Course guides
270408 - IR - Introduction to Robotics

Unit in charge: Barcelona School of Informatics
Teaching unit: 707 - ESAII - Department of Automatic Control.
Degree: BACHELOR'S DEGREE IN ARTIFICIAL INTELLIGENCE (Syllabus 2021). (Compulsory subject).
Academic year: 2021  ECTS Credits: 6.0  Languages: Catalan, Spanish

LECTURER

Coordinating lecturer: JUAN ARANDA LÓPEZ
Others: Segon quadrimestre: JUAN ARANDA LÓPEZ - 11 ANAÍS GARRRELL ZULUETA - 11

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
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.
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.
CE24. To ideate, design and build intelligent robotic systems to be applied in production and service environments, and that have to be capable of interacting with people. Also, to create collaborative and social intelligent robotic systems.
CE25. To ideate, design and integrate mobile robots with autonomous navigation capability, fleet formation and interaction with humans.
CE28. To plan, ideate, deploy and direct projects, services and systems in the field of artificial intelligence, leading its implementation and continuous improvement and assessing its economic and social impact.

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.
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.

TEACHING METHODOLOGY

Teaching methodology is described in Activities

LEARNING OBJECTIVES OF THE SUBJECT

1. To know robot components and what's the difference against other automatic machines
2. To know the different types of robots that are in the market and their characteristics. Understand their manuals and specifications, as well as regulations and standards according to current legislation.

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory classes</td>
<td>30,0</td>
<td>20.00</td>
</tr>
<tr>
<td>Laboratory classes</td>
<td>30,0</td>
<td>20.00</td>
</tr>
<tr>
<td>Self study</td>
<td>90,0</td>
<td>60.00</td>
</tr>
</tbody>
</table>

Total learning time: 150 h

CONTENTS

(ENG) Introducció

Description:

Specific objectives:
(ENG)

Related activities:
(ENG)

(ENG) Morfologia del robot.

Description:
(ENG) Components. Estructures i característiques dels robots.

Specific objectives:
(ENG)

Related activities:
(ENG)
(ENG) Robots mòbils

Description:

Specific objectives:
(ENG)

Related activities:
(ENG)

(ENG) Percepció de l'entorn

Description:

Specific objectives:
(ENG)

Related activities:
(ENG)

(ENG) Navegació de robots mòbils

Description:

Specific objectives:
(ENG)

Related activities:
(ENG)

(ENG) Localització del robot mòbil

Description:
(ENG) Sistemes de localització (GPS, US, IR, rutes fixes). Navegació basada en punts de referència.

Specific objectives:
(ENG)

Related activities:
(ENG)

(ENG) Robots manipuladors

Description:
(ENG) Arquitectures i característiques.

Specific objectives:
(ENG)

Related activities:
(ENG)
**(ENG) Cinemàtica dels robots manipuladors.**

**Description:**

**Specific objectives:**
(ENG)

**Related activities:**
(ENG)

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**(ENG) Generació de trajectòries**

**Description:**
(ENG) Camins i trajectòries. Trajectòries a l'espai d'articulacions. Trajectòries a l'espai cartesià.

**Specific objectives:**
(ENG)

**Related activities:**
(ENG)

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**(ENG) Programació i Control del robot**

**Description:**
(ENG) Control a l'espai d'articulacions. Arquitectura de control d'un manipulador. Entorns i llenguatges de programació de robots.

**Specific objectives:**
(ENG)

**Related activities:**
(ENG)

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**(ENG) Aplicacions de la robòtica**

**Description:**

**Specific objectives:**
(ENG)

**Related activities:**
(ENG)
ACTIVITIES

**(ENG) Que és un robot?**

**Description:**

**Specific objectives:**
(ENG) 1, 7

**Material:**
(ENG)

**Delivery:**
(ENG)

**Related competencies:**
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.
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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**Full-or-part-time:** 2h

Theory classes: 2h
**Morfologia del robot.**

**Description:**
(ENG) Components. Estructures i característiques dels robots.

**Specific objectives:**
(ENG) 1, 2

**Material:**
(ENG)

**Delivery:**
(ENG)

**Related competencies :**
CG7. To interpret and apply current legislation, as well as specifications, regulations and standards in the field of artificial intelligence.
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**Full-or-part-time: 10h**
Theory classes: 4h
Laboratory classes: 2h
Self study: 4h
(ENG) Robots mòbils

Description:

Specific objectives:
(ENG) 2, 5

Material:
(ENG)

Delivery:
(ENG)

Related competencies:
CG7. To interpret and apply current legislation, as well as specifications, regulations and standards in the field of artificial intelligence.
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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 techniques, the technology, the economy and the sustainability.
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.

Full-or-part-time: 16h
Theory classes: 4h
Laboratory classes: 4h
Self study: 8h
**Percepció de l'entorn**

**Description:**

**Specific objectives:**
(ENG) 3, 4

**Material:**
(ENG)

**Delivery:**
(ENG)

**Related competencies:**
- 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.
- 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.
- CG6. To identify opportunities for innovative applications of artificial intelligence and robotics in constantly evolving technological environments.
- 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.
- 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.

**Full-or-part-time:** 14h
- Theory classes: 2h
- Laboratory classes: 4h
- Self study: 8h
(ENG) Navegació de robots mòbils

Description:

Specific objectives:
(ENG) 4, 5

Material:
(ENG)

Delivery:
(ENG)

Related competencies:
CG5. Work in multidisciplinary teams and projects related to artificial intelligence and robotics, interacting fluently with engineers and professionals from other disciplines.
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.
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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CE24. To ideate, design and build intelligent robotic systems to be applied in production and service environments, and that have to be capable of interacting with people. Also, to create collaborative and social intelligent robotic systems.
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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.

Full-or-part-time: 16h
Theory classes: 4h
Laboratory classes: 4h
Self study: 8h
**Description:**
Sistemes de localització (GPS, US, IR, rutes fixes). Navegació basada en punts de referència

**Specific objectives:**
4, 5, 6

**Material:**

**Delivery:**

**Related competencies:**

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

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.

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.

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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.

**Full-or-part-time:** 14h

Theory classes: 2h
Laboratory classes: 4h
Self study: 8h
### (ENG) Robots manipuladors

**Description:**  
(ENG) Arquitectures i característiques

**Specific objectives:**  
(ENG) 2, 3

**Material:**  
(ENG)

**Delivery:**  
(ENG)

**Related competencies:**  
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.  
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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.

**Full-or-part-time: 8h**  
Theory classes: 2h  
Laboratory classes: 2h  
Self study: 4h
(ENG) Cinemàtica dels robots manipuladors

Description:
9. Generació de trajectòries

Specific objectives:
(ENG) 2, 5

Material:
(ENG)

Delivery:
(ENG)

Related competencies:
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.
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.
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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.
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.

Full-or-part-time: 8h
Theory classes: 2h
Laboratory classes: 2h
Self study: 4h
**ENG Generació de trajectòries**

**Description:**
(ENG) Camins i trajectòries. Trajectòries a l'espai d'articulacions. Trajectòries a l'espai cartesià.

**Specific objectives:**
(ENG) 5, 6

**Material:**
(ENG)

**Delivery:**
(ENG)

**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.
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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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.

**Full-or-part-time:** 8h
Theory classes: 2h
Laboratory classes: 2h
Self study: 4h
**Programació i Control del robot**

**Description:**
(ENG) Control a l'espai d'articulacions. Arquitectura de control d'un manipulador. Entorns i llenguatges de programació de robots

**Specific objectives:**
(ENG) 4, 5, 6

**Material:**
(ENG)

**Delivery:**
(ENG)

**Related competencies:**
CG5. Work in multidisciplinary teams and projects related to artificial intelligence and robotics, interacting fluently with engineers and professionals from other disciplines.
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.
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**Full-or-part-time:** 22h
Theory classes: 4h
Laboratory classes: 6h
Self study: 12h
(ENG) Aplicacions de la robòtica

Description:
(ENG) Robòtica Industrial. Robòtica de serveis. Robòtica d’exploració. Robòtica mèdica i assistencial

Specific objectives:
(ENG) 5, 7

Material:
(ENG)

Delivery:
(ENG)

Related competencies:
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.
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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.

Full-or-part-time: 2h
Theory classes: 2h
(ENG) Resolució d'exercicis

Description:
(ENG) Resolució d'exercicis (entre 3 i 6) avaluables realitzats com a treball personal o en parella

Specific objectives:
(ENG) 1, 2, 3, 4, 5, 6, 7

Material:
(ENG)

Delivery:
(ENG)

Related competencies:
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.
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.
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.
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.
CG6. To identify opportunities for innovative applications of artificial intelligence and robotics in constantly evolving technological environments.
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.
CE25. To ideate, design and integrate mobile robots with autonomous navigation capability, fleet formation and interaction with humans.
CE28. To plan, ideate, deploy and direct projects, services and systems in the field of artificial intelligence, leading its implementation and continuous improvement and assessing its economic and social impact.
CE24. To ideate, design and build intelligent robotic systems to be applied in production and service environments, and that have to be capable of interacting with people. Also, to create collaborative and social intelligent robotic systems.
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.

Full-or-part-time: 30h
Self study: 30h
BIBLIOGRAPHY

Basic: