the Natural Language Processing area

**STUDY LOAD**

---

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

**Total learning time:** 150 h

**CONTENTS**

---

**Natural Language Processing and its applications**

**Techniques, resources and applications associated with word analysis**

**Techniques, resources and applications associated with the analysis of word sequences**

**Techniques, resources and applications associated with sentence analysis**

## ACTIVITIES

### Sesió introductoria

#### Specific objectives:

1, 2

#### Related competencies :

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.

CG6. To identify opportunities for innovative applications of artificial intelligence and robotics in constantly evolving technological environments.

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.

CE27. To design and apply speech processing techniques, speech recognition and human language comprehension, with application in social artificial intelligence.

CE02. To master the basic concepts of discrete mathematics, logic, algorithmic and computational complexity, and its application to the automatic processing of information through computer systems . To be able to apply all these for solving problems.

CE14. To master the foundations, paradigms and techniques of intelligent systems and to analyze, designing and build computer systems, services and applications that use these techniques in any field of application, including robotics.

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.

CE15. To acquire, formalize and represent human knowledge in a computable form for solving problems through a computer system in any field of application, particularly those related to aspects of computing, perception and performance in intelligent environments or environments.

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.

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

#### Full-or-part-time: 4h

Theory classes: 2h

Laboratory classes: 2h



## Identificación de unidades lingüísticas en un documento

### Specific objectives:

1, 2

### Related competencies :

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.

CG6. To identify opportunities for innovative applications of artificial intelligence and robotics in constantly evolving technological environments.

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.

CE27. To design and apply speech processing techniques, speech recognition and human language comprehension, with application in social artificial intelligence.

CE02. To master the basic concepts of discrete mathematics, logic, algorithmic and computational complexity, and its application to the automatic processing of information through computer systems . To be able to apply all these for solving problems.

CE14. To master the foundations, paradigms and techniques of intelligent systems and to analyze, designing and build computer systems, services and applications that use these techniques in any field of application, including robotics.

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.

CE15. To acquire, formalize and represent human knowledge in a computable form for solving problems through a computer system in any field of application, particularly those related to aspects of computing, perception and performance in intelligent environments or environments.

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.

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

### Full-or-part-time: 2h

Theory classes: 2h



## Bloc de tratamiento de una palabra

### Specific objectives:

1, 2

### Related competencies :

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.

CG6. To identify opportunities for innovative applications of artificial intelligence and robotics in constantly evolving technological environments.

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.

CE27. To design and apply speech processing techniques, speech recognition and human language comprehension, with application in social artificial intelligence.

CE02. To master the basic concepts of discrete mathematics, logic, algorithmic and computational complexity, and its application to the automatic processing of information through computer systems . To be able to apply all these for solving problems.

CE14. To master the foundations, paradigms and techniques of intelligent systems and to analyze, designing and build computer systems, services and applications that use these techniques in any field of application, including robotics.

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.

CE15. To acquire, formalize and represent human knowledge in a computable form for solving problems through a computer system in any field of application, particularly those related to aspects of computing, perception and performance in intelligent environments or environments.

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.

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

### Full-or-part-time: 11h

Theory classes: 8h

Practical classes: 3h



### Bloc de tratamiento de secuencias de palabras con significado

#### Specific objectives:

1, 2

#### Related competencies :

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.

CG6. To identify opportunities for innovative applications of artificial intelligence and robotics in constantly evolving technological environments.

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.

CE27. To design and apply speech processing techniques, speech recognition and human language comprehension, with application in social artificial intelligence.

CE02. To master the basic concepts of discrete mathematics, logic, algorithmic and computational complexity, and its application to the automatic processing of information through computer systems . To be able to apply all these for solving problems.

CE14. To master the foundations, paradigms and techniques of intelligent systems and to analyze, designing and build computer systems, services and applications that use these techniques in any field of application, including robotics.

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.

CE15. To acquire, formalize and represent human knowledge in a computable form for solving problems through a computer system in any field of application, particularly those related to aspects of computing, perception and performance in intelligent environments or environments.

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.

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

#### Full-or-part-time: 7h

Theory classes: 5h

Practical classes: 2h

### Bloc de tratamiento de una frase aislada

#### Full-or-part-time: 6h

Theory classes: 4h

Practical classes: 2h

### Bloc de tratamiento de un texto como secuencia de frases

#### Full-or-part-time: 2h

Theory classes: 1h 30m

Practical classes: 0h 30m



#### Práctica 1

**Full-or-part-time:** 4h  
Laboratory classes: 4h

#### Pràctica 2

**Full-or-part-time:** 8h  
Laboratory classes: 8h

#### Práctica 3

**Full-or-part-time:** 8h  
Laboratory classes: 8h

#### Práctica 4

**Full-or-part-time:** 8h  
Laboratory classes: 8h



**Specific objectives:**

3

**Related competencies :**

- 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.
- CG7. To interpret and apply current legislation, as well as specifications, regulations and standards in the field of artificial intelligence.
- CG5. Work in multidisciplinary teams and projects related to artificial intelligence and robotics, interacting fluently with engineers and professionals from other disciplines.
- 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.
- CE27. To design and apply speech processing techniques, speech recognition and human language comprehension, with application in social artificial intelligence.
- CE02. To master the basic concepts of discrete mathematics, logic, algorithmic and computational complexity, and its application to the automatic processing of information through computer systems . To be able to apply all these for solving problems.
- CE14. To master the foundations, paradigms and techniques of intelligent systems and to analyze, designing and build computer systems, services and applications that use these techniques in any field of application, including robotics.
- CE16. To design and evaluate human-machine interfaces that guarantee the accessibility and usability of computer systems, services and applications.
- 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.
- 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.
- 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.
- 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.
- 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.
- 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.
- 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.
- 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:** 45h

Self study: 45h





## Examen

### Specific objectives:

1, 2

### Related competencies :

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.

CG6. To identify opportunities for innovative applications of artificial intelligence and robotics in constantly evolving technological environments.

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.

CE27. To design and apply speech processing techniques, speech recognition and human language comprehension, with application in social artificial intelligence.

CE02. To master the basic concepts of discrete mathematics, logic, algorithmic and computational complexity, and its application to the automatic processing of information through computer systems . To be able to apply all these for solving problems.

CE14. To master the foundations, paradigms and techniques of intelligent systems and to analyze, designing and build computer systems, services and applications that use these techniques in any field of application, including robotics.

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.

CE15. To acquire, formalize and represent human knowledge in a computable form for solving problems through a computer system in any field of application, particularly those related to aspects of computing, perception and performance in intelligent environments or environments.

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.

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

**Full-or-part-time:** 45h

Self study: 45h

## GRADING SYSTEM

NEX: final exam grade

NLAB: average grade of laboratory practices

NF: final grade of the course

$$NF = 0.5*NEX + 0.5*NLAB$$

Reassessment

Only those students who had previously taken the final exam and failed it can take the reassessment exam.



## BIBLIOGRAPHY

---

### Basic:

- Jurafsky, Dan; Martin, James H. *Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition*. Upper Saddle River, N.J: Prentice Hall,, 2019.
- Manning, Christopher; Schütze, Hinrich. *Foundations of Statistical Natural Language Processing*. Cambridge, Mass: MIT Press,, 1999. ISBN 0262133601.
- Clark, Alexander; Fox, Chris; Lappin, Shalom. *The Handbook of Computational Linguistics and Natural Language Processing*. John Wiley & Sons. Oxford: Wiley-Blackwell, 2012. ISBN 9781444324044.