270130 - ROB - Robotics

Coordinating unit: 270 - FIB - Barcelona School of Informatics
Teaching unit: 707 - ESAII - Department of Automatic Control

Academic year: 2018
Degree: BACHELOR'S DEGREE IN INFORMATICS ENGINEERING (Syllabus 2010). (Teaching unit Optional)
ECTS credits: 6
Teaching languages: Catalan, Spanish

Teaching staff

Coordinator:
- Antonio Benito Martínez Velasco (antonio.b.martinez@upc.edu)

Others:
- Anais Garrell Zulueta (agarrell@iri.upc.es)
- Cecilio Angulo Bahon (cecilio.angulo@upc.edu)
- Joan Aranda López (joan.aranda@upc.edu)

Degree competences to which the subject contributes

Specific:

CCO1.1. To evaluate the computational complexity of a problem, know the algorithmic strategies which can solve it and recommend, develop and implement the solution which guarantees the best performance according to the established requirements.
CCO1.3. To define, evaluate and select platforms to develop and produce hardware and software for developing computer applications and services of different complexities.
CCO2.1. To demonstrate knowledge about the fundamentals, paradigms and the own techniques of intelligent systems, and analyse, design and build computer systems, services and applications which use these techniques in any applicable field.
CCO2.2. Capacity to acquire, obtain, formalize and represent human knowledge in a computable way to solve problems through a computer system in any applicable field, in particular in the fields related to computation, perception and operation in intelligent environments.
CCO3.1. To implement critical code following criteria like execution time, efficiency and security.

CCO3.2. To program taking into account the hardware architecture, using assembly language as well as high-level programming languages.

CEC2.1. To analyse, evaluate, select and configure hardware platforms for the development and execution of computer applications and services.

CES1.2. To solve integration problems in function of the strategies, standards and available technologies

CES1.8. To develop, maintain and evaluate control and real-time systems.

CES2.1. To define and manage the requirements of a software system.

CES2.2. To design adequate solutions in one or more application domains, using software engineering methods which integrate ethical, social, legal and economical aspects.

CT1.1A. To demonstrate knowledge and comprehension about the fundamentals of computer usage and programming, about operating systems, databases and, in general, about computer programs applicable to the engineering.

CT1.1B. To demonstrate knowledge and comprehension about the fundamentals of computer usage and programming. Knowledge about the structure, operation and interconnection of computer systems, and about the fundamentals of its programming.

CT1.2A. To interpret, select and value concepts, theories, uses and technological developments related to computer science and its application derived from the needed fundamentals of mathematics, statistics and physics. Capacity to
solve the mathematical problems presented in engineering. Talent to apply the knowledge about: algebra, differential and integral calculus and numeric methods; statistics and optimization.

CT1.2B. To interpret, select and value concepts, theories, uses and technological developments related to computer science and its application derived from the needed fundamentals of mathematics, statistics and physics. Capacity to understand and dominate the physical and technological fundamentals of computer science: electromagnetism, waves, circuit theory, electronics and photonics and its application to solve engineering problems.

CT1.2C. To use properly theories, procedures and tools in the professional development of the informatics engineering in all its fields (specification, design, implementation, deployment and products evaluation) demonstrating the comprehension of the adopted compromises in the design decisions.

CT2.1. To demonstrate knowledge and capacity to apply the principles, methodologies and life cycles of software engineering.

CT2.5. To design and evaluate person-computer interfaces which guarantee the accessibility and usability of computer systems, services and applications.

CT3.5. To identify the use possibilities and benefits which can be derived from an application in the different business software typologies and existent ICT services.

CT3.6. To demonstrate knowledge about the ethical dimension of the company: in general, the social and corporative responsibility and, concretely, the civil and professional responsibilities of the informatics engineer.

CT4.1. To identify the most adequate algorithmic solutions to solve medium difficulty problems.

CT4.2. To reason about the correction and efficiency of an algorithmic solution.

CT4.3. To demonstrate knowledge and capacity to apply the fundamental principles and the basic techniques of the intelligent systems and its practical application.

CT5.2. To know, design and use efficiently the most adequate data types and data structures to solve a problem.

CT5.3. To design, write, test, refine, document and maintain code in an high level programming language to solve programming problems applying algorithmic schemas and using data structures.

CT5.4. To design the programs architecture using techniques of object orientation, modularization and specification and implementation of abstract data types.

CT5.5. To use the tools of a software development environment to create and develop applications.

CT5.6. To demonstrate knowledge and capacity to apply the fundamental principles and basic techniques of parallel, concurrent, distributed and real-time programming.

CT8.1. To identify current and emerging technologies and evaluate if they are applicable, to satisfy the users needs.

Generical:

G5. TEAMWORK: to be capable to work as a team member, being just one more member or performing management tasks, with the finality of contributing to develop projects in a pragmatic way and with responsibility sense; to assume compromises taking into account the available resources.

G7. AUTONOMOUS LEARNING: to detect deficiencies in the own knowledge and overcome them through critical reflection and choosing the best actuation to extend this knowledge. Capacity for learning new methods and technologies, and versatility to adapt oneself to new situations.

G8. APPROPRIATE ATTITUDE TOWARDS WORK: to have motivation to be professional and to face new challenges, have a width vision of the possibilities of the career in the field of informatics engineering. To feel motivated for the quality and the continuous improvement, and behave rigorously in the professional development. Capacity to adapt oneself to organizational or technological changes. Capacity to work in situations with information shortage and/or time and/or resources restrictions.

G9. PROPER THINKING HABITS: capacity of critical, logical and mathematical reasoning. Capacity to solve problems in her study area. Abstraction capacity: capacity to create and use models that reflect real situations. Capacity to design and perform simple experiments and analyse and interpret its results. Analysis, synthesis and evaluation capacity.
270130 - ROB - Robotics

Teaching methodology

Teaching methodology is described in Activities

Learning objectives of the subject

Study load

<table>
<thead>
<tr>
<th>Total learning time: 150h</th>
<th>Hours large group:</th>
<th>30h</th>
<th>20.00%</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Hours small group:</td>
<td>30h</td>
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<tr>
<td></td>
<td>Guided activities:</td>
<td>6h</td>
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<tr>
<td></td>
<td>Self study:</td>
<td>84h</td>
<td>56.00%</td>
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</table>
### Content

#### (ENG) Introducció

**Degree competences to which the content contributes:**

**Description:**

**Related activities:**
(ENG)

**Specific objectives:**

#### (ENG) Morfologia del robot.

**Degree competences to which the content contributes:**

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

**Related activities:**
(ENG)

**Specific objectives:**

#### (ENG) Cinemàtica dels robots manipuladors

**Degree competences to which the content contributes:**

**Description:**

**Related activities:**
(ENG)

**Specific objectives:**

#### (ENG) Generació de trajectòries

**Degree competences to which the content contributes:**

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

**Related activities:**
(ENG)

**Specific objectives:**
### (ENG) Programació i Control del robot

**Degree competences to which the content contributes:**
- **Description:** (ENG) Control a l'espai d'articulacions. Arquitectura de control d'un manipulador. Entorns i llenguatges de programació de robots industrial.

**Related activities:**
- (ENG)

**Specific objectives:**

### (ENG) Robots mòbils

**Degree competences to which the content contributes:**
- **Description:** (ENG) Mecanismos de locomoció. Tipus de robot mòbils. Cinemàtica directa i inversa. Maniobrabilitat.

**Related activities:**
- (ENG)

**Specific objectives:**

### (ENG) Percepció de l'entorn

**Degree competences to which the content contributes:**
- **Description:** (ENG) Classificació dels sensors. Característiques. Sensors de profunditat. Sensors d'orientació.

**Related activities:**
- (ENG)

**Specific objectives:**

### (ENG) Navegació de robots mòbils

**Degree competences to which the content contributes:**
- **Description:** (ENG) Navegació reactiva. Evasió d'obstacles. Planificació basada en mapes.

**Related activities:**
- (ENG)

**Specific objectives:**
### (ENG) Localització del robot mòbil

**Degree competences to which the content contributes:**

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

**Related activities:**
(ENG)

**Specific objectives:**

### (ENG) Aplicacions de la robòtica

**Degree competences to which the content contributes:**

*Description:*

**Related activities:**
(ENG)

**Specific objectives:**

### (ENG) Desenvolupament d'un projecte de robotització

**Degree competences to which the content contributes:**

*Description:*

**Related activities:**
(ENG)

**Specific objectives:**
### Planning of activities

| (ENG) Desenvolupament Tema 1 | Hours: 3h  
|---|---
| Theory classes: 2h  
| Practical classes: 0h  
| Laboratory classes: 0h  
| Guided activities: 0h  
| Self study: 1h  |

**Description:**
(ENG) Participar activament a les sessió presencial. Estudi autònom dels materials proposats. Busqueda d'informació respecte la robòtica, els sistemes robots i les seves aplicacions.

**Support materials:**
(ENG)

**Descriptions of the assignments due and their relation to the assessment:**
(ENG)

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

| (ENG) Desenvolupament Tema 2 | Hours: 11h  
|---|---
| Theory classes: 4h  
| Practical classes: 0h  
| Laboratory classes: 2h  
| Guided activities: 0h  
| Self study: 5h  |

**Description:**
(ENG) Participar activament en la sessió presencial. Estudi autònom dels materials proposats. Resolució dels problemes proposats.

**Support materials:**
(ENG)

**Descriptions of the assignments due and their relation to the assessment:**
(ENG)

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

| (ENG) Desenvolupament Tema 3 | Hours: 16h  
|---|---
| Theory classes: 4h  
| Practical classes: 0h  
| Laboratory classes: 2h  
| Guided activities: 2h  
| Self study: 8h  |

**Description:**
(ENG) Participar activament en la sessió presencial. Estudi autònom dels materials proposats. Resolució dels problemes proposats.
### Support materials:
(ENG)

### Descriptions of the assignments due and their relation to the assessment:
(ENG)

### Specific objectives:
(ENG) 4, 5

### (ENG) Desenvolupament Tema 4

<table>
<thead>
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<th>Hours: 13h</th>
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<tbody>
<tr>
<td>Theory classes: 3h</td>
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<tr>
<td>Practical classes: 0h</td>
</tr>
<tr>
<td>Laboratory classes: 4h</td>
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<tr>
<td>Guided activities: 0h</td>
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<tr>
<td>Self study: 6h</td>
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</tbody>
</table>

### Description:
(ENG) Participar activament en la sessió presencial. Estudi autònom dels materials proposats. Resolució dels problemes proposats.

### Support materials:
(ENG)

### Descriptions of the assignments due and their relation to the assessment:
(ENG)

### Specific objectives:
(ENG) 4, 5

### (ENG) Desenvolupament Tema 5

<table>
<thead>
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<th>Hours: 18h</th>
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<tbody>
<tr>
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<tr>
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<td>Laboratory classes: 6h</td>
</tr>
<tr>
<td>Guided activities: 1h</td>
</tr>
<tr>
<td>Self study: 8h</td>
</tr>
</tbody>
</table>

### Description:
(ENG) Participar activament en la sessió presencial. Estudi autònom dels materials proposats. Resolució dels problemes proposats.

### Support materials:
(ENG)

### Descriptions of the assignments due and their relation to the assessment:
(ENG)

### Specific objectives:
(ENG) 3, 4, 5, 12, 13
### Desenvolupament Tema 6

**Hours:** 13h  
- Theory classes: 4h  
- Practical classes: 0h  
- Laboratory classes: 2h  
- Guided activities: 1h  
- Self study: 6h

**Description:**  
(ENG) Participar activament en la sessió presencial. Estudi autònom dels materials proposats. Resolució dels problemes proposats.

**Support materials:**  
(ENG)

**Descriptions of the assignments due and their relation to the assessment:**  
(ENG)

**Specific objectives:**  
(ENG) 1, 3, 4, 5, 9

### Desenvolupament Tema 7

**Hours:** 12h  
- Theory classes: 2h  
- Practical classes: 0h  
- Laboratory classes: 4h  
- Guided activities: 0h  
- Self study: 6h

**Description:**  
(ENG) Participar activament en la sessió presencial. Estudi autònom dels materials proposats. Resolució dels problemes proposats.

**Support materials:**  
(ENG)

**Descriptions of the assignments due and their relation to the assessment:**  
(ENG)

**Specific objectives:**  
(ENG) 6, 9, 13, 14

### Desenvolupament Tema 8

**Hours:** 14h  
- Theory classes: 3h  
- Practical classes: 0h  
- Laboratory classes: 4h  
- Guided activities: 1h  
- Self study: 6h

**Description:**  
(ENG) Participar activament en la sessió presencial. Estudi autònom dels materials proposats. Resolució dels problemes proposats.
### Support materials:

(ENG)

### Descriptions of the assignments due and their relation to the assessment:

(ENG)

### Specific objectives:

(ENG) 3, 4, 5, 6, 7, 8, 9, 11, 12, 13, 14

<table>
<thead>
<tr>
<th><strong>(ENG) Desenvolupament Tema 9</strong></th>
<th><strong>Hours:</strong> 10h</th>
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<td><strong>Support materials:</strong></td>
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<td><strong>Descriptions of the assignments due and their relation to the assessment:</strong></td>
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### Description:


### Support materials:

(ENG)

### Descriptions of the assignments due and their relation to the assessment:

(ENG)

### Specific objectives:

(ENG) 6, 7, 8, 9, 12, 13

<table>
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<td><strong>Support materials:</strong></td>
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<td><strong>Descriptions of the assignments due and their relation to the assessment:</strong></td>
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<td><strong>Specific objectives:</strong></td>
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### Description:


### Support materials:

(ENG)

### Descriptions of the assignments due and their relation to the assessment:

(ENG)

### Specific objectives:

(ENG) 10, 11, 12, 15, 16

<table>
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<tr>
<th><strong>Theory classes:</strong></th>
<th><strong>Practical classes:</strong></th>
<th><strong>Laboratory classes:</strong></th>
<th><strong>Guided activities:</strong></th>
<th><strong>Self study:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>2h</td>
<td>0h</td>
<td>4h</td>
<td>0h</td>
<td>4h</td>
</tr>
<tr>
<td>1h</td>
<td>0h</td>
<td>0h</td>
<td>0h</td>
<td>2h</td>
</tr>
</tbody>
</table>
### Desenvolupament Tema 11

**Hours:** 8h  
Theory classes: 2h  
Practical classes: 0h  
Laboratory classes: 2h  
Guided activities: 0h  
Self study: 4h

#### Description:
(ENG) Participar activament en les sessió presencial. Estudi autònom dels materials proposats. Resolució dels problemes proposats

#### Support materials:
(ENG)

#### Descriptions of the assignments due and their relation to the assessment:
(ENG)

#### Specific objectives:
(ENG) 6, 10, 11, 12, 13, 14, 15, 16, 17, 18

### Resolució d'exercicis (entre 3 a 6) avaluables realitzats com a treball personal

**Hours:** 20h  
Guided activities: 0h  
Self study: 20h

#### Description:
(ENG)

#### Support materials:
(ENG)

#### Descriptions of the assignments due and their relation to the assessment:
(ENG)

#### Specific objectives:
(ENG) 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18

### Examens final individuals en hora i aula indica

**Hours:** 13h  
Guided activities: 3h  
Self study: 10h

#### Description:
(ENG)

#### Support materials:
(ENG)

#### Descriptions of the assignments due and their relation to the assessment:
(ENG)

#### Specific objectives:
(ENG) 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18
Qualification system

Not yet translated

Bibliography

Others resources:

Hyperlink

http://www.ifr.org

http://www.euron.org

https://www.robotics.org/