

## Course Outlines

Year 1

### COMPUTERS STRUCTURE

#### Description

The subject describes von Neumann architecture, presenting an architecture of a elementary computer, its modes of addressing and instruction set and the way of representing the data and the operation with them. On the other hand, part, the way in which the peripheral devices that are usually connected to the Input/Output of a computer, emphasizing its performance and capacity to storage.

#### Syllabus

##### 1.- Introduction to computers

Von Neumann Computer Components and Basic Schematic

Main memory

Central Process Unit

Buses

I/O Unit

Phases of Execution of an Instruction

Systems Software

Characteristic parameters of a computer

Professors: M.Luisa Córdoba, Santiago Rodríguez and Rafael Sautua.

##### 2.- Programming in Assembler

Machine language and instruction formatting

Addressing Modes

Types of Instructions

Assembly language

Architecture of the MC88110: Instruction Set

Syntax: Tags and Mnemonics

Pseudoinstructions: org, res, data

Macros

Assembly programming

Data Structures

Subroutines: parameter passing, stack frame, and recursion

Professors: M.Luisa Córdoba, Santiago Rodríguez and Rafael Sautua.

##### 3.- Processor

Basic functions of the control unit

Elemental Operations

Elementary Computer Structure and Control Signals

Timing: clock cycle, critical path

Schedules

Control Unit Design

Wired Control Unit

Micro-programmed control unit: structure, sequencing and Microprogramming

Control memory size optimization: encoding of fields, overlapping of fields.

Levels of execution. Privileged/User Mode

Unscheduled sequence break. Interruptions and traps (exceptions)

Computer Status

Professors: M.Luisa Córdoba, José Antonio Mateo and Rafael Sautua.

#### 4.- Computer arithmetic

Basic characteristics of the representation of Information

Numerical and alphanumeric representations.

ALU Operator Concept and Structure

Representation and fixed-point arithmetic

Pure binary

Complement to 2 and 1

Sign-magnitude

Excess M (excess  $2n-1$ )

State Flip-Flops

Floating Point Representation and Arithmetic

Definition, range and resolution.

Normalization and implicit bit techniques

Rounding techniques

Guard digits

IEEE-754 Standard

Professors: M.Luisa Córdoba, Santiago Rodríguez and Rafael Sautua.

#### 5.- Peripherals

Introduction: Definition and classification

Storage Devices

Magnetic Support: Fundamentals and Discs

Semiconductor Support: Solid State Disk

Monitors: fundamentals and characteristic parameters.

Communication devices: serial line and Ethernet.

Teachers: José Antonio Mateo, Manuel Nieto and Rafael Sautua.

#### Bibliography

de Miguel, P. Fundamentals of Computers. Paraninfo, 2004. 9th edition.

Stallings, W. Computer Organization and Architecture. Prentice Hall, 7th edition. 2006.

Patterson, D.A.; Hennessy, J. L. Computer Structure and Design. Ed. Reverté 2011. 4th edition.

García Clemente and others. Computer structure. Problems solved. RAMA, 2006. 1st edition.

Teaching material

The following material is available (only ETSIInf of the UPM) By logging in with the upm.es credentials (without @alumnos.upm.es):

Topic 1.- Introduction

Transparencies.

Topic 2.- Programming in Assembler

Transparencies.

Collection of Statements of instructions and addresses problems.

88110 Emulator Description

Parameter Switching to Subroutine and Pile frame management.

Statements of the examples of the Transparencies.

Problem statements to solve in class.

Topic 3.- Processor

Transparencies of this topic.

Collection of processor problem statements

Topic 4.- Computer Arithmetic

Transparencies

Problem statements

Topic 5.- Peripherals

Transparencies of this topic.

Problem Statements: Part I

Problem Statements: Part II

Collecting Issues of examination.

Solved exams from previous courses and the course current

Academic year 2022-2023.

First part: morning shift and afternoon shift

Second half

Recovery from the first set

July Call: First midterm

July Session: Second Partial

Academic year 2023-2024.

First partial

Second half

Recovery from the first set

July Call: First midterm

July Session: Second Partial

Academic year 2024-2025.

First partial

Second half

Recovery from the first set

Optional practice (explained by Teams or Zoom)

Assembler Practice

The most important features of the tools are described necessary for the implementation of the project and the implementation of a set of subroutines in assembler.

A RISC MC88110 processor simulator will be used.

More information: [click here](#)

Professors: José L. Pedraza and Manuel Nieto

Project

Assembler Programming

The student must perform a set of subroutines that Use The concepts of information representation on the computer and their processing as well as the handling of the most commonly used data structures in high-level languages.

The project will be carried out on an emulator of the 88110 simplified. An Assembly program is available that generates code for the emulator.

More information: [click here](#)

Professors: José L. Pedraza and Manuel Nieto

Evaluation and Standards

The subject consists of two parts: theory and project, non-liberatory, which are evaluated separately as detailed below. To approve the subject must achieve a 5 in the weighted average of both parts, as detailed below.

During the evaluation tests, calculators may NOT be used programmable, and mobile phones must be turned off.

## EVALUATION OF THE THEORETICAL PART

The "global assessment test" will consist of an exam on the date set by the Head of Studies, in which The topics that make up this part of the subject will be evaluated.

Ordinary Call:

Two midterm exams, not liberatory, will be carried out, if The resources of the center allow it and if they are carried out in a single shift for all students of the double degree in Computer Engineering and Business Administration and those of Computer Engineering. The first is expected to be Celebrate in week 11 and evaluate topics 1, 2, and 3. The second midterm exam will be held at the official examination period on the date indicated by the Head of studies and will evaluate topics 4 and 5. The grade for partial evaluation, progressive evaluation, will be calculated according to the following formula:

$$\text{Nota\_Parc} = 0.65 \cdot \text{First partial grade} + 0.45 \cdot \text{Second partial grade}$$

Additionally, in this call it will be possible to recover the First part. The weight of the recovered partial will be 0.55 In the event that a student presents himself When recovering the midterm, only the grade will be taken into account obtained in the latter exam. Once the exam has been distributed, the student will not be able to leave the classroom until after 20 minutes and will be

considered as presented to said exam. To be evaluated by midterms, the student must obtain a grade minimum of two points in each of the partials or their recovery.

Extraordinary call:

The exam of the extraordinary call of July will consist of two parts, corresponding to the two partial ones mentioned in the previous section:

If the student does not apply for any of them, he or she will keep the qualification and weight on the grade of theory that he would have obtained in said partial in the ordinary call, unless he or she has been involved in case of fraudulent behaviour (see section RETENTION OF QUALIFICATIONS).

If the student takes a partial exam in this call, it will be only taking into account the mark obtained in this last exam, with which he will lose the one he had obtained in the ordinary call. Once the exam has been distributed, the student will not be able to leave the classroom until after 20 minutes, and you will be considered as having taken the exam

The grade obtained in this call will be calculated in a similar way to the ordinary call, taking into account that the weight of the partials to those that the student presents will be 0.55 for the first and 0.45 for the second.

To be evaluated in this call, the student must have a minimum grade of 2 points out of 10 in each of the partials.

## PROJECT EVALUATION

It will be carried out based on the results obtained by the student in the deliveries made, the report presented and an exam. The Deliveries will be made in the automatic evaluation system provided for the subject, which will be open from week 8 and will be will close at the end of the semester, in the ordinary call, not being possible to recover the project in this call.

For the extraordinary call in July, deadlines will be established for delivery and will take an exam on the date indicated by the Head of Studies. The criteria will be identical to those indicated for the ordinary call.

The student who is evaluated through the global assessment test will have to make the submissions and the exam on the same dates established for the rest of the students.

The deadlines and evaluation dates of the project will be duly specified in the documentation that will be provided to the student on the website of the subject.

## CALCULATION OF THE FINAL GRADE

Ordinary Call:

To pass the subject in the ordinary call, it will be necessary to have an overall grade greater than or equal to 5, this being obtained according to the following formula:

$$\text{Nota\_global} = 0.8 * \text{Nota\_Teoría} + 0.2 * \text{Nota\_Proyecto}$$

where Nota\_Teoría corresponds to the grade obtained in the partial evaluation (Nota\_Parc).

#### Extraordinary Call:

To pass the subject in the extraordinary call it will be necessary to have an overall grade greater than or equal to 5, this being obtained according to the formula indicated in the previous section, where Nota\_Teoría corresponds in this case to the grade obtained in the partial evaluation (Nota\_Parc) or in the extraordinary call.

### GRADE RETENTION

In case of not passing the subject, the following will be preserved: Qualifications of the parts passed (see Note-1):

**Theory.** The mark obtained in the ordinary call, in each of the partial exams, will be kept until the extraordinary call of July. Partial payments will not be kept for subsequent years. However, if the theory grade (Nota\_Teoría) obtained is greater than or equal to 5, will be retained for the following academic year as long as the Theoretical content of the subject.

**Project.** When an overall grade greater than or equal to 3 is obtained (execution, report and exam) will be kept for the following academic year. However, the student may waive the grade obtained in a call or course and perform it again in its entirety.

**Note-1.-** Given that both the partial and final tests of the subject lack of a liberatory nature, the conservation of the corresponding notes is a prerogative of the subject for the benefit of the students, which will not be applied to those students who have been involved in cases of fraudulent behaviour in either of the two calls of the academic year.

### EXAM REVIEW

The dates of publication of notes and revision will be notified in the statement of the corresponding exam.

Once the grades of an exam of the subject (of theory or projects), a review request period for those students who consider that there is an error in the qualification. This request from review will be made by connecting to the URL (WEB)

[http://www.datsi.fi.upm.es/docencia/Estructura\\_09/privado/rev\\_estr.html](http://www.datsi.fi.upm.es/docencia/Estructura_09/privado/rev_estr.html). The student must fill in their access credentials from the intranet of the center.

Once these exams have been reviewed by the teachers, the list will be published of revised notes. If the student wishes to review in person, they must do so on the date, place and time established.

The solutions of the exams will be published on the website of the subject, except in the case of test type or short response, due to the small size of the source material of this type of exams. In any case, the student will be able to see their solutions on the day of the review Face.

Students are reminded that the purpose of exam revision is detect and correct possible errors that may arise in the process of qualification. It is not a question of individually explaining how it is resolved the examination or to vary or discuss the criteria for correction for a specific person.

#### DEALING WITH COPIES AND OTHER FRAUDULENT BEHAVIOUR

The exams will be carried out on a personal level, and the practices and project in the groups Established. If it is detected that a student has copied, used non-documentation allowed in an exam or some group has cheated in the performance of the practices or project, the provisions of article 13 of the UPM Evaluation Regulations approved by the Governing Council on 26 May 2022 will apply, and will not be grant the prerogative of keep any notes obtained so far, both for the call in which the copy is detected (February, including the progressive evaluation, or July) and for the next call or Academic year (see Note-1 of the section RETENTION OF GRADES).

In addition, your evaluation in the following exams of the subject may be taken by a special exam, which will take place in the room/classroom assigned by the coordinator of the subject or by the professor to whom he or she delegates, and that will not necessarily have to be carried out together with the rest of the Students. In the event of fraudulent behaviour that is considered serious, will be raised to the Rector the facts for him to take the measures corresponding disciplinary measures.

In particular, in the case of internships and projects, it will be taken into account that the responsibility for the work is shared by all members of the group, so in case of detecting any copy, the rule will apply to all students belonging to the source and destination groups of the copy. Copying is understood to be both the use of information such as resources assigned to another student or group. To avoid problems and complaints that cannot be addressed, it is recommended students to be especially careful with the files that are use for the realization of the internships or projects, since it depends on whether or not the work can be copied. In particular, always use removable devices when working on a Computer Center PC (do not leave the files on the hard drive even temporarily), make use of the mechanisms provided by the operating system and make sure That the files that are stored in the network storage systems are protected.

#### COMMUNICATION WITH STUDENTS

Communication with the teaching team will be carried out in person (circumstances permitting) in tutorial schedule that will be updated on the website of the subject. Also, if the In person, communication with the teacher by mail will be allowed to the corporate addresses of the university and always from an official UPM address of the student. The department estimates that the response time to a message is one or two school days, so the student cannot expect that a message is answered immediately or a message is answered over the course of a weekend. If the topic to be discussed is not possible solve it by this means, the student could suggest to carry out a synchronous tutoring using Teams. The teacher decide whether the issue to be dealt with can be resolved by this means and, in if so, the student will be summoned to the telematic meeting.

In the event that the communication initiated by the student is already resolved by other means, (e.g. a exam review) the teacher may refer you to the regulations for resolve your situation or ignore the message since it is already contemplated in the regulations.

## RECOVERY OF EVALUATION ACTIVITIES

In the event that the performance of an evaluation activity involves the interruption of classes for the semester of the subject, the activity loss will be recovered in periods of evaluation, present in the schedule, when decide on the coordination of the subject according to the others semester subjects.



Year 2

## LANGUAGE PROCESSORS

This site contains all the necessary information about the subject of Language Processors taught in the Bachelor's Degree in Computer Engineering, in the Bachelor's Degree in Mathematics and Computer Science and in the double Bachelor's Degree in Computer Engineering and Business Administration and Management of the Higher Technical School of Computer Engineering of the Polytechnic University of Madrid.

The objective of this subject is for students to learn how to design and build Language Processors. Therefore, at the end of the course, the student should be able to create a program that analyzes a source language. The subject is focused on the construction of a Processor for a language with a block structure.

Throughout the course, each of the modules of a Language Processor – lexical, syntactic and semantic analysis, symbol table and error manager – are explained and different techniques applicable in the construction of these modules are reviewed. The logical continuation of a Language Processor is explained in the optional subject Language Translators, where the rest of the modules of a Compiler will be studied.

As an application of the knowledge acquired, students have to develop a Practice that consists of the realization of a real Processor, the source language being a subset of sentences extracted from some programming language. This Practice is carried out in groups of up to three people. It is intended to be a work that progressively advances as the syllabus covers the different modules of the Language Processor, so that the student starts as soon as the first module has been explained and finishes at the end of the course.

The information on this website is structured in the following contents:

Start: This same page.

General Standards: Description of the General Standards of the subject.

Syllabus: Language Processors Syllabus.

Bibliography: List of bibliographic references related to Language Processors.

Timetables: Table with class schedules, place of teaching and teaching staff.

Tutorials: Table with the tutorial schedules of each of the teachers of the subject.

Exams: Dates and times of the Language Processors exams corresponding to the current course.

Practice: Standards and instructions for carrying out the practice of building a JS Language Processor-- (Bibliography for Practice).

Working Groups: Formation of groups and assignment of options to each group of practices for the construction of the Processor.

Tools: Some useful tools for building Language Processors.

Documentation: Notes, examples and documents used in the subject.

FAQ: Frequently asked questions and answers related to the subject.

Notice Board: Latest news, novelties and notices related to the subject.

## COMPUTER INSTALLATION PROJECT

(This is the public website of the subject. Work website in <http://moodle.upm.es/titulaciones/oficiales>)

(Compulsory 3ECTS, 6th semester, 3rd year, Bachelor's Degree in Computer Engineering UPM)

This subject will enable the student to "Prepare the technical specifications for a computer installation that complies with current standards and regulations", which is one of the fundamental competencies established in the Bachelor's Degree in Computer Engineering.

### Program

(2 hours/week, about 8 weeks of class and group project)

Types of IT Facilities: Components, Specifications, Life Cycle and Availability

Mechanical and distribution aspects of a Computer Installation

Aspects related to Security in Computer Installations

Aspects related to the power supply of equipment - electrical engineering

Thermal aspects / cooling or heating of equipment - thermotechnics

EMI/EMC Analysis and Recommendations

Equipment connectivity aspects - structured cabling

Certifications

## DISTRIBUTED SYSTEMS

The subject presents the most relevant aspects of the design and implementation of distributed systems. The student must develop practical examples that will allow him to consolidate theoretical concepts.

The information contained on this page is also available on the subject's Moodle site.

Alias	Plan	Course	Guy	Duration	Credits				
SD	GII	6th	Week.	Obli.	Semiannual	6 ECTS			
Tutorials									
Name	Dispatch		L	M	X	J	V		
Fernando Pérez Costoya									
(fperez@fi.upm.es)	4201		.		9:00-10:00	15:00-17:00	14:00-16:00	13:00-14:00	
María de los Santos Pérez Hernández									
(mperez@fi.upm.es)	4204		.		10:30-12:30	16:00-18:00	16:00-18:00	.	
Pablo Toharia									
(ptoharia@fi.upm.es)	4102		10:30-13:00						
15:00-18:00	.		.		.		.		

### News

An error occurred while reading the data from this feed:

<http://laurel.datsi.fi.upm.es/web/foro-DESCONECTADO/rss.php?f=23>

Course organization

Course calendar

Calendario de la asignatura

Syllabus

Presentation and Introduction (presentation; introduction)

Definition of a distributed system

Distributed Computing Models

Objectives of a distributed system

Software architecture

Components of a distributed s.

Architecture of the Distributed System (Part 1, Part 2, Condensed Document for Use during the First Exercise, Case Study: Bitcoin) (Outline of the content of topics 1 and 2 (part I) in Free Mind prepared by Luis Gómez (PDF)); (Outline of the content of topics 1 and 2 (part I) in Free Mind prepared by Luis Gómez (native format))

Architectures for Distributed Computing

Client-server model

Publisher-subscriber model

Producer-consumer model

Peer-to-peer architectures

Class exercises

Exercise of this course: morning group (model 1)

Exercise of this course: morning group (model 2)

Exercise of this course: morning group (model 3)

Exercise of this course: morning group (model 4)  
Exercise of this course: afternoon group (model 5)  
Exercise of this course: afternoon group (model 6)  
Exercise of this course: afternoon group (model 7)  
Resolved financial year for the 2019/2010 academic year; Same unresolved exercise  
Resolved exercise of the 2018/2019 academic year (morning group); Same unresolved exercise  
Resolved exercise of the 2018/2019 academic year (afternoon group); Same unresolved exercise  
Resolved exercise of the 2017/2018 academic year (morning group); Same unresolved exercise  
Resolved exercise of the 2017/2018 academic year (afternoon group); Same unresolved exercise  
Resolved exercise of the 2016/2017 academic year (morning group); Same unresolved exercise  
Resolved exercise of the 2016/2017 academic year (afternoon group); Same unresolved exercise  
Resolved exercise of the 2015/2016 academic year (morning group); Same unresolved exercise  
Resolved exercise of the 2015/2016 academic year (afternoon group); Same unresolved exercise  
Resolved financial year for the second half of 2014/2015.  
Resolved financial year for the first half of 2014/2015.  
Communication (Transparencies))  
Message Passing  
Programming with sockets (Transparencies; Example Programs)  
Remote Procedure Calls (RPCs))  
Guide to Programming with Sun/ONC RPCs  
Remote Method Invocation (RMI)  
Guide to Programming in Java RMI  
Distributed File Systems  
Structure of an SFD  
Name Resolution  
Data Access  
Cache management  
Deadbolt Management  
NFS, AFS and CODA Case Studies  
Parallel file systems:  
Case Studies: GPFS and Google File System  
Name and Directory Service  
Name Service  
Name hierarchy  
Namespace distribution and replication  
A practical example study: DNS  
Directory Service  
A Case Study – LDAP  
Implementation strategies and consistency models  
Synchronization

Clocks and logical time  
Distributed mutual exclusion  
Consensus issues  
Distributed transactions  
Process Management  
Planning in parallel/distributed systems  
Static planning  
Load balancing  
Process migration  
Practical projects

As specified in the regulations of the subject, there are two types of practical projects:

In groups: Carried out in groups of two students

Individual: Made individually

There will be four projects, two of each type, whose statements will be published throughout the course.

Electives

The statement of these will be published throughout the course. The grade of each of them is added directly to the total grade of the subject, provided that it is passed.

In-class exercises

As specified in the regulations of the subject, the subject comprises four application exercises that will be carried out in class, at the end of the corresponding topics. The dates of the exercises are indicated both in the learning guide of the subject and in the calendar of the same.

Subject Learning Guide

Distributed Systems Learning Guide

Class Schedule

6F1M-A and 6F1M-B

Monday from 10:05 to 11:55

Wednesday from 12:05 to 13:55

6F2M-A and 6F2M-B

Tuesday from 10:05 to 11:55

Thursday from 12:05 to 13:55

Consulting Notes

Access the page for consulting grades for the subjects in the operating systems group.

Standards

The subject will be evaluated through 2 types of tests:

Exercises in class. At the end of some topics, during the regular timetable of the subject, an exercise will be carried out on the content of the topics that have been taught since the previous

exercise. There will be 4 individual exercises, the dates of which are specified both in the learning guide of the subject and in the calendar of the same.

Practical projects. The development of these projects will be carried out remotely using the resources offered by the Calculation Centre for this purpose, and relying on tutorials for the resolution of any aspect related to their development. The deadlines will be staggered throughout the course and will be published on the subject's website well in advance. There will be 2 practical projects of an individual nature and 2 of development in pairs.

The final grade of the subject will be calculated considering two parts: 50% corresponds to the exercises in class and 50% to the practical projects. With regard to practical projects, to give greater flexibility to the student, the grade assigned to them is such that it allows the student to obtain the entire grade of the practical part by completing only three of the four projects. In this way, each practical project, whether individual or group, will have a weight of 16.7% in the grade of the subject. As a result of this adjustment, even if three of the four practical projects are carried out, the student can obtain the maximum grade in the subject. However, the student must obtain a minimum grade of 4 in both the sum of the individual projects and the group projects. Note that the internship can be passed by doing only an individual project and a group project as long as both have a grade greater than or equal to 4 and that the sum is greater than or equal to 15 (a 12 would be enough to compensate for the internship).

The grade of each of the two parts (class exercises and practical projects) will correspond to the average of the different tests of this type taken by the student. It is not compulsory to take any complete test of either type, but in order to pass the subject, in addition to having a final grade greater than or equal to 5, it will be necessary to have a minimum grade of 4 in each of the two parts, as well as to comply with the specific restrictions of practical projects described in the previous paragraph.

#### Copy

In the event that copies of practices or theories are detected, both parties involved (copiers and copiers) will be suspended for the entire current call.

#### Bibliography

Distributed Systems, Concepts and Design. George Coulouris, Jean Dollimore, Tim Kindberg and Gordon Blair. Fifth Edition, Addison Wesley. 2012

Distributed Systems. Maarten van Steen and Andrew S. Tanenbaum. Third Edition. 2017

## LANGUAGE TRANSLATORS

### Beginning

This site contains the necessary information about the optional subject of Language Translators taught in the third year (sixth semester) of the Bachelor's Degree in Computer Engineering of the Higher Technical School of Computer Engineering of the Polytechnic University of Madrid.

The objective of this subject is to learn how to design and build Language Translators. Therefore, at the end of the course, the student should be able to translate an entry, which follows the rules of a given language and which is lexically, syntactically and semantically correct, into an equivalent output written in another language. The subject is focused on the construction of a Language Translator for a language with a block structure.

This subject is the clear and natural continuation of the Language Processors subject corresponding to the third year (fifth semester), in which it is explained how to analyze a program written in a language. Therefore, in order to take full advantage of the Language Translators subject, it is essential to have previously taken the Language Processors subject.

Throughout the course, each of the modules of a Language Translator – intermediate code generator, code generator, code optimizer – is explained along with the execution environment, and different techniques applicable to their design are reviewed.

As an application of the knowledge acquired, students have to develop a Practice that consists of the realization of a real Translator, whose source language is a subset of sentences extracted from some programming language. This Practice is carried out in groups of up to three people. It is intended to be a work that progressively advances as the syllabus covers the different modules of the Language Translator, so that the internship group begins as soon as the first module has been explained and ends at the end of the course.

The information on this website is structured in the following contents:

Start: This same page.

General Rules: Description of the General Standards of the subject.

Syllabus: Syllabus of Language Translators.

Bibliography: List of Bibliographic references related to Language Translators.

Timetables: Table with timetables of class, place of teaching and teachers who teach them.

Tutorials: Table with schedules of tutorials from the professors of the subject.

Exams: Dates and times of the Language Translator exams corresponding to the current academic year.

Practice: Rules and instructions for carrying out the construction practice of a Boreal Language Translator (Bibliography for practice).

Working Groups: Formation of groups and options assigned to each working group for the construction of the Language Translator.

Tools: Some useful tools for building Language Translators.

Documentation: Notes and documents used in the subject.

FAQ: Frequently asked questions and answers related to the subject.

Notice Board: Latest news, novelties and notices related to the subject.

Introduction

Introduction to Language Translators

Analysis and Synthesis

Phases in the Synthesis stage

Intermediate Code Generation

Intermediate languages

Judgments and expressions

Runtime Environment

Runtime Memory Organization

Activation Registration

Access to local, non-local, and global variables

Parameter Passing

Code Generation

End Machine Codes

Generation schemes

Code Optimization

Machine-independent optimizations

Machine-dependent optimizations



## PRACTICUM DEGREE

Degree

Practicum

Description

Procedure

Before enrolling

license plate

After enrolment

during the Practicum

Calendar

Presentation

Organization of the subject

Competencies and learning outcomes

Regulations and legislation

Summary of the roles of the academic tutor and the professional tutor

### 1.Description

Practicum is a subject that is part of the 4th year Electivity subject of 12 ECTS.

For the Bachelor's Degrees in Computer Engineering and Bachelor's Degrees in Data Science and A.I., it is a requirement to have passed 50% of the credits of the degree in order to take it and to have enrolled in all the compulsory and basic subjects of previous years. It can be taken in the 7th or 8th semester.

For the Bachelor's Degree in Mathematics and Computer Science, it is a requirement to have completed 120 ECTS corresponding to basic and compulsory subjects of the first two years (revision of the degree report March 2022). It can be taken in the 7th or 8th semester.

For the Double Degree in Computer Engineering + Business Administration, the practicum is a subject that is part of the subject Internships in Companies of the Mention in Management and Management of Information Technologies in Business, of the 5th year of 12 ECTS. It can be taken in the 9th or 10th semester. (Preferably in the 10th semester)

### 2.Procedure

The External Relations Office (OREX) of the ETSIINF will provide support and advice to the realization of the practicum through these functions:

advice and help in the search and arrangement of students' internships

the control of the development of external internships

advice to all parties on methodological aspects

Only practicum with curricular internships is admitted (except in exceptional cases in Double Degree. Consult with OREX)

Before a student enrolls in this subject, the center must ensure that there is a guarantee and adequacy of compliance with objectives and guarantee that each enrolled student has an associated company that has selected and accepted him.

## 2.1 Initiation of the process:

### Show of interest

Those students who choose to take the practicum must submit the Expression of Interest and their Curriculum Vitae within the following deadlines and in the following way:

### Submission deadlines:

From 1 to 30 April if you wish to do it in the first following semester (from September to December)

From November 1 to 30 if you wish to do it in the second semester following (from February to June)

### Form of presentation:

Through the following link: <https://short.upm.es/gcud0>  
Internship Search in Company and Practicum Project

If you are a student, you must enter the link to this platform:

<https://practicas-externas.upm.es/>

and also, (essential)

1.- Mark "active search"

2.- Upload CV in documentation

3.- Upload to that website the INVOICE of the national mobility insurance for that academic year (essential for internships) that you will have previously contracted at the following link

<http://www.disser.es/segurouniversidadpolitecnicamadrid/>

4.- Obtain, if they do not have one, an electronic signature from FNMT. The information and application page on FNMT's certificates. Accreditation in person with a valid ID card can be done at the General Registry of the UPM without an appointment.

### Certificate application

manual:[http://www.cert.fnmt.es/documents/10445900/10528353/solicitud\\_certificado\\_persona\\_fisica.pdf](http://www.cert.fnmt.es/documents/10445900/10528353/solicitud_certificado_persona_fisica.pdf)

The annex that will regulate your internship will be generated at the end of the process. The signature of this annex is done through the UPM signature holder so, in addition to having an electronic signature (ESSENTIAL) you will have to have downloaded "self-signature" on the

computer from which it is signed (information here: <https://autofirma.net/universidad-politecnica-de-madrid/> ) . Information to sign at the UPM Signature Holder as a guest here.

The student must find out about the profile and activity of the companies collaborating with the UPM (see <https://practicas-externas.upm.es/> page ). You must select from all the current offers proposed through the portal in both curricular and extracurricular internships of the corresponding period. In any case, the UPM must have signed and in force an Educational Cooperation Agreement with said company. The company will carry out its selection processes, selecting the students who best suit its requirements and needs. The student must start the selection process of the company chosen by him

The student must submit the Practicum project before June 17, 2025 (inclusive), through this link (and fill in some fields) for approval by the External Internship committee, where the objectives of the stay, conditions, description of the work to be carried out during the internship period are described, signed by the company tutor and the student himself.

<https://short.upm.es/2y7gj>

El documento pdf a adjuntar lo tienes disponible aquí Documento Proyecto de Practicum para Grados y Doble Grado

2. La comisión de Prácticas Externas se reunirá antes del periodo de matrícula para aprobar o rechazar las propuestas presentadas por los alumnos y decidirá sobre su adecuación, atendiendo a los objetivos del practicum y los resultados de aprendizaje descritos en la memoria del título.

3. Posteriormente, se notificará al estudiante la resolución de la comisión, así como siguientes instrucciones para poderte matricular de Practicum.

4. La estancia en la empresa requiere la formalización de un anexo para cada estudiante, que deberá tener TODAS LAS FIRMAS antes de comenzar la estancia. Es importante que el estudiante vaya entrando en la plataforma para ir aceptando fases de las etapas para la generación del anexo.

Horas a realizar en el Practicum:

Las horas a realizar en la empresa serán de 27 h por ECTS de la asignatura. (12 ECTS, a 27 h cada ECTS, hacen necesarias 324 h de prácticas en la empresa).

Con carácter general las prácticas externas tendrán una dedicación máxima de 25 horas semanales.

Con carácter general la estancia en la empresa será en el primer semestre del curso 2025\_2026, del 15 de septiembre del 2025 al 15 de diciembre del 2025.

Independientemente del tiempo que se utilice para realizar el Practicum, lo que depende del tipo de jornada laboral que se realice, éste deberá estar concluido y la documentación entregada antes de su evaluación, fijada en el calendario del periodo de exámenes de cada semestre.

Observación importante: Es responsabilidad exclusiva del alumno asegurarse, antes de la matrícula, de que la beca/contrato que ha seleccionado cubrirá el tiempo necesario para realizar la asignatura de practicum. La OREX se ocupa de ayudar en la gestión al alumno, pero no es responsable del cumplimiento de las condiciones de la beca/contrato por parte de la empresa ni por parte del alumno.

## 2.2 Matrícula:

La asignatura practicum se matriculará por el sistema de automatrícula, junto con el resto de las asignaturas, y en semestre en que se realizará el practicum. La matrícula está restringida a sólo los estudiantes que cumplan los requisitos.

El seguro de movilidad nacional es obligatorio y debe adquirirse on-line en el siguiente enlace (<https://disser.es/project/seguro-accidentes-upm/>) o también puede adquirirse al hacer la matrícula.

Es IMPRESCINDIBLE para formalizar el convenio de prácticas que el estudiante haya subido previamente a la aplicación la FACTURA de pago del seguro (Factura en PDF)

## 2.3 Después de haber realizado la matrícula:

La OREX asignará un tutor académico (interno), profesor de la titulación, que haga el seguimiento del desarrollo del practicum. Los tutores académicos serán propuestos por los directores de los departamentos del centro, a instancias del coordinador de la asignatura practicum, en número ponderado por la carga crediticia del departamento de la titulación.

Tanto el tutor interno como el externo supervisarán el desarrollo de las mismas, facilitando la coordinación y comunicación entre ellos. En el apartado 5 se resumen las funciones del tutor académico y del tutor profesional.

El alumno desarrollará las prácticas en la empresa o departamento de la universidad.

## 2.4 Durante el practicum:

### a) Informe del Tutor Profesional Practicum

A tenor de lo que dispone el RD 1707/2011 en sus artículos 13 y 14, el tutor profesional emitirá informes de evaluación, un informe final sobre el desarrollo de la práctica, incluyendo sus apreciaciones sobre el desempeño del estudiante.

En dichos informes se contemplarán los siguientes aspectos:

Capacidad técnica.

Capacidad de aprendizaje.

Administración de trabajos.

Habilidades de comunicación oral y escrita.

Sentido de la responsabilidad.  
Facilidad de adaptación.  
Creatividad e iniciativa.  
Implicación personal.  
Motivation.  
Receptivity to criticism.  
Punctuality.  
Relationships with their work environment.  
Ability to work in a team.  
Numerical assessment of the practice up to that point  
Those other aspects that are considered appropriate, such as  
Compliance with the objectives and obligations derived from the specific training project.  
Technical skills specific to the degree they are studying and their level within it.  
The reports of academic and professional tutors will be filled in a web link that will be sent directly by email to each tutor a few days before the deadline

#### b) Student reports

The student will fill in a web link that will be sent directly by email.

The final report must develop the following aspects:

Personal data of the student.  
Collaborating entity where the internship has been carried out and place of location.  
A specific and detailed description of the tasks, work carried out and departments of the entity to which it has been assigned.  
Assessment of the tasks carried out with the knowledge and skills acquired in relation to university studies.  
List of the problems raised and the procedure followed for their resolution  
Identification of the contributions that, in terms of learning, the internships have entailed.  
Evaluation of practices and suggestions for improvement.  
A diary or record of the activity performed  
An analysis of the working conditions experienced in the centre,  
A reflection on the characteristics of the work environment and the organisation in which the internship took place,  
A personal assessment of the experience, in terms of learning.

#### (c) Report of the Academic Tutor Practicum

The academic tutors will guide the students in the preparation of the internship reports. Both tutors will be able to contact each other to coordinate the student's follow-up.

#### 4. Evaluation

The file made up of the reports of both tutors and the student's final report will be sent by the academic tutor to OREX, so that, within the established period, it can be transferred to the practicum committee.

For the final grade, the student must make an oral defense of the work done (process and results). Presentations will be made on the official days and times of the exam of the subject in each of the calls. There will be several presentation sessions in parallel, and your academic tutor may be part of the evaluation committee.

The tribunal, having seen the reports of the evaluation committees, will issue the corresponding minutes.

### 3. Calendar

Deadline for submission of the practicum project for the academic year 2025-2026 1st semester: June 17, 2025

Deadlines for submission of reports for the academic year 2024-2025, 2nd semester:

#### - Final Reports

Professional Tutor Report 20-May-2025

Student Report 20-May-2025

Academic Tutor's Report 13-June-2025

- File with presentation (transparencies) 16-June-2025

- Online presentation: 17- June-2025

### CLASSROOMS:

Method of delivery of reports:

Reports from the professional tutor and the academic tutor. An online report will be filled out, the link to which will be sent by email to each tutor.

Student reports. The student must submit through the Virtual Classroom before the established dates.

### 4. Presentation

The planned online presentation will consist of the delivery of a moodle assignment to students with a PowerPoint presentation with a recorded voice of a maximum duration of 10 minutes with a maximum date of June 16, 2025.

The file to be delivered is recommended to be a .ppsx extension, which occupies similar to a normal presentation, but can be viewed as a video. It must not exceed 20MB and must be hosted on Moodle.

### 5. Organization of the subject

Coordinator:

The subject will be coordinated by a professor of the degree designated by the Director of the centre. In addition to the coordinator, the subject has a committee.

External Internship Committee:

The committee of the subject will be composed of:

The coordinator, who will act as president.

A representative of the curricular itinerary committee that coordinates the optional subject of the degree.

The directors of the departments and departmental sections of the school, or teachers to whom they delegate.

One representative per department and departmental section of the school appointed by its director.

In addition, if the number of students enrolled so requires, it will be completed with more teachers so that the number of members of the committee is close to half of the number of students enrolled.

The professors will be proposed by the directors of the departments at the request of the coordinator, the distribution among the departments being proportional to the credit load of the department in the degree.

Tasks of the External Internships Committee:

Evaluate the practicum project presented by the students and decide which ones are suitable according to the objectives of the practicum and the learning outcomes described in the degree report. Where appropriate, recommend the modification of the proposal or reject it.

Propose improvement actions when it is considered that there are significant deviations from the student's initial work plan.

To be a member, together with the academic tutor, of the evaluation committees of the work carried out. The work of each student will be evaluated by their academic tutor and two professors from the subject committee. The evaluation will take into account the student's oral presentation and the reports of the academic and external tutors, as well as the student's final report.

Each member of the committee, with the exception of the president and the representative of the vertical coordination committee of the degree, will be part of the evaluation committees of several students. The coordinator will be in charge of appointing these evaluation committees. To propose changes to these regulations for consideration by the academic committee of the degree and approval, where appropriate, by the academic planning committee of the centre.

Course Tribunal:

The Director of the school will appoint the members of the External Internship Evaluation Tribunal for each degree (at least fifteen calendar days before the start of the enrolment period in the first semester of the course. It will be made up of 5 professors who teach in the degree.

The Director of the school will appoint those who will act as President and Secretary of the tribunal, the remaining three being members.

They will be responsible for delivering and signing the minutes of the subject.

## 6. Competencies and learning outcomes

Bachelor's Degree in Computer Engineering

Bachelor's Degree in Mathematics and Computer Science

Bachelor's Degree in Data Science and A.I.

Double Degree in Computer Engineering + Business Administration

## 7. Current regulations and legislation related to Practicum

Regulations on External Academic Internships (Approved by the Governing Council of the Polytechnic University of Madrid in its session of February 28, 2013)

REGULATIONS GOVERNING EVALUATION SYSTEMS IN TRAINING PROCESSES LINKED TO BACHELOR'S AND MASTER'S DEGREES WITH CURRICULA ADAPTED TO R.D.

1393/2007 (Approved by the Governing Council of the Polytechnic University of Madrid in its session of July 22, 2010)

Thesis of the degree in Mathematics and Computer Science from the UPM. ANECA.

Royal Decree 1707/2011, of 18 November 2011, which regulates external academic internships for university students.

Royal Decree 1493/2011, of 24 October 2011, which regulates the terms and conditions of inclusion in the General Social Security Scheme of people who participate in training programmes, in development of the provisions of the third additional provision of Law 27/2011, of 1 August, on updating, adaptation and modernisation of the Social Security system.

## 8. Summary of the functions of the academic tutor and the professional tutor

In the Third stipulation, the framework agreement of educational cooperation that is signed between the collaborating entity, the student and the tutors, says:

"THIRD: The ETSI INFORMATTICOS will appoint an Academic Tutor from among its teaching staff, whose function will be the methodological and technical advice in the areas of the student's work. Likewise, the collaborating entity will appoint a Professional Tutor to carry out the functions of guide, supervisor and advisor to the student while carrying out the internship in said entity, who will make and send the Academic Tutor a final report, (without prejudice to the preparation of an intermediate follow-up report if requested by the University). at the conclusion of the internship, designed for this purpose."

By agreement of COA in May 2016, it is the responsibility of the Curricular Tutor assigned to the student by the sub-directorate of students, to act as Academic Tutor of internships in companies when the student requests to take the Practicum subject.

The methodological and technical advice of the academic tutor is on practice management procedures: dates, forms, feasibility of tasks, etc. They will supervise that the tasks entrusted to the student are appropriate for their degree. It is the external tutor who must "f) Provide the complementary training that the student needs to carry out the internship." (see excerpt from RD 1707)

The Sixth Stipulation of the same agreement reads:



"SIXTH: The students will carry out the internships subject to the regime and schedule determined in the Individual Agreement, under the supervision of the Professional Tutor (also called tutor of the collaborating entity, or external tutor) appointed in the collaborating entity, who will carry out the functions established in article 11.2 of Royal Decree 1707/2011 and periodic controls of the training received, without there being, as has already been established, any employment relationship between the students and said entity, so that the person carrying out the internship will be considered a student of the UPM for all purposes."

Extract from RD 1707/2011 (December 2011) where the rights and duties of guardians are discussed:

Article 11. Rights and duties of the tutor of the collaborating entity.

1. The tutor of the collaborating entity will have the following rights:

To be informed of the academic regulations that govern external internships.

To receive guidance and operational guidelines on the performance of their duties in relation to internships.

To participate in the design of the Training Plan and to propose and direct its development.

To participate in the evaluation of the practices.

To the accreditation of their activity, if requested, by the University.

To all those activities or rights, especially programmed by the University to promote their involvement in educational cooperation and their permanent training in the tutorial task.

2. It shall also have the following duties:

To welcome the student, facilitate their integration into the workplace and organise the activity to be carried out, in accordance with the provisions of the training programme.

Inform the student about the organisation and operation of the entity and about the regulations that affect them, especially those relating to safety and prevention of occupational risks.

To provide the complementary training required by the student to carry out the internship.

To provide help and assistance to the student for the resolution of those questions of a professional nature that may be needed in the performance of the activities carried out in the same.

Provide the student with the material means essential for the completion of the internship, including personal protective equipment if necessary.

Supervise their activities, guide and control the development of the practice with a relationship based on mutual respect and commitment to learning.

Coordinate with the academic tutor the development of the activities established in the Educational Cooperation Agreement, including those modifications to the training plan that may be necessary for the normal development of the internship, as well as the communication and resolution of possible incidents that may arise in the development of the internship and the control of permits for the performance of exams.

Issue reports, intermediate and final, on the development of the internship.

Participate in the evaluation of the quality of the internships and collaborate in their improvement.

Article 12. Rights and duties of the academic tutor of the university.

1. The academic tutor of the university will have the following rights:

Recognition of their academic activity with criteria equivalent to the academic recognition granted to other subjects of the curriculum managed and supervised through individual tutoring, such as the final degree or master's degree project or project.

To participate in the design of the Training Plan.

To be informed of the academic regulations that govern external internships.

To be informed of the content of the Educational Cooperation Agreement that covers each practice they supervise.

To receive guidance and operational guidelines on the performance of their duties in relation to internships.

To participate in the academic evaluation of the internship.

2. It shall also have the following duties:

Establish contact with the professional tutor, well in advance of the start of the internship, to determine the activities, related to the training project, to be carried out by the student during the internship period.

To guide the student, before and during the stay, with the aim of helping them to obtain the best use of the internship.

Supervise and monitor the stays during their development, providing the necessary support and monitoring the acceptable fulfilment of the objectives of the training programme, maintaining the level of contact deemed appropriate with each of the parties and agreeing on the modifications that may be deemed appropriate to the initial programme on the fly.

Carry out an evaluation of the stay carried out by the student, especially in its technical aspects, for which it will take into account the reports provided by the professional tutor and by the student.

Participate in the evaluation of the quality of the internships and collaborate in their improvement.

Year 3

## COMMUNICATIONS PROTOCOL ENGINEERING

The subject of Communications Protocol Engineering is an optional subject (8 semester) of the Curriculum of the Computer Engineering Degree.

The objective of the Communications Protocol Engineering subject is for the student to know, firstly, the formal description techniques used to specify communications protocols as a preliminary step for their subsequent implementation and their advantages for the automatic generation of source code. The student will use tools such as SDL (Specification and Description Language) widely used in the industry in the formal description of protocols.

Secondly, the student will be able to identify and handle the most common communications software programming interfaces today such as Berkeley Sockets, Windows Sockets, Java, Python or Android Sockets.

Finally, the student will be able to understand the techniques for implementing distributed applications using the different programming interfaces as well as analyze the performance of the proposed solutions. In short, the student will be able to design and implement communications software in most distributed applications

### A. Objectives

Describe the formal description techniques used to formally specify communications protocols and present their advantages in protocol engineering.

Analyze the most commonly used programming interfaces in the corporate environment: Berkeley Sockets, Windows Sockets, Java Sockets, Python Sockets and Android Sockets.

Understand the techniques for implementing distributed applications using the different programming interfaces.

Study the performance of software implementations.

### B. Contents

#### MODULE 1: PROTOCOL SPECIFICATION, DESIGN, AND VERIFICATION

Formal description techniques are the basis of automated support in different development activities. The formal specification is an essential tool in communications protocol engineering. By employing formal description techniques, significant improvements can be obtained in product quality, time to market and life cycle cost. The formal specification allows for efficient verification and validation of communications protocols as a preliminary step to software product development. This module describes the existing methodologies for the formal specification of protocols as a preliminary step to the development of the software product. Among them, one of the most widely used is the SDL standard (Specification and Description Language, ITU Z.100).

#### MODULE 2: PROTOCOL IMPLEMENTATION

Communications protocols are developed, in general, in a distributed environment and within the framework of the so-called Client-Server model. Programming interfaces (APIs) for

communications protocols provide the user with a series of functions or calls to the Operating System with which to implement Client-Server applications.

The API is the interface offered to the programmer. The availability of the API depends on both the operating system used and the programming language. The functions of an API in communication protocols are varied: reservation of resources for communication, specification of local and remote communication points, initiating a connection (client), waiting for a connection (server), sending and/or receiving data, terminating a connection, aborting communication, handling errors, freeing up resources, etc.

This module presents the most widely used programming interfaces (APIs) for communications protocols. These are the Berkeley Sockets interfaces for Unix operating systems, the Windows Sockets interface for Windows operating systems, the cross-platform Java sockets interface, the socket interface in Python environments (widely used in Data Analysis environments) or the socket interface in Android environments. In each of the environments, distributed applications are developed using the functionalities provided by each interface.

## C. Table of Contents

### 1. Protocol Specification, Design, and Verification

#### 1.1 Levels of description of a structured architecture

#### 1.2 Protocol Development (Formal Specification, Implementation. Conformity)

#### 1.3 Specification Methodologies (SDL, Petri Nets, Estelle, Lotos, Prolog)

### 2. Implementation of Protocols

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#### 2.2 Application Programming Interfaces (APIs) in Communications Software

#### 2.3 Designing applications with the Berkeley Sockets Interface

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##### 2.3.4 Server Software Implementation

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#### 2.4 Designing Applications with the Windows Sockets Interface

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#### 2.5 Designing Sockets Interface Applications in Java

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