In addition to the general offer of courses taught in English, some Centers also offer for incoming students English Friendly Courses (EFC): subjects taught in Spanish, in which the syllabus summary, lecturer tutoring, examinations and/or papers are available in English.

<table>
<thead>
<tr>
<th>FACULTY OF INFORMATICS (226)</th>
<th>SEMESTER</th>
<th>CREDITS</th>
<th>SCHEDULE</th>
</tr>
</thead>
<tbody>
<tr>
<td>26236 Administración Sistemas y Redes</td>
<td>Sep. 2020- Jan. 2021</td>
<td>6</td>
<td>M</td>
</tr>
<tr>
<td>26248 Diseño y Construcción de Sistemas Digitales</td>
<td>Sep. 2020- Jan. 2021</td>
<td>6</td>
<td>M</td>
</tr>
<tr>
<td>26260 Procesado Digital de Sonido e Imagen</td>
<td>Sep. 2020- Jan. 2021</td>
<td>6</td>
<td>A</td>
</tr>
<tr>
<td>26238 Interacción Persona Computador</td>
<td>Sep. 2020- Jan. 2021</td>
<td>6</td>
<td>M</td>
</tr>
<tr>
<td>26210 Servicios y aplicaciones en red</td>
<td>Sep. 2020- Jan. 2021</td>
<td>6</td>
<td>M</td>
</tr>
<tr>
<td>26213 Modelos Abstractos de Cómputo</td>
<td>Sep. 2020- Jan. 2021</td>
<td>6</td>
<td>M</td>
</tr>
<tr>
<td>26026 Diseño de Bases de Datos</td>
<td>Sep. 2020- Jan. 2021</td>
<td>6</td>
<td>M</td>
</tr>
<tr>
<td>26217 Gráficos por Computador</td>
<td>Sep. 2020- Jan. 2021</td>
<td>6</td>
<td>M</td>
</tr>
<tr>
<td>26218 Minería de datos</td>
<td>Sep. 2020- Jan. 2021</td>
<td>6</td>
<td>M</td>
</tr>
<tr>
<td>26025 Sistemas de Gestión de Seguridad de Sistemas de Información</td>
<td>Sep. 2020- Jan. 2021</td>
<td>6</td>
<td>M</td>
</tr>
<tr>
<td>26261 Robótica, Sensores y Actuadores</td>
<td>Sep. 2020- Jan. 2021</td>
<td>6</td>
<td>A</td>
</tr>
<tr>
<td>26230 Métodos formales de desarrollo de software</td>
<td>Sep. 2020- Jan. 2021</td>
<td>6</td>
<td>A</td>
</tr>
<tr>
<td>26258 Electrónica Aplicada al Tratamiento de Datos</td>
<td>Jan. 2021- May 2021</td>
<td>6</td>
<td>A</td>
</tr>
<tr>
<td>26237 Tecnologías e Infraestructuras de Red</td>
<td>Jan. 2021- May 2021</td>
<td>6</td>
<td>M</td>
</tr>
<tr>
<td>26013 Metodología de la programación</td>
<td>Jan. 2021- May 2021</td>
<td>6</td>
<td>M</td>
</tr>
<tr>
<td>26241 Gestión Avanzada de Información</td>
<td>Jan. 2021- May 2021</td>
<td>6</td>
<td>M</td>
</tr>
<tr>
<td>25987 Gestión de Proyectos</td>
<td>Jan. 2021- May 2021</td>
<td>6</td>
<td>M</td>
</tr>
</tbody>
</table>

1 SCHEDULE: Morning (M)/ Afternoon (A): begins at 13.30.

By clicking the subject’s name, its Syllabus will appear.
This subject is an elective course of the 4th year of the Informatics Engineering Degree (in the speciality Computer Engineering (taught during the first four-month period).

The subject is intended to introduce the student of Computer Science to both the theoretical and practical aspects of Digital Signal Processing. Therefore, the subject uses concepts learned in previous subjects in the areas of mathematics (complex numbers, sinusoidal...) and programming. In the professional field, the subject enables students to process digitally any type of signal (sound, image, information from sensors, time series, etc.) in multiple fields (audio-visual, industry, medicine, meteorology, etc.). In this way, it serves as a link to other areas such as Data Science, Big Data, Industry 4.0, etc.

The fundamental objectives are:

- To introduce the student to the basic concepts related to Digital Processing: signals, systems, time and frequency analysis, filters.
- To deepen these concepts in the case of sound and image, and to show the methods used in digital systems to capture, process and produce this type of signals.
- To present practical applications of these techniques and alternatives for their implementation.
- To put into practice the concepts studied, applying them in the laboratory to real cases of sound (voice and music) and image processing, using MATLAB, one of the most widely used tools in this field.

2- COMPETENCES/LEARNING OUTCOMES OF THE SUBJECT

SPECIFIC COMPETENCES

The learning objectives to be achieved are those associated with the specific competences (SC) of the subject and are as follows:

SC1. To know and apply the fundamental mathematical concepts for the analysis and design of digital signal processing systems.

SC2. To understand the techniques used in digital systems to capture, process and produce sound and image signals.

SC3. To apply time and frequency analysis techniques to digital signals.

SC4. To design and implement digital filters for the processing of sound and image signals.

SC5. To use MATLAB to develop and implement digital signal processing systems.
GENERAL COMPETENCES

Added to the subject specific competences, the students will also acquire the general competences C4, C8 and C9 and the specific competences of the computing branch RI1 and RI9 as they appear in the following document:


3- THEORETICAL/PRACTICAL CONTENT

Theme 1
Introduction.
Signals and systems Why digital processing?

Theme 2
Digital signals.
Definitions and properties. Digitization. Basic signals and operations. Sound and image.

Theme 3
Time domain analysis.
Projects: Analysis of sound and image signals.

Theme 4
Frequency domain analysis.
Starting idea. Fourier series and transform. Application to two-dimensional systems.
Projects: Frequency analysis of sound and image signals.

Theme 5
Filters.
Projects: Linear systems (FIR, IIR) and filter design.

Theme 6
Applications of digital signal processing.
Areas of application and examples.
Final projects: medium/high complexity projects in which acquired competencies in the subject are applied.
4- METHODOLOGY

There are four types of activities:

- Autonomous study by the students of the material available in the virtual classroom for each subject in which the theoretical/practical concepts to be used are presented, as well as a proposal of exercises associated with them. In addition to directly accessible information, students can use bibliographic references as support material.

- Presentation and exercise classes in which, in a participative way, the theoretical/practical concepts of each topic are shared and the doubts associated with them are clarified, always emphasizing their usefulness and practical aspects. In these sessions, the initially proposed exercises ("on paper") will be shared in order to deepen the theoretical foundations. Exercises will also be proposed on each topic that the students will have to solve and that will be evaluated with the corresponding feedback.

- Development of specific projects in which the students (in groups of 2) apply the theoretical/practical concepts learned to real cases of sound (voice and music) and image processing, using MATLAB. For each of these sessions, a technical report of results must be submitted that will be evaluated with the corresponding feedback.

- Development of a final project (medium/high complexity level) in which the students (in groups of 2) will apply the theoretical/practical knowledge previously learned in the course.

In order to facilitate student learning, specific projects will be monitored by providing feedback based on previously established and shared evaluation criteria. In this way, students are aware of their level of learning and take steps to improve it if necessary.

5- TYPES OF TEACHING

Master class + Laboratory practices

6- ASSESSMENT SYSTEMS

The subject matter shall preferably be assessed by continuous assessment. Students who are unable to follow the continuous assessment will have the possibility of a final assessment.

7- TOOLS USED & GRADING PERCENTAGES

GAUR (the student’s management app): offers assessment tools, percentages and other options.
8- ORDINARY EXAM CALL: GUIDELINES & DECLINING TO SIT

In the ordinary call for proposals, the preferential assessment system will be in the form of continuous assessment. The mark is calculated as follows:

- Exercises in the classroom: 20%.
- Deliveries of specific projects: 30%
- Final project: 20%.
- Final knowledge test: 30%.

For the final assessment mode, the students will have to submit the reports corresponding to the specific projects and the final project before the date of the final knowledge test. In this case, the examination will weigh 60% and the practical part 40%.

To pass the course, in any modality, it is necessary to pass the final knowledge test.

Students may waive continuous assessment before 50% of the course has been taught in writing addressed to the teachers.

9- EXTRAORDINARY EXAM CALL: GUIDELINES & DECLINING TO SIT

In the case of the extraordinary call, the final mark is calculated based on two parts:

- Theory (60%): Assessed by a knowledge test.
- Practical (40%): This is assessed on the basis of the technical reports corresponding to the specific and final projects, which must be submitted before the date of the theory test.

In order to pass the course it is necessary to pass both parts (theoretical and practical).

10- COMPULSORY MATERIALS

- A personal computer.
- MATLAB software, necessary for the laboratory practices.

The centre provides both resources. In addition, students have the possibility of carrying out practical projects on their own computers using free software (Octave, Python...).

11- BIBLIOGRAPHY

BASIC REFERENCES:
IN-DEPTH BIBLIOGRAPHY:

WEBSITES:
www.mathworks.com
www.dsprelated.com
www.gnu.org/software/octave
www.scipy.org
DESCRIPTION AND CONTEXT OF THE SUBJECT

The "Human-Computer Interaction" subject is compulsory for students in the Software Engineering speciality in the Computer Science degree course, and optional for students of other specialities. You will need to have basic knowledge of Software Engineering, for example what a three-level architecture is or a software development cycle. During the term, the front end of a three-level web application will be developed.

COMPETENCES / LEARNING OUTCOMES OF THE SUBJECT

The subject aims at the student learning to: (1) analyse (apprehend/understand), discuss, evaluate and analyse user requirements in order to (2) analyse, design and evaluation systems that are usable, accessible and ergonomic in different environments and places in a structured and methodical way, (3) paying special attention to the different needs of different types of users with varying cognitive and psycho-motor (dis)abilities, (4) transmit and weigh up, in a collaborative manner with users, ideas, designs and applications for these systems.

In addition, we will work on other generic competences envisaged in the profile of the degree, in the document List_of_competences.pdf at http://www.ehu.es/documents/340468/516505/Lista+de+competencias.pdf, in particular the general competences : C3,C4, C5, C9 and C10 of the degree, as well as the specific competences IS1, IS2 and IS4 of the specialty of Software Engineering.

THEORETICAL-PRACTICAL CONTENT

Theme 1 Introduction. Basic concepts.
Theme 2 The human factor.
Theme 3 Devices for, and styles of, interaction.
Theme 6 Design techniques. New trends.
Theme 7 Interface evaluation techniques. Carry out a usability study. Measurements and analysis.

METHODOLOGY

The subject involves three main types of activities, all based on presence-based classes (one-off and regular) and student participation: theory classes, practical sessions in the laboratory and other sessions for work and discussion in groups.

Based on active teaching methodologies, both in the theory classes and in the practical sessions, and with the aim of encouraging students to participate actively and gain
satisfaction, activities based on teamwork and the presentation of solutions will be organised, followed by debates and the discussion of problems encountered in the practical work sessions.

**ORDINARY CALL: GUIDANCE AND WITHDRAWAL**

The assessment system for the subject offers two options: continuous assessment or exam and practical work -based assessment (final assessment).

1. Continuous assessment: based on one-off and regular attendance in class, presenting results, taking tests on the knowledge acquired and the performance of practical work (both individually and in groups). The grade is obtained from the following assessment results:

   a. Development project (75% of the grade, compulsory): a project on the construction of a usable interface, throughout the term. Individual tests on the knowledge acquired will be set, and the mark will help towards the end-of-project grade.

   b. Complementary work (25% of the grade): An evaluation of the summaries made from the course reading list and presentation of solutions, as well as participation in related debates.

2. Exam and practical work based- assessment (final assessment). Based on the established periods and procedures, with voluntary attendance in class. The final exam consists of two phases: one to assess the competences obtained in the course of the usable interface project (compulsory and done before the exam), and the other to assesses the level of knowledge shown in the subject. Both the practical work and the exam are individual and compulsory, and must be passed (with a mark of 5 for each one).

**EXTRAORDINARY ASSESSMENT**

The same requirements and assessment criteria as for the final assessment are applied. Pass grades are not carried over to the next year.

**MATERIALS THAT MUST BE USED**

Materials provided by the professor (notes, slides, definitions, articles, studies....).
Network Services and Applications

Description
This subject is taken in the third year, when the student must opt for one of the specialities. Anyway, this subject is compulsory for all students. Due to the importance that computer networks - especially the Internet - have nowadays, it is considered that all students should acquire basic knowledge about this area.
In this subject, the basic requirements for developing applications in which the network plays a key role are studied. The subject focuses on the part of application development that is linked to the existence of the Internet, giving special importance to the study of developments in TCP/IP and, specifically, web applications. Models for the creation of network applications and interfaces for their development are studied.

Syllabus
1. Design of network applications.
2. Interfaces for access to network services: sockets.
3. Web-based applications.
4. Advanced tools for the development of network applications.

Methodology
Being basically a practical subject, in the theoretical classes the main concepts are explained and the student then goes into greater depth following the references provided by the professor. Theoretical concepts are put into practice in the practical classes.

Students have to carry out two types of practical work in groups. 1) They do the practical work proposed in the laboratory classes, always supported by the professor. This practical component uses to be short (one session) and highly directed, without much margin for moving away from the objective.
2) Students have to carry out (mainly out of classroom) other more general practical work, using the main concepts taught in class in a wider and more realistic way. The content of the practical work should be agreed with the professor beforehand. Specifically, the students have to perform one of these practical projects associated to each of the 3 first themes.

Evaluation
Students have to choose between two types of evaluation: continuous or overall. In both cases, the weight of each theme in the syllabus is the same: 10%, 45%, 40% and 5%.
Initially, any student attending class is considered as enrolled in continuous evaluation. Their pre-enrolment becomes definitive after the confirmation of the application by the student within the established timescale (between 60% and 80% of the course). If, within these dates, the student does not confirm his/her enrolment in continuous evaluation it is understood that he/she opts out of it.

In continuous evaluation, attendance at class is compulsory. In this case, the evaluation is divided into three parts. On one hand, students do practical work in groups in the 3 first themes, mainly outside class hours. These represent 50% of the mark (10%, 20% and 20%). On the other hand, in themes 2 and 3 the student takes a written exam (multiple-choice), which represents 45% of the final mark (25% and 20%). It is necessary a mark of 3 in each exam to stay in continuous evaluation. Finally, in the last theme the practical work done in the laboratory is evaluated. It represents 5% in the final mark.

In the case of overall evaluation, the student has to hand in a number of practical projects (done outside class hours) on an individual basis, and agreed with the professor. He/she also has to take a written exam that represents 70% of the final mark.
The main objective of "Abstract Computation Models" subject is to determine the computational difficulty of those problems that can be solved by a computer. This subject presents theoretical contents to distinguish whether a given problem is very difficult to compute or not. Moreover, we will see that there exist problems that cannot be solved by any computer. "Abstract computation models" subject complements the knowledge of the previous "Languages, Computation and Intelligent Systems" subject.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Competencies:
1) Know basic Computability Theory concepts
2) Be able to formalize Computability Theory concepts
3) Realize that there are limits beyond which algorithmic methods do not work
4) Develop intuition about non computable and intractable problems
5) Know some Complexity classes and the relationship among them
6) Learn techniques for determining the computational difficulty of problems

COURSE CONTENTS, THEORETICAL & APPLIED

2) SAT problem. NP-complete problems. polynomial-time reductions. P versus NP question.
3) Techniques to deal with intractable problems. Aproximations. Randomness.
4) Limits of computation. More about undecidable problems.

TEACHING METHODS

Support material will be available in the eGela virtual classroom.

We will work with Python programming language in the laboratories.

TYPES OF TEACHING

<table>
<thead>
<tr>
<th>Types of teaching</th>
<th>M</th>
<th>S</th>
<th>GA</th>
<th>GL</th>
<th>GO</th>
<th>GCL</th>
<th>TA</th>
<th>TI</th>
<th>GCA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours of face-to-face teaching</td>
<td>40</td>
<td>15</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hours of student work outside the classroom</td>
<td>60</td>
<td>30</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Legend:  
M: Lecture-based  
S: Seminar  
GA: Applied classroom-based groups  
GL: Applied laboratory-based groups  
GO: Applied computer-based groups  
GCL: Applied clinical-based groups  
TA: Workshop  
TI: Industrial workshop  
GCA: Applied fieldwork groups

Evaluation methods

- Continuous evaluation
- End-of-course evaluation

Evaluation tools and percentages of final mark

- Written test, open questions  90%
- Exercises, cases or problem sets  10%

ORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

The subject has two different kinds of assessments: final (or overall) assessment and continuous assessment.

Continuous assessment

The student will voluntarily decide whether to take part or not in it, since it is offered exclusively for those students who can carry out continuous monitoring of the subject within the established dedication framework and can attend to presential activities.

Pre-enrolment in the continuous assessment mode will take place during the first week of the course. Pre-enrolment will
become definitive after confirmation of the application by the student on established dates (around the 12th week of the course, with approximately 70% of the continuous assessment already completed) and after partial performance verification by the teaching staff. If the student does not confirm his or her definitive enrolment in the continuous assessment on the abovementioned dates, it will be understood that he or she dismisses the enrolment.

The course is mainly focused on continuous assessment.

Continuous assessment will be evaluated by means of three written exams, with a weight of 30, 40 and 20% of the overall grade of the subject. Besides, a 10% of the grade will be determined by laboratory work.

Additionally, a minimum of a 30% grade must be achieved in each written exam and a minimum of 5 over 10 is required to pass the subject.

Final Assessment

This kind of assessment will be applicable to students who do not wish to take part in continuous assessment or those who do not meet the criteria continuous assessment.

In this case, a single written exam about the 100% of the subject must be performed. It will be carried out according to the official examination schedule of the Faculty. The minimum grade required in the final exam will be 5 out of 10.

EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

One single written exam about 100% of the subject in which the minimum grade is 5 out of 10.

MANDATORY MATERIALS

BIBLIOGRAPHY

Basic bibliography

John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman. "Introducción a la teoría de Autómatas, Lenguajes y Computación: 2ª edición". Pearson educación, 2002


Detailed bibliography


J. IBAÑEZ; A. IRASTORZA; A. SANCHEZ. "LOS PROGRAMAS WHILE. Bases para una teoría de la Computabilidad". Informe interno. UPV/EHU / LSI / TR 5-96.


Journals

Web sites of interest

http://www.jflap.org/

https://eu.udacity.com/course/intro-to-theoretical-computer-science--cs313

http://computational.complexity.googlepages.com/

OBSERVATIONS
The subject Database Design is located in the Software Engineering specialty of the degree in Computer Engineering. This subject is based on knowledge acquired in the subject called Databases that is taught in the second year, and also addresses issues of interest for the optional subject Databases Administration. It also establishes links with some aspects described in the Software Engineering subject, specifically at the data management level of the three-layer architectures.

In this subject, after successfully completing the objectives indicated below, the following competences will be acquired:

* The ability to evaluate the customer's needs and specify the software resources required to satisfy these needs, reconciling conflicting objectives through the search for acceptable compromises within the limitations of cost, time and the existence of already-developed systems and from the organizations themselves.

*The ability to identify and analyse problems and design, develop, implement, test and document software solutions based on knowledge of current theories, models and techniques.

Other general competences will also be worked on. These are described in the course profile in the document titled 'Lista de competencias.pdf', which is available at http://www.ehu.es/documents/340468/516505/Lista+de+competencias.pdf, in particular the general competences of the course C3, C4, C6, C8 and C9, as well as those of the Software Engineering speciality IS1, IS2, IS3 and IS4. And finally, transversal competences such as teamwork, oral and written communication, innovation, creativity and entrepreneurship, and autonomous learning.

Objectives

* Learn about the design phases of a database.

* Analyse data requirements to design conceptual schemes using E/R, E/R+ and UML.

* Design a logical schema (using a relational data model) of a database based on the conceptual schema.

* Normalise the relational schema.

* Define views over the relational schema.

* Define integrity constraints over the relational schema.

* Carry out the physical design of a database.

* Learn about other design techniques:
  ** Data Warehouses.
  ** Distributed databases.
EDUKI TEORIKO-PRAKTIKOAK (INGELESEZ)

1. Introduction: Principles of Databases Design, Life cycle of a DBS (Data Base System), design steps.
2. Conceptual Design: ER and UML models
   - ER model
   - ER+ model
   - Transformation from ER to Relational
   - Representation of conceptual design on UML
3. Normalization Process
4. SQL views
5. Integrity Constraints
6. Physical design
7. Other design techniques
   - Distributed Databases
   - Data Warehouses.

METODOLOGIA (INGELESEZ)

Most of the syllabus will be covered during teaching hours called classroom hours. Students will also have to strengthen their knowledge of concepts by working autonomously outside class hours (i.e. non-teaching hours), consulting specialised bibliography and doing project work and exercises.

In teaching and laboratory hours, time for discussion and the presentation of projects and exercises will be provided systematically, with the aim of encouraging students to participate actively in class and develop transversal skills.

OHIKO DEIALDIA: ORIENTAZIOAK ETA UKO EGITEA (INGELESEZ)

The academic subject has two modalities of evaluation: final and continuous. Continuous evaluation, which the student can sign up for voluntarily, is only offered to those students who can carry out a continuous follow-up of the subject within the established timeframe and attend teaching activities.

Pre-enrolment in continuous evaluation will be done within the established dates. The pre-enrolment will become definitive after the confirmation of the application by the student within the established dates (between 60% and 80% of the course) and after a previous check on his/her performance by the teaching staff. If, within these dates, the student does not confirm his/her enrolment in continuous evaluation it will be understood that he/she opts for leaving it.

Overall evaluation:
   - Written exam in the ordinary and extraordinary evaluations that are established.
     Final exam 100%
     Laboratory (must be performed at least 80% of those required) and practical work (at least a 5 mark must be obtained), are compulsory and must be performed before the exam.

Continuous evaluation will be done in the following tests:
   - Three written tests (exams): 28% + 28% + 14%
     (To continue in continuous evaluation, the student must obtain a minimum 3.5 mark (out of 10) in all the exams
- Group work, plus presentation: 15% (it is compulsory to obtain at least a 5 mark in the practical work)
- Laboratory work: 15%

Moreover, for the continuous evaluation an attendance of the (80% is required)

**EZOHIKO DEIALDIA: ORIENTAZIOAK (INGELESEZ)**

Assessment in extraordinary evaluation mode:
- Final exam 100%
- Laboratory (must be performed at least 80% of those required) and practical work (at least a 5 mark must be obtained) are compulsory. They must be done before the exam.
COMPUTER GRAPHICS

COURSE DESCRIPTION AND CONTEXT
The main objective is to train in the rendering of virtual scenes. The images will show objects placed in a virtual world, so the student has to learn to transform the objects to place them correctly positioned and oriented. To get different views of the scene a camera must be controlled and to get realistic images the illumination concepts should be taken into account. An overview of computer graphics and the basic concepts will be given: transformations of objects and camera views, representation of three-dimensional objects and algorithms for rendering images.

COURSE COMPETENCES / LEARNING OUTCOMES
In addition to the specific competences of Computer Graphics the general competences T3, T4, T8 and T9 will be acquired. As well as the competences K4, K5 and K6 of the area of Computation. The competences can be seen in the document http://www.ehu.es/documents/340468/516505/Gaitasunak.pdf

Contents
Topic 1 Introduction and basic concepts
Familiarization with the concepts related to Computer Graphics, knowledge of the problem of generating images, discretization, aliasing, basic drawing algorithms.

Topic 2 Geometric transformations
Transformations applicable to three-dimensional objects, matrix representation of transformations, use of homogeneous coordinates, concatenation of transformations

Topic 3 Reference systems, changes of reference systems. The camera
Reference systems. Matrix representation of the changes of reference systems.

Topic 4 Classification of object representation models
Different types of representation for 3D objects: spatial division, polygonal representation, solid, curves and polynomial surfaces.

Topic 5 Lighting of a point. Global lighting of the scene
Types of light sources. Lighting of a point. Interpolation of the lighting effects. Global solutions. Shades. Transparencies

Topic 6 Visibility and image rendering algorithms.

Methodology
There will be two types of classroom sessions: sessions guided by the teacher and laboratory sessions.
In the guided sessions the students will receive mainly theoretical explanations of the basic topics. On the other hand, practical laboratories will be used to develop the skills needed in Computer Graphics. The work that is not finished in the laboratory will have to be done outside the classroom. In order to perform the laboratory work, the student will have to apply the techniques and algorithms explained by the teacher. Therefore, students must spend some time, outside classroom, to assimilate these techniques.
The work done in the laboratory will be evaluated and taken into account, as well as the final exam.
Assessment

First (ordinary) call:
You can choose between global evaluation (final) and continuous evaluation. The continuous is voluntary and requires active participation: assistance to class and completion of work planned within the defined periods.

The continuous evaluation is chosen at the beginning of the course and must be confirmed after the development of a certain part of the subject (between 60% and 80%). The student has to request it and the teacher accepts it after verification of the appropriate continuation of the learning process.

It will be necessary to implement an application based on the presented concepts that allow creating a scene formed by different objects. The application must allow the modification and transformation of objects and, in turn, must be able to control a camera and illuminate the scene.

In the practical part, individual interviews will be carried out when it is considered necessary to determine the qualification of the work.

A minimum may be required in each of the evaluated parts (practical work and written test).

Second (extraordinary) call:
The same as for ordinary call.

Bibliography

Basic
MAKAZAGA, J. eta LASA, A. "Ordenadore Bidezko Iruigintza", UEU 1998
DELRIEUX C. and BAMBINI J.. "Computación Gráfica"

Advanced

Web
http://www.opengl.org/
http://www.eg.org/
http://education.siggraph.org/
Data Mining

This subject focuses on a field known as data mining or machine learning. It includes a series of techniques which, being based on artificial intelligence and classic statistics, have emerged strongly in the last decade for solving problems using large volumes of data. Its applications range from bioinformatics or finance to marketing-advertising, and also natural language.

Although the technological giants have been in the vanguard of this ‘data science - big data - data mining’ discipline for years, over the last few years more and more small- and medium-sized companies and institutions are becoming aware of the need to store data on their activities, and to analyse them to draw useful conclusions for their day-to-day operations. In the case of Euskadi, the machine tool sector and the term ‘Industry 4.0’ have increased the profile of our discipline.

The subject is closely linked to other computing subjects such as Artificial Intelligence and Algorithm Design; optional subjects include Heuristic Searches, plus others from other specialities related to databased and computing systems.

Students will study the main data mining techniques and will become familiar with real programs.

Theme 1 Introduction to data mining
Applications and success stories. Everything related to data mining as a discipline within the field of artificial intelligence

Theme 2 Distance-based classifiers: k-nearest neighbour
The intuitive nature of this classic method of data mining makes it ideal as the first technique of supervised classification. Its basic functioning will be studied, together with its main variants and parameters for use.

Theme 3 Techniques to evaluate and validate classifiers
Study of the main techniques for evaluating classifiers, with special emphasis on supervised classification methods and the estimation of success rates. Introduction to the main statistical tests for comparison between different classifiers.

Theme 4 Classification trees and decision rules
Study of these two algorithms, inspired by the philosophy of 'divide and rule', with special emphasis on the transparency and simplicity of its final models. Different growth and pruning options will be explained.

Theme 5 Classifiers based on Bayesian networks
Study of the basic theory underlying Bayes' theorem. Classification models of different complexity will be explained. We will examine the following applications of this type of classifiers: models for diagnosis and prognosis in medicine (evidence-based medicine, computational medicine).

Theme 6 Combination of classifiers
Study of the different techniques used to combine classifiers. The virtues of the consensus reached by classifiers will be highlighted.

Theme 7 Techniques for selecting variables
Study of basic concepts and techniques, both from the univariate and the multivariate points of view. Applications of this type of techniques: most important genes in an illness (a new area of bioinformatics).
Theme 8  Non-supervised classification (clustering)
Main clustering techniques. Describing the characteristics of this type of problem, differentiating them from the supervised ones. Practical examples: image segmentation, groups of foodstuffs based on their nutritional characteristics, segmentation of customers and targeted marketing and advertising.

Theme 9  Introduction to heuristic searches and genetic algorithms
Information Systems Security Management Systems (SGSSI)

Links to calendar, schedule and exams. The subject corresponds to the field of Computer Security, complements any speciality of the degree and has six credits assigned to it. It is taught in the fourth year of the Degree in Computer Engineering in the first four-month period.

Teachers.

- José Miguel Blanco
- José Luis Torre

Learning objectives and relation to specific skills

Develop a global vision of the different areas covered by Computer Security and general security problems arising from the use of computer equipment and applications. (RI2, C7, C11)

Conceive, plan and implement reasonable security policies and measures in professional environments, approaching the knowledge of Information Systems Security Management Systems. (RI2, C2, C10, C12)

Integrate IT security expertise at the ethical, legal and organizational levels. (C7, RI18, C11)

Topics

The contents of the course are structured in nine themes (the order does not determine the sequence of teaching):

- **Tema 1** Analysis and Management of Information System Security Risks
- **Tema 2** Data backup and backups
- **Tema 3** Access control to information resources: identification and authentication. Digital signature
- **Tema 4** Malware: risks and security measures
- **Tema 5** The human factor
- **Tema 6** Cifrado de la información: contextos de uso y técnicas básicas
- **Tema 7** Criptography: contexts of use and basic techniques
- **Tema 8** IT security planning, organization and management, auditing: techniques and standards
- **Tema 9** Legal, ethical and organizational aspects: GPRD, LSSI and Ley de Firma Electrónica

Teaching and learning methodology and activities to be carried out

The teaching methodology will be active, based on continuous monitoring and evaluation. Part of the classroom sessions will be organized according to the seminar
model and discussions and associated activities will be carried out inspired by real situations and cases. The TBL methodology combined with the "student generated questions and tests" will be used systematically.

The activities in the classroom will be closely linked to those that will be carried out outside of class time, both working individually and in groups. These activities, based on student involvement, will be linked to four lines of reflection, work and learning:

- Personal computer security
- The generation and management of trust (assurance and accreditation/certification)
- Computer security in organizations
- Social, political and ethical implications of information security issues

**Evaluation method**

The evaluation of this subject is based on two excluding alternative ways:

1. **Continuous assessment.** Based on a systematic and punctual attendance to classes, presentation of results, tests of lessons learned, and the performance of individual and team work, from the beginning of the semester to December.

2. **Final exam.**

**Calendar**

![Calendar Image]
References

- *Enciclopedia de la Seguridad Informática, Segunda Edición*, Álvaro Gómez Vieites, RAMA 2011
- *Seguridad por niveles*, Alejandro Corletti, disponible para su descarga libre en Internet, 2011

Web Repositories

- Ministerio de Administraciones Públicas. Secretaría del Consejo Superior de Administración Electrónica
  - Esquema Nacional de Evaluación y Certificación de la Seguridad de los Sistemas de Información: [http://administracionelectronica.gob.es/pae_Home/pae_Estrategias/pae_Seguridad_Inicio/pae_Esquema_Nacional_de_Seguridad.htm](http://administracionelectronica.gob.es/pae_Home/pae_Estrategias/pae_Seguridad_Inicio/pae_Esquema_Nacional_de_Seguridad.htm)
- Instituto Nacional de Ciberseguridad (INCIBE): [https://www.incibe.es/](https://www.incibe.es/)
- Encuentros Internacionales de Seguridad de la información (ENISE): [www.webcastlive.es/Nenise](http://www.webcastlive.es/Nenise) (sustituir N por un número en el rango 4-10). Las sesiones del 11Enise están accesibles en la playlist ENISE11 del canal de YouTube de INCIBE.

Resources available on the Web

- Subject board [http://tiny.cc/sgssi](http://tiny.cc/sgssi)
- MAGERIT (Metodología de Análisis y Gestión de Riesgos de los Sistemas de Información): [https://www.ccn-cert.cni.es/herramientas-de-ciberseguridad/ear-pilar/metodologia.html](https://www.ccn-cert.cni.es/herramientas-de-ciberseguridad/ear-pilar/metodologia.html)

Journals

"ROBOTICS, SENSORS AND ACTUATORS" Teaching guide

Description and Contextualization of the Subject

Robotics is a complex subject that gathers knowledge from other areas such as mechanics, automatic control, electronics, hardware and software design, human-robot interaction, etc. Computer studies require an introduction to robotics that allows simultaneously - to assimilate the basic concepts and the technical language of the field of robotics, to facilitate the integration of the computer graduate in a robotics team - to take advantage of advanced hardware and software development knowledge available to computer students, to apply them in the field of robotics, so that they can add value when integrated into a robotics team.

Competences / Learning outcomes of the subject

This subject is intended to introduce the student of computer science in both the theoretical and practical aspects of robotics. The mathematical apparatus that supports these concepts will be revised superficially. Among its objectives are:

1) Review the basic techniques used to control robots and intuitively introduce basic concepts, such as spatial representation and kinematic and dynamic problems.
2) Study the structure and basic characteristics of mobile robots
3) Learn how to program mobile robots using advanced software techniques
4) Introduce the problems related to intelligent behaviour and with person-robot communication

The subject is based on five practices that allow applying the theoretical knowledge acquired, and giving an idea of the possibilities and limitations of the robots and their programming

Theoretical-practical contents

THEORY

Topic 1. Introduction
- Definitions, antecedents and evolution
- Attributes, morphology and fields of application
- Types of robots. Taxonomy
- Computing and Robotics

Topic 2. Hardware and software for robots
- Real-time embedded systems
- Control software
- Simulators

Topic 3. Sensors
- Passive and active sensors characteristics
- Calibration of sensors
- Advanced techniques: sensory perception and fusion

Topic 4. Actuators
- Electric motors
- Transmissions
- Reductions
- PDI control of electric motors

Topic 5. Mobile robots
- Characteristics:
  o Structure
  o Locomotive system
- Behavioural strategies:
Deliberative, Reagent and Hybrid Systems

Navigation:
- Mapping: Types of maps. Absolute and relative positioning
- Planning: Path planning
- Driving: Track Tracking and Avoidance of Obstacles

Topic 6. Advanced aspects
- Portability of software for robots. ROS
- Multi-robot systems:
  - Collaboration
  - Social behaviour
  - Distributed intelligence
- Human-robot interface

LABORATORIES
In addition to the following practices, students can propose the realization of others of their invention that, once agreed with the teacher and properly specified, will participate in the calculation of the final grade of the subject.

Laboratory 1. Introduction to hardware and software used in mobile robotics laboratories
- Raspberry Pi 2, iRobot, BAM (Bluetooth Adapter Module)
- PuTTY, NetBeans, iRobot Create, iRobot Framework

Laboratory 2. Calibration of the iRobot sensors

Laboratory 3. Navigation by dead reckoning

Laboratory 4. Navigation by means of marks and avoidance of obstacles

Laboratory 5. Navigation in a labyrinth: Planning and driving

Methodology
This subject is completely developed in the Robotics Laboratory of the Faculty of Computing of the UPV / EHU. The objective is to combine the theoretical presentations with the laboratory practices. Each subject presented and developed in class is accompanied by a laboratory practice in which the proposals presented theoretically are applied.

The written and oral presentation of the results of each of the practices allows a detailed follow-up of the progress of each student.

Most of the practices take place during class hours, but students have access to the laboratory outside of class hours, to complete the practices that have not ended in class or to develop their own proposals.

Evaluation systems
Final Evaluation System
- Tools and qualification percentages:
  - Written test to develop (%): 40
  - Oral defence (%): 20
  - Team work (problem solving, project design) (%): 40

Ordinary Call: Orientations
Although the practices are carried out in pairs, the final evaluation is individual. To recognize the participation of each student to the group work, personal interviews and an examination of knowledge acquired in the practices will be carried out.
Compulsory use materials. Bibliography

Basic bibliography

In depth bibliography

Journals
- Robotics and Autonomous Systems [https://www.journals.elsevier.com/robotics-and-autonomous-systems/]
- Advanced Robotics [http://www.tandfonline.com/loi/tadr20]

Web addresses
SUBJECT

Formal methods make software development acquire a more scientific character and similar to other disciplines related to engineering, as well as promote the use of tools with solid foundations, as occurs in other well-established disciplines. These methods are called formal because they are based on mathematics, mainly on mathematical logic. Some years ago the industrial development of system using formal techniques was considered a complex theoretical exercise and unfeasible in real problems. However, the increasing complexity and importance of the computer systems ended up making patent the importance of construct reliable and safe systems, i.e. systems that lack errors or failures. Not only because of the terrible repercussions these failures can have in areas where security is critical, but also because of the economic and quality repercussions that affect companies. This, together with the fact that computer systems play an increasingly essential role in society (in particular, they are more and more present in the devices that we use every day) made the industrial world change its attitude. Thus, in the last decades, formal methods have gained a notable advance and their use in the industrial field has ceased to be the utopia that their detractors claimed. Currently there are large companies, such as Intel, IBM, Sony, Siemens, Amazon or Microsoft, which collaborate very actively both in the creation of tools to help formal software development, and in the application of these tools to obtain reliable industrial applications. In fact, this course uses a software development tool created by Microsoft: Dafny. Although the usefulness of formal methods, and their efficiency, in industrial developments are already proved, more work is still needed for most engineers to know and apply them. This work must be carried out by the universities that must include them in their academic content; by the teachers, who must be trained and researched in this area of knowledge; and by the students, who must have a more solid formation in mathematics and logic. This course contributes to this task of ensuring that the software engineer's work is true engineering, so that the end user receives reliable and safe products.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

The specific objectives of this subject are:
- Understand the importance of programming being a more scientific than craft activity.
- Know the history and motivation of formal methods of software development.
- Know the state of the art in the area of formal software development.
- Know the languages, methods and concrete tools of formal software development.
- Ability to handle languages and concrete tools of formal software development.

THEORETICAL/PRACTICAL CONTENT

Topic 1.- Introduction
Topic 2.- Mathematical Induction
Topic 3.- Introduction to the Dafny System
Topic 4.- Generation of Verification Conditions
Topic 5.- Proving Properties and Software Development in Dafny
Topic 6.- Structural Induction and Datatypes
Topic 7.- Ghost Entities
Topic 8.- Dynamic Memory.

METHODS

TYPES OF TEACHING

<table>
<thead>
<tr>
<th>Type of teaching</th>
<th>M</th>
<th>S</th>
<th>GA</th>
<th>GL</th>
<th>GO</th>
<th>GCL</th>
<th>TA</th>
<th>TI</th>
<th>GCA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classroom hours</td>
<td>40</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hours of study outside the classroom</td>
<td>60</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Legend:
- M: Lecture
- S: Seminario
- GA: Pract.Class.Work
- GL: Pract.Lab work
- GO: Pract.computer wo
- GCL: Clinical Practice
- TA: Workshop
- TI: Ind. workshop
- GCA: Field workshop

ASSESSMENT SYSTEMS

- Continuous assessment system
- Final assessment system

TOOLS USED & GRADING PERCENTAGES
In order to pass the subject in continuous evaluation, students must complete and deliver several (five or six) individual practical works that prove their knowledge of the tools and techniques that are addressed in class. Students will receive feedback on these works as the teacher corrects them, so that they are useful for learning.

ORDINARY EXAM CALL: GUIDELINES & DECLINING TO SIT

- Individual work 100%

EXTRAORDINARY EXAM CALL: GUIDELINES & DECLINING TO SIT

COMPULSORY MATERIALS

- Lectures slides.
- The on-line tutorial and the documentation of the Web page:

BIBLIOGRAPHY

Basic bibliography

- The on-line tutorial and the documentation of the Web page:

In-depth bibliography


Journals

- ACM Transactions on Computational Logic
- ACM Transactions on Software Engineering and Methodology
- Applicable Algebra in Engineering, Communication and Computing
- Formal Aspects of Computing
- Formal Methods in System Design
- Journal of Automated Reasoning
- Software Testing Verification & Reliability

Useful websites

- Dafny: a language and program verifier for functional correctness
- The Verification Corner (Microsoft Research): http://research.microsoft.com/en-us/projects/verificationcorner/
- Formal Methods and Software Technology - Interesting Conferences
  http://user.it.uu.se/~bengt/Info/conferences.shtml

REMARKS
Electrónica Aplicada al Tratamiento de Datos

Description:
The objective of this subject is to study the structure and functioning of the electronic elements that allow communicating digital systems, in particular a computer, with the outside world.

It begins studying the elements that capture and condition the signals of the real world. Next, the basic circuits for processing these signals are studied: analog, digital, analogue digital conversion, data acquisition cards and signal processing (DSP). This subject is completed with some practical simulation and design exercises using widely used programs in the field of electronic circuit design. All this will be very useful when dealing with topics such as: the design of integrated circuits, design of applications based on microprocessors, the study of signal processing or robotics, etc., object of other subjects of the degree.

Evaluation:
The evaluation of the subject is basically continuous, taking into account the quality and way of presentation of assignments, problems, minimum knowledge controls of each subject, the work done in the laboratory practices and the attendance to the classes. Evaluation through a final exam is also an option.

The final exam consists on a written test in which the degree of knowledge of the subject, both theoretical and practical, treated in the subject will be evaluated.
Network Technologies and Infrastructures

Objective:

Acquire sufficient knowledge to take on the following tasks:

- Manage computer network infrastructures (local, corporate campus, data centre, or a corporate network with WAN links).
- Design computer networks.
- Manage teams of technicians responsible for these networks.
- Self-training in any specific area of networked technologies.

Context in the degree course:

The subject:

- Deepen and extend the concepts and techniques seen in the "Introduction to Computer Networks" subject in the 2nd year.
- It complements the “Systems and Networks Administration” subject in the 3rd year.
- It provides a solid basis to the subjects “Komunikazio Mugikorrak eta Multimediakoak”, “Network Design and Projects” and “Security, Performance and Availability of Services and Infrastructures” in the 4th year.

Previous knowledge:

To take the course, it is necessary to have knowledge of the content of the subject “Introduction to Computer Networks” (2nd year). To do this, we recommend not enrolling in “Network Technologies and Infrastructures” if you have not previously passed “Introduction to Computer Networks”.

Contribution to the vocational training of students.

- Knowledge of commonly-used technologies in the computer networks around us.
- Practical experience in the use of networked equipment, mainly switches and routers.
- Confidence in oneself when it comes to taking on responsibilities as a network engineer.

Practical credits

Work will be done on the GNS3 emulator.
Areas to be worked on:

1. Routing protocols: OSPF, BGP.
2. Local network technologies: Spanning Tree Protocol, VLAN, redundancy.

Teaching Methodology

Different teaching methodologies will be followed, using the most suitable one for each area to be worked on or skills to be acquired. In general, autonomous work and personal initiative will be encouraged for the search of information that can complement that provided in class.

Conceptual content in the subject will be introduced by lectures, with the students participating in occasional debates. Problem-solving in class will be done in a participative way. Problems and exercises to be solved will be given individually or in groups in order to facilitate the comprehension and assimilation of the technical concepts presented in class.
The formulation of questions and open discussion will be encouraged so that the student can acquire skills in oral communication, the ability to summarise and teamwork.

The practical credits will be in the laboratory, working on the GNS3 network emulator.

**Assessment**

To facilitate and ensure student learning, feedback will be given based on previously established criteria of continuous assessment, so that students will have the opportunity to become aware of their learning and of ways to improve it.

The weight of assessment of the theoretical part in the final grade is 70%, and the practical part 30%.

To withdraw from the call, it is just enough to not present one of the assessment assignments.

In the extraordinary call, assessment is done in a written exam in which the weight of the theoretical part is 70% and the practical part 30%.

To withdraw from the call, it is enough to not present oneself at the exam.
“Programming Methodology” complements the knowledge of the previous subject called “Basic Programming” adding formal aspects to the algorithm design.

COMPETENCIES/LEARNING RESULTS FOR THE SUBJECT

Skills in analysis, design, implementation, and maintenance of correct software
Skills in program specification, documentation, validation, and verification
Skills to reason about program properties
To know the relationship between iteration and recursion
To know techniques for correct program transformation

COURSE CONTENTS, THEORETICAL & APPLIED

1) Specification, Correction and Design by Contract
2) Preconditions and Postconditions. Formal Specification
3) Hoare's Formal System
4) Recursion
5) Algebraic Specification of Abstract Data Types
6) Burstall's Method

TEACHING METHODS

The student has to read the book and do the exercises provided at the end of the chapters (after the classes). The theoretical classes will focus on providing general information about the discipline, solving doubts about the subject and resolving different kinds of exercises.

EVALUATION METHODS

The subject has two modes of assessment: by final (or overall) assessment and by continuous assessment. CONTINUOUS EVALUATION: The student will be able to take part voluntarily in it, since it is offered exclusively for those who can carry out the continuous monitoring of the subject within the established framework of dedication and assistance to presental activities. Pre-enrolment in the continuous assessment mode will take place during the first week of the course. Pre-enrolment will become definitive after confirmation of the application by the student on the dates established (around the 12th week with approximately 70% of the weight of the evaluation already completed) and after verification of partial performance by the teaching staff. If the student does not confirm his or her definitive enrolment in the continuous assessment on the above-mentioned dates, it will be understood that he or she dismisses this enrolment.

The course is focused on continuous assessment.

In this case, a final examination of competence must be done. It will be carried out according to the official schedule of examinations of the Faculty and which will represent 100%. The minimum grade required in the final exam will be 5 out of 10.

- Written test, open questions 90%
- Exercises, cases or problem sets 10%
EXTRAORDINARY EXAMINATION PERIOD: GUIDELINES AND OPTING OUT

A final examination of competence where the minimum grade is 5 out of 10.

MANDATORY MATERIALS

Support material is available in the eGela virtual classroom.
A laboratory of recursion is done using ADA programming language.

BIBLIOGRAPHY

Basic bibliography
- Especificación, Verificación y Derivación Formal de Programas.
- Programazioaren Metodologia.
  Alvez J., Arregi X., Lucio P., Maritxalar M. Open Course Ware. UPV/EHU. 2013.

Detailed bibliography

Journals
- Acta Informatica
- Programming and Computer Software
- Science of Computer Programming
- Software Quality Journal
- Transactions on Software Engineering and Methodology

Web sites of interest

OBSERVATIONS
Advance Information Management (Gestión Avanzada de la Información)

Description
"Advanced Information Management" is a compulsory subject within the Specialty of Software Engineering. This subject rests on aspects taught in “Web Systems” and “Databases”. On the one hand, the knowledge on XML technologies seen in “Web Systems” is broadened. On the other hand, the new data management needs that go beyond the relational model are addressed.

The management of data has been and is, increasingly important in any organization. From the systems of files and databases, the current organizations have had to face new challenges as the volume, diversity and the means in which these data were transported, managed and produced increase. This subject familiarizes the student with these new information technologies.

Competencies
Become familiar with the different types of resources that must be managed in an organization (people, processes, documents, customers) and offer the appropriate mechanisms to offer a comprehensive management solution.

Contents
Theme 1 The organization: processes, people and resources Present the different perspectives from which an organization should be managed.

Topic 2 Management and definition of processes (BPMN, BPEL) Present the fundamentals of process management. We will study the notation used for the specification of business processes through BPMN (Business Process Modeling Language) as well as languages for its execution such as BPEL (Business Process Execution Language)

Topic 3 Resource management: knowledge management, document management Present the practices used in an organization for the identification, creation, representation and distribution of the knowledge generated by its employees. Present the set of rules, techniques and practices used in an organization to manage the flow of documents.

Topic 4 People management: role management, client management, use of social networks. Present the existing mechanisms to manage the people who interact in an organization from different perspectives. From the perspective of employees, the roles that people play in organizations through protocols such as LDAP (Lightweight Directory Access Protocol) From
the perspective of customers using CRM (Client Resource Management) techniques

Topic 5 Integrated management platforms: Web portals: classification, functions and architecture Study the opportunities offered by the portals for the integral management of organizations. The different types of existing portals will be studied, what is their architecture and what are their objectives. A test case will be made for an organization

**Methodology**
According to the eminently practical content of the subject, lectures are accompanied by weekly laboratories where students will check their understanding of the concepts taught through solving practical exercises. Student groups will be set to jointly develop a project that will involve the intensive use of XML technologies.

**Teaching arrangements**

<table>
<thead>
<tr>
<th>Tipo de Docencia</th>
<th>M</th>
<th>S</th>
<th>GA</th>
<th>GL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horas de Docencia Presencial</td>
<td>40</td>
<td></td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>Horas de Actividad No Presencial del Alumno</td>
<td>70</td>
<td></td>
<td></td>
<td>20</td>
</tr>
</tbody>
</table>

**Continuous Assessment**
This subject has two assessment modes: the overall assessment and the continuous assessment.

The continuous assessment is offered exclusively to the students that can carry out the continuous pursuit of the subject in the established frame of dedication and attendance to the face-to-face activities. The pre-registration in the continuous evaluation mode will be done on the established dates. The pre-registration will become final after the confirmation of the application by the student on the dates that are established (between 60% and 80% of the course) and after verification of partial performance by the faculty. If on the aforementioned dates the student does not confirm their definitive registration in continuous evaluation, it will be understood that they renounce it.

Continuous assessment:
- Practical works for evaluation: 30%.
- Written tests associated with continuous assessment: 70%.

To pass the subject it will be necessary to pass each part separately.

Weight of each matter in the final note:
- XML: 60%
- Relational-object: 20%
- BigData: 20%

Overall assessment:
- Final exam: 100% The exam will consist of a part of basic concepts and written practical exercises.

Final examen in June
Final exam: 100% The exam will consist of a part of basic concepts and written practical exercises.

Software to be used during the course
Software
- OXYGEN
- ORACLE
- HADOOP

Bibliography
- Unleashing Web 2.0: From Concepts to Creativity. G. Vossen; S. Hagemann. 2007
- Eliminating waste in software projects: Effective knowledge management by using web based collaboration technology: The enterprise 2.0 concept applied to lean software development. F. Dahlke 2008

URL
- http://www.w3schools.com/
- http://infolab.stanford.edu/~ullman/fcdb/oracle/or-objects.html
Teaching Guide:

Academic context of the subject

Specific training in Project Management in Computer Studies university degree courses, of a general nature, in the mid-1990s, to coincide with the conversion of the previous syllabus in Computer Studies into an Engineering course. In the adaptation process to the Undergraduate and Master’s structure, basic training in Project Management was included among the competences, both in the Undergraduate course and in the Master’s in Software Engineering.

The student takes this subject at the end of his/her third year. It is a case of providing knowledge and resources that will be of use in the final stage of their training and later career.

Although there are no prerequisites specifically mentioned in the syllabus, it is recommended that, before starting, the student should have obtained the credits for the first 5 semesters or (at least) the 120 credits corresponding to the first 2 years.

The basic skills to be developed to head computer projects fit in with the description of the International Project Management Association (IPMA) and the Project Management Institute (PMI). These are the basic references for Project Management in Engineering.

Among the competences are some related to professional practice. In the area of project management, in addition to the so-called ‘technical’ competences, contextual and behavioural ones are included, which in turn include ethics, legality and knowledge of regulations and professional practice. The approach for these aspects is merely introductory. The aim is that students should become aware that, as well as the technical aspects they are more familiar with, there are other very important ones that should be considered.

Learning objectives and relation to specific competences

Learning objectives are summarised in this section, associating the specific competences to them.

Basically, the idea is that the student should be able to:

- Identify the main phases, activities and roles related to the planning, monitoring and control of projects. (RI2, RI4, C2, C12)
- Identify and apply calculation and planning skills, using previous experience and knowledge. (C10, C12)
- Detect situations that require decision-making in projects and the introduction of changes, and be able to manage these situations. (RI2, RI4, C2, C10, C12)
- Identify the basic aspects of the management of information and communication systems associated with the life cycle of a project. (C2, C10, C12)
- Identify certain specific features of software projects and the professional roles that intervene in different types of software projects. (C7, C10, C11, RI18)
• Identify and consider the organisational, regulatory, legal and ethical environment in which work takes place and, in particular, the impact on project-related activities. (C7, C11)
• Develop and apply technical and behavioural skills in individual and group work, within the conceptual framework of Bases for Competence in Project Management. (C2, C12)

Teaching-learning methodology and activities to be carried out

The teaching is based on the completion of four projects, which gradually increase in duration, dedication and complexity. The projects cover 13 weeks of the course, although the other 2-3 also deal with aspects worked on in the projects, although seen from another perspective after they have been completed.

All the projects have important elements of the five phases that characterise the life cycle of the projects: Start, Planning, Execution, Monitoring and Supervision, and Closure.

In the same way as the duration and dedication increase, so does the number of people who make up the project team, starting from an individual project (P1) up to a team of 5/6 people (P4). In the intermediate steps, the team will consist of 2/3 (P2) and 3/4 people (P3). Depending on the progress made in class and the different students, the teaching staff decide the composition of the work teams in the different projects.

The initial project (P1), which is carried out while initial contact with the subject is being made, leads to the drawing up of a personal academic plan for the students during the term. This plan is completed with an analysis of the viability of the objectives proposed by the student for the Project Management subject. Students carrying subjects over from a previous year are asked to reflect about the risks involved in following the Project Management subject at the same time as their pending subjects.

The project sequence P2, P3 and P4 follows the same thread, so all the elements present in the previous projects reappear, although extended and inter-related in the successive projects, sometimes with new or more difficult elements, or simply enriched by a more realistic context.

The products to be developed in P3 and P4 are web systems that are simple, comprehensive and accessible by Internet. The systems developed are completely public, with the students creating them being fully responsible for them. Full accessibility facilitates several teaching processes, and also makes the student aware of his/her commitment to the outcome of the work. The projects are not distributed in private learning forums. In every case, after project P4 the resulting product will be a multilingual website of a certain size, developed using some of the most commonly found content managers. It should be fully functional in the Internet within a period of three weeks.