

## Course guide

### 270133 - CDI - Data and Image Compression

Last modified: 30/01/2024

**Unit in charge:** Barcelona School of Informatics  
**Teaching unit:** 749 - MAT - Department of Mathematics.

**Degree:** BACHELOR'S DEGREE IN INFORMATICS ENGINEERING (Syllabus 2010). (Optional subject).

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

#### LECTURER

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**Coordinating lecturer:** FERNANDO MARTÍNEZ SÁEZ

**Others:** Segon quadrimestre:  
FERNANDO MARTÍNEZ SÁEZ - 11, 12

#### PRIOR SKILLS

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Basic mathematical language.

#### DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

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##### 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.

CCO1.2. To demonstrate knowledge about the theoretical fundamentals of programming languages and the associated lexical, syntactical and semantic processing techniques and be able to apply them to create, design and process languages.

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.

CT1.2C. 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.

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.

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.

##### Generical:

G3. THIRD LANGUAGE: to know the English language in a correct oral and written level, and accordingly to the needs of the graduates in Informatics Engineering. Capacity to work in a multidisciplinary group and in a multi-language environment and to communicate, orally and in a written way, knowledge, procedures, results and ideas related to the technical informatics engineer profession.

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.

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.

## TEACHING METHODOLOGY

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In the theory classes, the fundamentals of the different compression methods will be explained. Later will be implemented in the laboratory classes.

## LEARNING OBJECTIVES OF THE SUBJECT

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- 1.To understand what is lossless compression, the circumstances in which it is applicable, and the most important methods to achieve it.
- 2.To know the basic principles of information theory and the ways they are applied in relation to compression.
- 3.To become familiar with the concepts of lossy compression, the way the degree of compression and its fidelity are measured, and the most important methods used in practice.

## STUDY LOAD

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Type	Hours	Percentage
Guided activities	6,0	4.00
Hours small group	30,0	20.00
Hours large group	30,0	20.00
Self study	84,0	56.00

**Total learning time:** 150 h

## CONTENTS

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### Lossless coding

**Description:**

Source coding. Huffman Algorithm. Arithmetic coding. Dictionary techniques. Other methods.

### Lossy compression

**Description:**

Scalar and vectorial quantization. Discrete transforms. Wavelets. JPEG

## ACTIVITIES

### Development of the lossless compression block in theory classes, laboratory sessions and problem solving sessions.

#### Specific objectives:

1

#### Related competencies :

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G3. THIRD LANGUAGE: to know the English language in a correct oral and written level, and accordingly to the needs of the graduates in Informatics Engineering. Capacity to work in a multidisciplinary group and in a multi-language environment and to communicate, orally and in a written way, knowledge, procedures, results and ideas related to the technical informatics engineer profession.

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.

#### Full-or-part-time: 75h

Theory classes: 7h 30m

Practical classes: 7h 30m

Laboratory classes: 15h

Self study: 45h

### Development of the lossy compression block in lectures, laboratory sessions and problem solving sessions.

#### Specific objectives:

3

#### Full-or-part-time: 75h

Theory classes: 7h 30m

Practical classes: 7h 30m

Laboratory classes: 15h

Self study: 45h

### Final exam

#### Specific objectives:

2

#### Related competencies :

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.

G3. THIRD LANGUAGE: to know the English language in a correct oral and written level, and accordingly to the needs of the graduates in Informatics Engineering. Capacity to work in a multidisciplinary group and in a multi-language environment and to communicate, orally and in a written way, knowledge, procedures, results and ideas related to the technical informatics engineer profession.

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## GRADING SYSTEM

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50 % Problems and quizzes.

50 % Lab delivery.

## BIBLIOGRAPHY

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### Basic:

- Sayood, K. Introduction to data compression. Fifth edition. Cambridge, Mass.: Morgan Kaufmann, 2018. ISBN 9780128094747.
- Taubman, D.S.; Marcellin, M.W. JPEG2000: image compression fundamentals, standards and practice. Kluwer Academic Publishers, 2002. ISBN 079237519X.
- Salomon, D.; Motta, G. Handbook of data compression. 5th ed. Springer, 2010. ISBN 9781848829039.
- Poynton, C. Digital video and HD: algorithms and interfaces. 2nd ed. Morgan Kaufmann, 2012. ISBN 9780123919328.
- Salomon, D. A concise introduction to data compression. Springer, 2008. ISBN 9781848000728.

### Complementary:

- Hankerson, D.R.; Harris, G.A.; Johnson, P.D. Introduction to information theory and data compression. 2nd ed. Chapman & Hall/CRC Press, 2003. ISBN 1584883138.
- Walker, J.S. A primer on wavelets and their scientific applications. 2nd ed. Chapman & Hall/CRC, 2008. ISBN 9781584887454.
- Solem, J.E. Programming computer vision with Python. O'Reilly, 2012. ISBN 9781449316549.
- Bock, A.M. Video compression systems: from first principles to concatenated codecs. Institute of Electrical Engineers (IEE), 2009. ISBN 9781849191036.