

**COURSE DATA****Data Subject**

Code	34686
Name	Advanced programming
Cycle	Grade
ECTS Credits	6.0
Academic year	2023 - 2024

Study (s)

Degree	Center	Acad. year	Period
1400 - Degree in Computer Engineering	School of Engineering	4	First term
1407 - Degree in Multimedia Engineering	School of Engineering	4	First term

Subject-matter

Degree	Subject-matter	Character
1400 - Degree in Computer Engineering	16 - Optional subject	Optional
1407 - Degree in Multimedia Engineering	19 - Optatividad	Optional

Coordination

Name	Department
BARBER MIRALLES, FERNANDO	240 - Computer Science

SUMMARY

The course "Advanced Programming" is a subject of the fourth year of the Degree of Computer Engineering.

This subject is thought to teach programming techniques especially suitable to improve program efficiency, including for example templates and metaprogramming.

The subject is focused on C++. The latest standards of C++ will be studied (C++11, C++14, ...) and C++ will be the programming language for all the works.

These techniques are very interesting in game programming and other systems, where efficiency is a must. They also allow taking full advantage of C++.



PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

It is highly desirable that students have taken the courses "Informatics", Programming and Data Structures and Algorithms. It is necessary to have an intermediate level of programming in C++. Also, it is desirable to have some basic knowledge of processor architecture.

OUTCOMES

1400 - Degree in Computer Engineering

- C2 - Ability to acquire, obtain, formalise and represent human knowledge in a computable form for solving problems through a computer system in any field, particularly in those related to aspects of computing, perception and action in intelligent environments.

1405 - Grado en Ingeniería Multimedia

- Program correctly in the different specific languages of multimedia systems taking into account time and cost restrictions.

LEARNING OUTCOMES

This course allows to obtain the following results of learning:

- 1 Use of new standards of C++ (C++11)
- 2 Be able to improve program efficiency.
- 3 Advanced use of templates.
- 4 Use of metaprogramming in C++.
- 5 Understand the advantages and limitations of different data structures and be able to select the best option for a particular problem.
- 6 Be able to use dynamic programming.



DESCRIPTION OF CONTENTS

1. Introduction to efficient programming

- General strategies. Profiling.
- Sorting with no comparisons. Countsort. Radixsort.
- Amortized analysis of algorithms. Expansible vector

2. Standard C++11

- Modifications to the core language.
- Modifications to the standard library.

3. Efficiency improvement in C++

- Common optimizations in C++.
- Dynamic Memory in C++. New and delete modifications.

4. Use of templates

- Template functions.
- Template classes.
- Variadic Templates.

5. Advanced use of templates

- Polymorphism and templates.
- Traits templates and Policy classes.
- Metaprogramming.
- Expression templates: Efficient numeric arrays.
- Efficient numeric arrays in other languages: Python.

6. Efficiency improvement in recursive programs

- Function embedding.
- Unfold/Fold transformation. Recursive-Iterative transformation.
- Dynamic programming. Floyd algorithm.

**WORKLOAD**

ACTIVITY	Hours	% To be attended
Theory classes	30,00	100
Laboratory practices	20,00	100
Classroom practices	10,00	100
Development of group work	20,00	0
Development of individual work	6,00	0
Study and independent work	5,00	0
Readings supplementary material	5,00	0
Preparation of evaluation activities	15,00	0
Preparing lectures	11,00	0
Preparation of practical classes and problem	28,00	0
TOTAL	150,00	

TEACHING METHODOLOGY

The course themes will be developed at the classroom based activities providing general as well as integrated view, analysing in details and of major complexity the key aspects and encouraging students' participation at every point. These activities are complemented by practical activities in order to apply basic concepts and expand them with the knowledge and experience which is gained during the performance of the proposed works. They include the following classroom activities:

- Lessons of problems and questions in classroom
- Sessions of discussions, solving of problems and exercises previously worked by students
- Laboratory practice
- Classroom evaluation through individual questionnaires at the presence of the professorship

Besides the classroom activities the students are to work at individual tasks (out of the classroom) like: monograph works, guided bibliographic search, issues and problems, as well as preparation for lessons and exams. These tasks mainly will be carried out individually in order to upgrade skills of independent work, but in addition will be included some projects which will require the small group (2-4 students) participation with the purpose to build up the capacity for integration into work groups.

The e-learning platform (Aula Virtual) is used in the University of Valencia as a form of communication with students. Students have access through it to the teaching materials used at lessons as well as to problems and exercises to be resolved.



EVALUATION

The evaluation of the course is carried out according to the following scheme:

- Continuous evaluation (*N_Continua*) based on the degree of participation and involvement in the teaching-learning process, taking into account regular assistance at the planned classroom activities, resolution of issues and problems and of works to be delivered.
- Individual objective test (*N_Examenes*) consisting of several tests or knowledge tests which include both theoretical and practical issues as well as problems. Some of the tests may be substituted with works.
- Evaluation of practical activities (*N_Practicas*) taking into account the achievement of objectives in the lab sessions, resolving problems and projects elaboration.

The final course grade will be calculated according to the following formula:

$$\text{Final Grade} = 20\% N_Continua + 50\% N_Examenes + 30\% N_Practicas$$

It is required to obtain a minimum grade of 4.5 out of 10 in *N_Examenes* and *N_Practicas* to pass the course.

The grade of *N_Continua* is not recoverable. The grade is maintained in 2º call.

In any case, the evaluation of this subject will be done in compliance with the University Regulations in this regard, approved by the Governing Council on 30th May 2017 (ACGUV 108/2017)

REFERENCES

Basic

- B. Stroustrup, The C++ Programming Language, 4ª Ed., Addison-Wesley, 2013.
- T.H. Cormen et al, Introduction to Algorithms, 3ª Ed., The MIT Press, 2009.
- D. Vandevorde, N.M. Josuttis, C++ Templates: The Complete Guide, 2ª Ed. Addison-Wesley, 2017.

Additional

- N.M. Josuttis, "The C++ Standard Library: A Tutorial and Reference", 2º Ed. Addison-Wesley. 2012.
- P. Deitel, H. Deitel, "C++ How to Program", 9ª Ed, Prentice Hall. 2013.



- S. Meyers, "Effective C++: 55 Specific Ways to Improve your Programs and Designs", 3^a Ed. Addison-Wesley. 2005.
- S. Meyers, "More Effective C++: 35 New Ways to Improve your Programs and Designs", Addison-Wesley. 1995.
- S. Meyers, "Effective STL: 50 Specific Ways to Improve your Use of the Standard Template Library", Addison-Wesley. 2001.
- A. Alexandrescu, "Modern C++ Design: Generic Programming and Design Patterns Applied", Addison-Wesley. 2001.
- M. Gregoire, "Professional C++", John Wiley & Sons. 2018.
- S. Meyers, "Effective Modern C++", Ed. O'Reilly Media, 2014.