

# Course guide 270207 - COM - Computers

Last modified: 31/01/2025

Unit in charge:	Barcelona School of Informatics
Teaching unit:	701 - DAC - Department of Computer Architecture.

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

Academic year: 2024	ECTS Credits: 7.5	Languages: Catalan
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# LECTURER

Coordinating lecturer:	JAVIER VERDU MULA
Others:	Segon quadrimestre: MARC RUIZ RAMÍREZ - 11 JAVIER VERDU MULA - 11, 12

# **PRIOR SKILLS**

Basic programming

# **DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES**

# Specific:

CE4. Use current computer systems, including high performance systems, for the process of large volumes of data from the knowledge of its structure, operation and particularities.

### **Generical:**

CG1. To design computer systems that integrate data of provenances and very diverse forms, create with them mathematical models, reason on these models and act accordingly, learning from experience.

CG2. Choose and apply the most appropriate methods and techniques to a problem defined by data that represents a challenge for its volume, speed, variety or heterogeneity, including computer, mathematical, statistical and signal processing methods.

CG4. Identify opportunities for innovative data-driven applications in evolving technological environments.

# Transversal:

CT5. Solvent use of information resources. Manage the acquisition, structuring, analysis and visualization of data and information in the field of specialty and critically evaluate the results of such management.

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.

CT7. Third language. Know a third language, preferably English, with an adequate oral and written level and in line with the needs of graduates.

### **Basic:**

CB1. That students have demonstrated to possess and understand knowledge in an area of ??study that starts from the base of general secondary education, and is usually found at a level that, although supported by advanced textbooks, also includes some aspects that imply Knowledge from the vanguard of their field of study.

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



# **TEACHING METHODOLOGY**

The course is based on classroom theory and laboratory. The lectures follow the program set out in this syllabus, are usually based on material provided through slides, but complemented with the explanations of the lecturers.

On the lectures, the course promotes a dialogue between teacher and students by providing activities carried out jointly based on particular aspects of the current topic.

Laboratory classes follow the same subjects and are based on documentation provided, explaining how to develop the current practice.

# LEARNING OBJECTIVES OF THE SUBJECT

- 1.Know about the objectives of the course
- 2.Work with different types of data, natural, integer, floating point, and their grouping
- 3.Demonstrate knowledge and understanding of the fundamentals of computers and on the basic structure of a computer.
- 4.Describe and work with the program execution environment.
- 5. Knowledge on the structure of programs, and be able to work with their analysis and management tools.
- 6.Know about the basic principles of the programming languages.
- 7.Knowledge and work with the operating system services
- 8.Knowledge and work with libraries
- 9.Know and work with the program compilation tools
- 10.Know and work with parallel programming models
- 11.Know and work with basic techniques of performance analysis
- 12.Know and work with the input/output tools provided by the execution environments
- 13.Know and work with the storage systems

# **STUDY LOAD**

Туре	Hours	Percentage
Hours large group	45,0	24.00
Hours small group	30,0	16.00
Self study	112,5	60.00

Total learning time: 187.5 h

# CONTENTS

### **Data representation**

### **Description:**

Know and work with the different data types and their representation in computers. Binary encoding, characters, integers, strings, floating point values, and their grouping in classes, structures, and unions.

# **Computer elements**

#### **Description:**

Description of the elements that constitute a computer: processors, memory hierarchy, input/output components, data storage and the way they are interconnected.



# **System libraries**

## **Description:**

This chapter presents the functionalities offered by the system libraries. Shows the format of executable files, and how and which information can be obtained from them.

#### **Compilation environment**

# **Description:**

It presents the tools performing compilation and interpretation of programming languages. It describes the compilation and optimization options offered by compilers. It completes the structure of the executable files, with symbol table, and debugging information.

#### **Operating System**

#### **Description:**

Describes the objectives of the Operating System in an execution environment. This chapter presents the basic OS abstractions and its interface. System calls, interrupts, exceptions.

#### **Programming foundations**

### **Description:**

Description of the basic environment on top of which programs can be executed. Definition of operating system, execution levels, user and system (privileged), concepts of program and process. Program and libraries structure. Basic principles of programming languages, interpretation and compilation. Assembly language. Translation from high level languages to low level languages.

#### Introduction to parallelism

#### **Description:**

Parallelism and concurrency. Processes and threads. Synchronization. Programming models

### **Basic techniques of performance analysis**

#### **Description:**

Performance of applications, metrics, sources of the information, performance counters, high resolution timers. Performance analysis, Gflops, bandwidth.

### Input/output subsystem

#### **Description:**

It introduces the input/output subsystem of the execution environment, channels, terminals, files, pipes.

### Storage systems

### **Description:**

It describes the physical components of the Input/Output system to store data: disks, and filesystems. It provides a view of the fault tolerance mechanisms, based on redundant disks systems and logical volumes.



# **ACTIVITIES**

### **Course presentation**

# Specific objectives:

1

### **Related competencies :**

CB1. That students have demonstrated to possess and understand knowledge in an area of ??study that starts from the base of general secondary education, and is usually found at a level that, although supported by advanced textbooks, also includes some aspects that imply Knowledge from the vanguard of their field of study.

Full-or-part-time: 7h Self study: 2h Theory classes: 1h Laboratory classes: 4h

# **Fundamentals of programming**

# Specific objectives:

4, 5, 6, 8, 9

### **Related competencies :**

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 CE4. Use current computer systems, including high performance systems, for the process of large volumes of data from the knowledge of its structure, operation and particularities.

CG1. To design computer systems that integrate data of provenances and very diverse forms, create with them mathematical models, reason on these models and act accordingly, learning from experience.

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.

CT7. Third language. Know a third language, preferably English, with an adequate oral and written level and in line with the needs of graduates.

CT5. Solvent use of information resources. Manage the acquisition, structuring, analysis and visualization of data and information in the field of specialty and critically evaluate the results of such management.

Full-or-part-time: 32h Self study: 20h Theory classes: 6h Laboratory classes: 6h



### **Data representation**

# Specific objectives:

2

# **Related competencies :**

CB1. That students have demonstrated to possess and understand knowledge in an area of ??study that starts from the base of general secondary education, and is usually found at a level that, although supported by advanced textbooks, also includes some aspects that imply Knowledge from the vanguard of their field of study.

CE4. Use current computer systems, including high performance systems, for the process of large volumes of data from the knowledge of its structure, operation and particularities.

**Full-or-part-time:** 14h Self study: 6h Theory classes: 6h

Laboratory classes: 2h

# The computer and its elements

# Specific objectives:

3

# **Related competencies :**

CB1. That students have demonstrated to possess and understand knowledge in an area of ??study that starts from the base of general secondary education, and is usually found at a level that, although supported by advanced textbooks, also includes some aspects that imply Knowledge from the vanguard of their field of study.

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: 18h

Self study: 10h Theory classes: 6h Laboratory classes: 2h



# **Partial control**

Specific objectives:

1, 2, 3, 4, 5, 6, 7, 8, 9

### **Related competencies :**

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.

CB1. That students have demonstrated to possess and understand knowledge in an area of ??study that starts from the base of general secondary education, and is usually found at a level that, although supported by advanced textbooks, also includes some aspects that imply Knowledge from the vanguard of their field of study.

CB5. That the students have developed those learning skills necessary to undertake later studies with a high degree of autonomy CE4. Use current computer systems, including high performance systems, for the process of large volumes of data from the knowledge of its structure, operation and particularities.

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**Full-or-part-time:** 13h Self study: 10h Guided activities: 3h

# **Operating System**

**Specific objectives:** 7, 12, 13

# **Related competencies :**

CB5. That the students have developed those learning skills necessary to undertake later studies with a high degree of autonomy CE4. Use current computer systems, including high performance systems, for the process of large volumes of data from the knowledge of its structure, operation and particularities.

CG4. Identify opportunities for innovative data-driven applications in evolving technological environments.

CG1. To design computer systems that integrate data of provenances and very diverse forms, create with them mathematical models, reason on these models and act accordingly, learning from experience.

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CT5. Solvent use of information resources. Manage the acquisition, structuring, analysis and visualization of data and information in the field of specialty and critically evaluate the results of such management.

Full-or-part-time: 50h 30m Self study: 26h 30m Theory classes: 14h Laboratory classes: 10h



# Parallelism

# Specific objectives:

10, 11

# **Related competencies :**

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.

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CT5. Solvent use of information resources. Manage the acquisition, structuring, analysis and visualization of data and information in the field of specialty and critically evaluate the results of such management.

**Full-or-part-time:** 34h Self study: 18h Theory classes: 12h Laboratory classes: 4h



# Laboratory test

### **Description:**

Laboratory test of the course, consisting of a laboratory session, with a specific wording, done in an individual way. It is performed during a particular lab session.

### **Specific objectives:**

1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13

### **Related competencies :**

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.

CB1. That students have demonstrated to possess and understand knowledge in an area of ??study that starts from the base of general secondary education, and is usually found at a level that, although supported by advanced textbooks, also includes some aspects that imply Knowledge from the vanguard of their field of study.

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CT5. Solvent use of information resources. Manage the acquisition, structuring, analysis and visualization of data and information in the field of specialty and critically evaluate the results of such management.

**Full-or-part-time:** 12h Self study: 10h Guided activities: 2h



# Final exam

### **Description:**

Final exam of the course, consisting of theoretical questions related to all subjects explained in both theoretical classes and laboratory sessions

### **Specific objectives:**

1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13

### **Related competencies :**

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.

CB1. That students have demonstrated to possess and understand knowledge in an area of ??study that starts from the base of general secondary education, and is usually found at a level that, although supported by advanced textbooks, also includes some aspects that imply Knowledge from the vanguard of their field of study.

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CT5. Solvent use of information resources. Manage the acquisition, structuring, analysis and visualization of data and information in the field of specialty and critically evaluate the results of such management.

**Full-or-part-time:** 13h Self study: 10h Guided activities: 3h

# **GRADING SYSTEM**

There are two exams for the theory part:

- PT: The partial theory control (30%)

- FT: The final theory exam (40%)

Regular Assessment: The final mark of the course comes from

- MAX(70%FT; 30%PT+40%FT)

- The lab test (20%) at the end of the term
- We also assess the tracking of lab performance (10%) that is related to individual tests performed in particular lab sessions.

Reassessment: Only the students that fail the course can go to the Reassessment exam (only theory exam). Thus, the final mark of the course is the maximum between the regular assessment mark and the one obtained with the previous formula, but replacing the global theory mark with the Reassessment mark (that is, 70% of the course mark).



# **BIBLIOGRAPHY**

# **Basic:**

- Patterson, D.A.; Hennessy, J-.L.; Alexander, P. Computer organization and design: the hardware/software interface. 5th ed. Burlington: Elsevier Morgan Kaufmann, 2014. ISBN 9780124077263.

- Bryant, Randal E; O'Hallaron, David. Computer systems : a programmer's perspective. 3rd ed. Essex: Pearson, 2016. ISBN 9781292101767.

# RESOURCES

# Hyperlink:

- http://docencia.ac.upc.edu/FIB/GCED/COM