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>26260 Procesado Digital de Sonido e Imagen</td>
<td>Sep. 2018- Jan. 2019</td>
<td>6</td>
<td>A</td>
</tr>
<tr>
<td>26228 Programación Funcional</td>
<td>Sep. 2018- Jan. 2019</td>
<td>6</td>
<td>A</td>
</tr>
<tr>
<td>26214 Inteligencia Artificial</td>
<td>Jan. 2019- May 2019</td>
<td>6</td>
<td>M</td>
</tr>
<tr>
<td>26211 Compilación</td>
<td>Jan. 2019- May 2019</td>
<td>6</td>
<td>M</td>
</tr>
<tr>
<td>26258 Electrónica Aplicada al Tratamiento de Datos</td>
<td>Jan. 2019- May 2019</td>
<td>6</td>
<td>A</td>
</tr>
<tr>
<td>26237 Tecnologías e Infraestructuras de Red</td>
<td>Jan. 2019- May 2019</td>
<td>6</td>
<td>M</td>
</tr>
<tr>
<td>26013 Metodología de la programación</td>
<td>Jan. 2019- May 2019</td>
<td>6</td>
<td>M</td>
</tr>
<tr>
<td>25987 Gestión de Proyectos</td>
<td>Jan. 2019- May 2019</td>
<td>6</td>
<td>M</td>
</tr>
<tr>
<td>26245 Diseño y proyectos de Redes</td>
<td>Sep. 2018- Jan. 2019</td>
<td>6</td>
<td>A</td>
</tr>
<tr>
<td>26261 Robótica, Sensores y Actuadores</td>
<td>Sep. 2018- Jan. 2019</td>
<td>6</td>
<td>A</td>
</tr>
<tr>
<td>26230 Métodos formales de desarrollo de software</td>
<td>Sep. 2018- Jan. 2019</td>
<td>6</td>
<td>A</td>
</tr>
<tr>
<td>26233 Programación Lógica</td>
<td>Jan. 2019- May 2019</td>
<td>6</td>
<td>A</td>
</tr>
</tbody>
</table>

1 SCHEDULE: Morning (M)/ Afternoon (A): begins at 13.30.
By clicking the subject’s name, its Syllabus will appear.
1- DESCRIPTION & CONTEXTUALISATION OF THE SUBJECT

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:

http://www.informatika.ehu.es/p248-content/eu/contenidos/informacion/indice_informatica_titulacion/eu_titulacion/adjuntos/General%20competences%20of%20the%20degree.pdf

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
26256- DISTRIBUTED SYSTEMS

Description of the subject

A few decades ago, the development of IT technology led to the interconnection of individual computers in networks that would allow joint access to shared resources. The next step was the integration of resources and services into distributed systems to provide users and applications with interoperability and transparent access. The course focuses on the concepts dealt with by distributed systems and the mechanisms that support the integration of services and resources, so that one can understand how paradigms and currently-used applications are supported, e.g. cloud computing and decentralised and fault-tolerant data management.

Competences

Understand the need to provide abstractions and tools in IT networks to integrate resources and support distributed applications in a transparent manner.

Understand the basis mechanisms that allow the implementation of abstractions and distributed system tools.

Obtain the capacity to evaluate the performance of the mechanisms and understand the need of trade-offs in distributed systems with a view to optimising performance.

Obtain the capacity to undertake the development, in groups, of simple projects on distributed systems, document the solutions and present them in public.

Learning outcomes

Identify the properties required of distributed systems.

Identify these properties in different distributed systems and solutions: distributed file systems, fault-tolerant systems, and distributed agreement algorithms.

Propose distributed solutions to specific problems.

Analyse and compare the performance of distributed solutions and mechanisms.

Prepare technical reports explaining design decisions based on specifications, and in accordance with the state of the art, cost and performance.

Present and defend the adopted solutions in an oral presentation.
Theoretical and practical content

Theoretical content

1. Introduction: Properties of distributed systems, Distributed applications, Mobile and pervasive computing, Hardware and communication support.


4. Distributed file systems.


Practical work

Group work in the field of distributed systems. The following themes are covered (among others): distributed file systems, grid computing, mobile and ubiquitous computing, cloud systems.

Methods

The theoretical-practical content is not necessarily dealt with in the order stated, Instead, a combined approach is made, of guidance regarding problems and lectures. An initial problem is defined (e.g. implementation of a distributed system in the cloud) and its design is analysed step by step, looking at the design and evaluation of the mechanisms that make it up. The group work is then completed and a report produced.

In general, the format followed in each step consists of, first, motivating the students so that they can discuss and propose solutions, with guidance from the professor, and then discuss and complement them in a lecture with the solutions and mechanisms that the state of the art can offer. Later, they are asked to reformulate and evaluate the proposals in a short written report which, once corrected by the professor, can be used in an assessment test.
In continuous assessment, the group reports are evaluated and individual revision tests are taken. On completing the course, the practical work is evaluated using the report and a brief oral presentation.

The alternative solution test, as well as a written exercise with problems (80%), includes the presentation of practical work (20%).

Pre-enrolment in continuous assessment will be done on the set dates. Pre-enrolment becomes definitive following the confirmation of the application by the student on the set dates (between 60% and 80% of the course) and after verification of his/her partial performance by the teaching staff. If the student does not confirm his/her definitive enrolment in continuous assessment, it will be understood that he/she withdraws from it.

An overall assessment is made in the form of a written exam (80%) and the handing in of practical work in the set dates (20%).

**Compulsory materials**

Documentation in the web site of the course (e-Gela).

**Basic bibliography**

Course notes and exercises (available through e-Gela).


**Other bibliography**


**Journals**

IEEE Transactions on Parallel and Distributed Systems

(Springer) Distributed Computing

(Elsevier) Journal of Parallel and Distributed Computing

ACM Transactions on Computer Systems

**Websites**

www.cdk4.net

http://www.prenhall.com/tanenbaum

http://www.ntp.org/

http://www.jgroups.org/

http://www.spread.org/

http://web.mit.edu/Kerberos/
DESCRIPTION AND CONTEXT OF THE SUBJECT:

The functional paradigm, which is gradually acquiring more importance in the academic and commercial fields, is based on a declarative conception of the problem to be solved, as an alternative to imperative programming. The main aim is to declare or specify the problem through mathematical functions that are also executable, obtaining a program (or prototype) directly from the specification.

This subject is an introduction to the functional paradigm. It studies the main characteristics of modern functional languages, specifically the Haskell programming language.

COMPETENCES / LEARNING OUTCOMES:

By taking this subject, the following competences are expected to be acquired:
- Differentiate between declarative and imperative programming.
- Learn about the main characteristics of modern functional languages.
- Acquire the necessary skills to program in Haskell, using the concepts of the functional paradigm.
- Use a Haskell interpreter to implement programs.

THEORETICAL-PRACTICAL CONTENT:

Theme 1. Introduction.
Theme 3. Type constructors. Pattern matching. Polymorphism.
Theme 4. List functions. Higher order.
Theme 5. Overloaded operators. Type classes.
Theme 8. Lazy evaluation. Infinite lists.
Theme 10. Programming with actions: I/O.

METHODOLOGY:

- Theory lessons are devoted to conceptual explanations and examples.
- Exercise lists for each theme will be provided. A number of solutions to the exercises will be corrected.
- In the laboratories theoretical concepts are reinforced by carrying out exercises and/or practical work to be handed in.
ASSESSMENT:

In the ordinary evaluation you can choose between
- continuous assessment, through 2 written tests (60%) + handing in exercises and/or practical work (40%)
  or
- overall assessment, through a single final written exam (100%).

If you wish to withdraw from the continuous assessment you can do it until one month before the completion of the subject.

In the extraordinary evaluation only overall assessment is available, in the form of a written exam (100%).

COMPULSORY MATERIALS:

- Subject material available in eGela (slides, exercise lists, laboratories, etc).
- Haskell language interpreter used in the laboratories.

BIBLIOGRAPHY


Useful links in Internet:
• “Home page” of Haskell http://www.haskell.org/
• http://book.realworldhaskell.org

<table>
<thead>
<tr>
<th>FUNCTIONAL PROGRAMMING</th>
<th>Other data</th>
<th>2018/19</th>
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</thead>
</table>

Professor: Marisa Navarro
email: marisa.navarro@ehu.eus
Office 233 of the Computer Science Faculty
Tutorial timetable: Tuesdays from 10:30-13:30 and Wednesdays from 15:30-18:30

Class timetable: Tuesdays 09:00-10:30, Wednesdays 10:45-12:15, Thursdays 12.30-14:00
Place: all classes (theory and practice) take place in laboratory 1.4
DESCRIPTION AND CONTEXT OF THE SUBJECT

The "Person-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 Ingeneering.

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....).
DESCRIPTION OF THE SUBJECT

The general objectives are two: The aim is for the student to become familiar with the techniques used to translate high-level programming languages, and to be able to apply previous knowledge in the creation, design and processing of languages, as well as in the resolution of practical problems in related fields.

COMPETENCES

The student will acquire the following specific competences:
1. Understand the main concepts about the translation of languages, and have a global vision of the area
2. Know how to analyze the lexical, syntactic and semantic structure of high-level programming languages
3. Make the specification and design of the respective phases of analysis and the translation phase
4. Apply and implement the analysis and translation phases
5. Apply what has been observed to different translation problems

The following transversal competences will be worked on:
- Team work
- Written and oral communication
- Adaptation to new situations

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 C4, C5, C8, C9 and C10 of the degree, as well as the specific competences CC1, CC2 and CC3 of the specialty of Computing.

THEORETICAL-PRACTICAL CONTENT

Topic 1. Introduction
Topic 2. Lexical Analysis
Topic 3. Syntactic analysis
Topic 4. Translation and Semantic Analysis
Topic 5. Generation of code
Topic 6. Applications

METHODOLOGY

In addition to the lectures, mandatory practical sessions and practical laboratory sessions will be held. The latter complement the master classes. The aim of the practical sessions is to promote continuous and team work and enable continuous assessment. The objective of the practical sessions is to design, program and apply what has been learned to different problems. In both types of classes active methodologies will be used, so student participation is essential. Practical sessions will be carried out in groups.
ASSESSMENT SYSTEMS: GENERAL CRITERIA

Course assessment has two modes: continuous assessment and final assessment. Continuous assessment requires the active participation of the students. Therefore, it requires attendance at theoretical and laboratory classes, and required deliveries in the face-to-face activities: exercises, practices, presentations...

CONTINUOUS ASSESSMENT

- 40% Written exams: Three partial exams will be taken.
- 10% Laboratory activities: exercises, presentations, etc.
- 50% Practice: Assessment is based on incremental compliance objectives.

All the exams, practice and activities in continuous assessment are obligatory.

The conditions to pass in continuous assessment are:
- Achieve at least 30% of the score, taking into account the three written tests
- Achieve at least 30% of the score in each laboratory activity
- Properly develop the content corresponding to 40% of the practice
- Exceed a mark of 5 or more according to the percentage calculation of the grade in continuous assessment

If the student does not express his/her withdrawal from continuous assessment and does not meet any of the conditions to fulfill continuous assessment, he/she will not pass the course in the ordinary call. If the reason for the failure was not correctly developing the content corresponding to 40% of the grade in practical work, the student should only present this work in the extraordinary call.

FINAL ASSESSMENT

- 60% written exam: done on the exam date according to the official calendar.
- 40% Practice: The valuation is based on the fulfillment of incremental objectives.

Both the exam and the practical work set for the final assessment are obligatory.

In the written test of the final assessment, in addition to the content developed in the three written tests of the continuous assessment, the knowledge acquired in the laboratories will be evaluated.

The conditions to pass in the final assessment are:

- Achieve at least 40% of the written test score
- Properly develop the content corresponding to 40% of the practical work score
- Exceed a mark of 5 or more according to the percentage calculation of the grade in final assessment

If the reason for the failure was not to correctly develop the content corresponding to 40% of the score of the practical work, the student should only present the practical work in the extraordinary call.

EXTRAORDINARY EXAM CALL

The same percentages assessment and conditions apply as in the final assessment.
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.

Competencies:

Once the subject has been passed, the students must have acquired certain specific competences of the subject, that is, they should be able to:

CE1. Handle with the basic instrumentation of an electronic laboratory.

CE2. Identify the appropriate sensor for the capture of a certain physical signal.

CE3. Design a basic signal conditioning device (amplification and filtering).

CE4. Simulate the operation of analog electronic circuits

CE5 Design an analog to digital and digital to analog conversion circuit.

CE6. Process information received from sensors with data acquisition systems.

Contents:

UNIT 0. Introduction: Interface with the real world.

UNIT 1. Acquisition of signals: sensors.

UNIT 2. Conditioning of signals: the operational amplifier and its applications.

UNIT 3. A / D and D / A converter circuits.

UNIT 4. Cards and data acquisition systems (DAQ).

Methodology:

Active methodologies of cooperative learning will be used, looking for the active participation of the students and the work in-group, something fundamental for the achievement of the desired competences in this specialty.

In addition to theory classes, practical laboratory sessions based on cooperative learning are proposed.

The content of the practical topics is developed in the laboratory, in-group.
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.
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/ Mobile and Multimedia Communications”, “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 Cisco equipment (switches and routers) and/or the GNS3 simulator.

Areas to be worked on:

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

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 with the aim of facilitating 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 mainly be in the laboratory, working on the GNS3 network simulator, and/or directly on network equipment (Cisco switches and routers).

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.

**Assessment**

Assessment for the subject is combined, one part being made in continuous form and the other in a final written exam.

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 enough to simply 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 simply not present oneself at the exam.
Adding formal aspects to algorithm design, "Programming Methodology" complements the knowledge of the previous subject "Basic Programming"

Index of topics
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

Competences
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

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

Evaluation
The subject has two modes of assessment: by final (or overall) assessment and by continuous assessment.

CONTINUOUS EVALUATION: The student takes part voluntarily, 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 presential activities. Pre-enrollment in the continuous assessment mode takes place during the first week of the course. Pre-enrollment becomes 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 enrollment in the continuous assessment on the above-mentioned dates, it is understood that he or she dismisses this enrollment.
The course is focused on continuous assessment.
Three written tests are developed with a weight of 20% + 40% + 30%. Laboratory work accounts for 10%.

FINAL EVALUATION: This is applicable to students who do not wish to take part in the system of continuous assessment and to those who do not pass the conditions for final registration.
In this case, a final examination of competence must be done. It is carried out according to the official schedule of examinations of the Faculty, and which represents 100%. The minimum grade required in the final exam is 5 out of 10.
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. Applications in specialised environments: mobile devices.

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 this subject is to determine the computational difficulty of those problems that can be solved by a computer. It presents theoretical contents to distinguish whether a 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" complements the knowledge of the previous subject called "Languages, Computation and Intelligent Systems".

**Competences**
To know basic concepts from Computability Theory
To be able to formalize concepts.
To realize that there exists limits beyond which the algorithmic methods do not work.
To develop intuition about non computable problems and intractable problems
To know some Complexity classes and the relationship among them
To learn new techniques for determining the computational difficulty of problems

**Index of topics**
2. SAT problem. NP-complete problems. polynomial-time reductions. The question P versus NP.

**Material**
Support material will be available in the eGela virtual classroom.
We will work with the Python programming language in the laboratories.

**Evaluation**
The subject has two modes of assessment: by final (or overall) assessment and by continuous assessment.

**CONTINUOUS EVALUATION:** The student takes part voluntarily, 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 the course activities. Pre-enrollment in the continuous assessment mode takes place during the first week of the course. Pre-enrollment becomes 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 enrollment in the continuous assessment on the above-mentioned dates, it is understood that he or she dismisses this enrollment.
The course is focused on continuous assessment.
Three written tests are developed with a weight of 30% + 40% + 20%. Laboratory work accounts for 10%.

**FINAL EVALUATION:** This is applicable to students who do not wish to take part in the system of continuous assessment and to those who do not pass the conditions for final registration. In this case, a final examination of competence must be done. It is carried out according to the official schedule of examinations of the Faculty, and which represents 100%. The minimum grade required in the final exam is 5 out of 10.
DATABASE DESIGN

Description
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.

Competences
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 and 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 (IS2 and IS4 specified above). 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 (through a relational data model) of a database based on the conceptual schema.

* Normalise the relational schema.

* Define views over the relational schema.

* Define integrity rules over the relational schema.

* Carry out the physical design of a database.

* Learn about other design techniques:  
  ** Data Warehouses.  
  ** Distributed databases.
**Subject-matter**

1. Introduction: Principles of Databases Design, Life cycle of a DBS, 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.

**Methodology**

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.

**Ordinary Evaluation.**

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: 20 % (it is compulsory to obtain at least a 5 mark in the practical work)
- Laboratory work: 10% (minimum attendance 80%)

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

**Bibliography**


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 Irudigintza", UEU 1998
DELRIEUX C. and BAMBINI J.. "Computación Gráfica"  

Advanced

Web
http://www.opengl.org/
http://www.eg.org/
http://education.siggraph.org/
26218- DATA MINING/ MINERÍA DE DATOS

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
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>
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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.
Network Design and Projects
(Degree in Computer Engineering)
2018-2019 academic year

Teacher: José Miguel-Alonso (205).
  - Tutoring hours: Tuesday (14:15-17:15), Wednesday (10:00-13:00).

COURSE DESCRIPTION AND CONTEXT
The course is, to a large extent, the culmination of what has been studied in the area of computer networks leading to the degree, since it involves putting into practice the knowledge acquired to design and document a network. It is therefore imperative that students should have previously studied the course 'Introduction to Computer Networks', compulsory in second year.

The course is suitable for students who want to focus their professional practice on the design, implementation, and management of computer networks. That is, it is geared towards training network engineers.

COURSE COMPETENCES / LEARNING OUTCOMES
The competences acquired by the student are:
- An ability to understand and collect the needs of users and organisations with regard to the computer network.
- An ability to determine technical solutions for those needs.
- An ability to draft computer network projects and specifications for contracting computer networks.
- An ability to draft and assess procurement offers for IT network services and supplies.
- An ability to understand the interactions between the network and the applications that use it.
- An ability to understand and use new paradigms of network design, in particular, software-defined networks.

The learning outcomes of the course are:
- An understanding of solutions used in corporate networks.
- An understanding of the fundamental characteristics to take into account when choosing network equipment.
- An understanding of the structure and contents that a network project must have.
- An understanding of the use of network modelling and simulation tools.
- An understanding of the use of tools for software-defined networking: emulators, controllers.

Contents

Theory
  1. Computer network project engineering.
  2. Network structure.
  3. Network equipment.
  4. Building networks, campus networks and WAN lines.
  5. Outsourcing.
  7. High availability.
  8. Software-defined networking (SDN).
Practicals

As a complement to the theoretical part, there will be

- Laboratory activities aimed at assisting the design and sizing of networks, based on simulation, using packages like Riverbed Modeller.
- Laboratory activities to consolidate SDN-related concepts, using tools like Mininet and POX.

Bibliography

Basic


In-depth

- Mininet: http://mininet.org/

Assessment

First (ordinary) call:

- Exam 15%
- Project 1 network design: 35%
- Project 2 network dimensioning: 35%
- Project 3 SND: 15%

The dates to submit project deliverables will be announced along the course. A minimum of 35% in each part is required to pass the subject. Those in global evaluation must submit all the project deliverables before the date of the exam.

Second (extraordinary) call:

It will be evaluated exactly like the ordinary call. All the project deliverables must be submitted before the date of the exam. If any part of the first call has been passed (>=50%), that mark can be saved for the second call, provided this is requested in advance.
**Calendar**

The course is 6 credits, for which there are assigned 26 two-hour sessions in the calendar approved by the school. Following is the provisional course plan:

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<thead>
<tr>
<th>Tuesday 17:15 – 19:15</th>
<th>Friday 15:00 – 17:00</th>
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<td>Nov 27</td>
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<td>--- (Timetable changes)</td>
<td>Dec-5 (Wednesday with Friday’s schedule)</td>
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<td>Dec-14</td>
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<td>Dec-21 Last day to deliver projects</td>
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*Jan-10 (Thursday) Exam, ordinary call*  
*Jun-21 (Friday) Exam, extraordinary call*
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**
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

- Red Temática Iberoamericana de Criptografía y Seguridad de la Información: http://www.criptored.upm.es/
- Red Iris: http://www.rediris.es/servicios/seguridad/index.html.es
- 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
- Instituto Nacional de Ciberseguridad (INCIBE): https://www.incibe.es/
- Encuentros Internacionales de Seguridad de la información (ENISE): www.webcastlive.es/EnisN (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.
- Centro Criptológico Nacional (CCN-CERT): https://www.ccn-cert.cni.es/

Resources available on the Web

- Subject board 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

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
  - 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
26230 - Formal Methods in Software Development

ECTS Credits: 6

DESCRIPTION & CONTEXTUALISATION OF THE 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

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<tr>
<th>Type of teaching</th>
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<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></td>
<td>20</td>
<td></td>
<td></td>
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<tr>
<td>Hours of study outside the classroom</td>
<td>60</td>
<td></td>
<td>30</td>
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</table>

Legend:
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):

- Formal Methods and Software Technology - Interesting Conferences
  http://user.it.uu.se/~bengt/Info/conferences.shtml

**REMARKS**
Logic Programming - 2018/19

**Professor:** Marisa Navarro  
**marisa.navarro@ehu.eus**  
**office:** 233

**Tutorials:** Tuesday 17:00 - 19:30 & Thursday 10:00-13:30

**Credits:** 6  
**Term:** 2nd (for 10 weeks, at 3 modules per week) from 28 January - 10 April 2019  
**Class timetable:** Monday 17:15-19:15, Tuesday 15:00-17:00 and Thursday 15:00-17:00  
**Place:** Laboratory 1.4 of the Computer Science Faculty  
**LP Course on platform:** https://egela1819.ehu.eus/course/view.php?id=11883

**Competences / Objectives:**

The aim of this subject is to learn, using PROLOG language, the main characteristics of Logic Programming, part of the declarative programming paradigm.  
It is an optional subject taught in the fourth year that complements the basic subjects in the Programming line, and offers a broader vision of this line.  
Students who take this subject acquire knowledge and skills for representing and solving a range of problems in a different programming paradigm from the imperative one, which is the model studied in previous years.

**Methodology:**

To achieve the aims and competences described above, the methodology consists of:  
- Theoretical and practical classes.  
- The performance of a series of tasks during the course, in which the concepts studied are examined in practice and exercises are solved.  
- Continuous monitoring of the tasks carried out by the students is done by the professor.  
- One set of practical work (optional) on a subject chosen by the student.

**Syllabus:**

Theme 1. PROGRAMMING in PROLOG  
  Introduction to logic programming: operational syntax and semantics.

Theme 2. RECURSIVE DEFINITION of PROGRAMS  
  Recursive programs, tests and completion.

Theme 3. CONTROL in LOGIC PROGRAMMING  
  The cutting operator and its different uses. Negation in Prolog.
Theme 4. OTHER ASPECTS of PROLOG
Arithmetic in Prolog, metalogical predicates, input-output.

Theme 5. EXAMPLES of PROGRAMS
Representation and resolution of various problems using Prolog.

Theme 6. AREAS of APPLICATION
Examples of applications related to databases, expert systems, natural and formal language, etc.

Bibliography:
- Clocksin, W.F.; Mellish, C.S. Programming in Prolog, 2º ed. Springer-Verlag, 1986

Assessment:
- Assessment is continuous: a series of tasks done by the students throughout the course will be evaluated, consisting of two written tests (5.5 points on the final mark) and practical laboratory exercises (4.5 points on the final mark).

<table>
<thead>
<tr>
<th></th>
<th>Written tests</th>
<th>Laboratory exercises</th>
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</thead>
<tbody>
<tr>
<td>Laboratories 1 to 4</td>
<td></td>
<td>2.5 points</td>
</tr>
<tr>
<td>Test 1</td>
<td></td>
<td>2.5 points</td>
</tr>
<tr>
<td>Laboratories 5 and 6</td>
<td></td>
<td>2 points</td>
</tr>
<tr>
<td>Test 2</td>
<td></td>
<td>3 points</td>
</tr>
</tbody>
</table>

- Both parts must be passed (written tests and laboratory exercises) to pass the subject under continuous evaluation.
- There is also the option of carrying out practical work to improve one’s mark.
- In the ordinary evaluation modality, the option of an overall assessment also exists, in which a written test represents 100% of the mark.
- In the extraordinary evaluation, only the overall assessment will be taken into account.

Compulsory use materials:
- The LP subject is followed through the eGela platform. It contains all the material provided by the professor: notes on the subject and a list of exercises and tasks to be performed in the laboratories.

- Software: This year we will use SWI-Prolog. For any queries/downloads, visit the home page: http://www.swi-prolog.org