UAB
Universitat Autònoma de Barcelona

Algorithmics and Combinatorics in Graphs. Heuristic Methods

Code: 104388
ECTS Credits: 6

2025/2026

Degree	Type	Year
Computational Mathematics and Data Analytics	FB	1

Contact

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Teachers

Albert Ruiz Cirera

Teaching groups languages

You can view this information at the end of this
document.

Prerequisites

It is recommended that the student has taken Mathematics in the two baccalaureate courses and has examined this matter in the PAU.

[Translated from the Catalan version by Google translator]

Objectives and Contextualisation

- Know the combinatorial graphs and their terminology.
- Know the different search algorithms and movement in graphs.
- Know the types of dynamic data for representation of graphs and their implemtation in C.
- Know the basic algorithms of optimal searches in graphs and their complexity.

[Translated from the Catalan version by Google translator]

Learning Outcomes

1. KM02 (Knowledge) Distinguish the objects of calculus with functions and their properties and uses.
2. KM05 (Knowledge) Describe the mathematical concepts and objects specific to the graph theory.
3. SM05 (Skill) Develop independent strategies to solve problems specific to numerical calculus, probability and graph theory.

Content

- Combinatorial algorithms for graphics.
- Combined graphs and graph searches.
    - Theory of graphs: introduction.
    - Search in graphs: Depth-first and Breadth-first.
    - Greedy Algorithms.
    - Recursion.
- Abstract data types: Dynamic lists and trees.
- Graphic representation algorithms. Advantatges and disadvantages of each of the options.
- Abstract and dynamic data types for graphs and their implementation in C.
- Basic algorithms for optimal search graphs and their complexity.
    - Calculation of distances from latitude and longitude.
    - Algorithm of Dijkstra for optimal routes in graphs.
    - Algorithm A *: heuristic search for optimal paths in graphs.

[Translated from the Catalan version by Google translator]

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Attend the theoretical and practical classes	49	1.96	
Type: Supervised			
Completion of the practices	62	2.48	
Type: Autonomous			
Resolution of complementary exercises	30	1.2	

The weekly sessions of the subject will be divided, usually, in two parts:

1. A theoretical part in which the teacher will introduce the concepts, methods and examples related to the syllabus of the subject.
2. A practical part in which students will be proposed a series of problems or exercises in which they will be shown and a concrete work will be worked on that which has been seen in the theoretical part. Each practice will have a different statement, which will be published on the Virtual Campus and will involve the delivery of the answers to some questions raised.

Complementary exercises will also be proposed as an autonomous activity to help them understand the applied part of the subject.

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Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Assessment

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Delivery of practical exercices	25%	0	0	KM02, KM05, SM05
End of term exam	40%	4	0.16	KM02, KM05, SM05
Individual practical work	35%	5	0.2	KM02, KM05, SM05

The evaluation will consist of the following activities:

- A final exam, which accounts for 40% of the note.
- An individual practical work with a delivery period where it will be necessary to develop and implement algorithms, which account for 35% of the note.
- Delivery, during practical sessions, of practical exercises that will be carried out in groups of two. They count 25% of the note. This is a continuous evaluation activity and is not recoverable.

Teh final marks will be:

- The weighted average according to the weight of each part for those students who have obtained 3.5 or more in all parts.
- The minimum between 3.5 and the weighted average according to the weight of each part for those students who have done any of the individual evaluations and in any of the parts does not reach 3.5.
- Not assessable for those students who have not done any of the individual evaluations.

Those who have been evaluated in all three parts and do not pass the subject may present themselves for a retake of the final exam and the individual practical work. In particular, those who have not submitted the individual practical work and the final exam will not be able to present themselves for retake.

This subject does not allow a unique evaluation procedure.

[Translated from the Catalan version by Google translator]

Bibliography

- Fundamentos de programación (algoritmos, estructuras de datos y objetos), Luis Joyanes, McGraw-Hill, Madrid etc. (2003).
- Algoritmos y estructuras de datos - una perspectiva en C, Luis Joyanes y Ignacio Zahonero, McGraw-Hill, Madrid etc. (2004).
- Grafs combinatòris i cerques en gràfs:Wikipedia
- Tipus abstractes de dades i programació orientada a objectes: Llistes dinàmiques i arbres; Tipus abstractes i dinàmics de dades per a grafs i la seva implementació en C.
    Notes del curs
    Algoritmos + Estructura de datos = Programas, Niklaus Wirth, Ediciones del Castillo, Madrid (1986).
    C algoritmos, programación y estructuras de datos, Luis Joyanes Aguilar et al., McGraw-Hill, Madrid etc. (2005).
- Algorismes de representació de grafs. Avantatges inconvenients de cada una de les opcions: Wikipedia i notes del curs
- Càlcul de distàncies a partir de la latitud i la longitud: Wikipoedia i notes del curs

- Algorisme de Dijkstra per a rutes òptimes en grafs: Presentació d'Eric Demaine
- Algorisme A*: cerca heurística per a rutes òptimes en grafs
  Heuristics: Intelligent Search Strategies for Computer Problem Solving, Judea Pearl
  Addison-Wesley Pub (Sd) | ISBN: 0201055945 | 1984-04 | djvu (ocr) | 399 pages | 3.66 Mb
  Pagines: 33 to 46, 48, 49, 64, 65, 73--85.L'exemple a les pàgines 52--54 pot ser relevant.

Software

C

Groups and Languages

Please note that this information is provisional until 30 November 2025. You can check it through this link. To consult the language you will need to enter the CODE of the subject.

Name	Group	Language	Semester	Turn
(PLAB) Practical laboratories	1	Catalan	second semester	morning-mixed
(SEM) Seminars	1	Catalan	second semester	morning-mixed
(TE) Theory	1	Catalan	second semester	morning-mixed