UAB
Universitat Autònoma de Barcelona

Computer Networks and Internet

Code: 104353
ECTS Credits: 6

2024/2025

Degree	Type	Year
2503758 Data Engineering	FB	1

Contact

Name: Miguel Hernández Cabronero

Email: miguel.hernandez@uab.cat

Teachers

Ruben Martínez Vidal

Teaching groups languages

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

Prerequisites

There are no prerequisites, although it will be useful to have basic knowledge of Linux and of the Python programming language.

Objectives and Contextualisation

In this course, the concepts about the operation of TCP/IP based networks (and Internet in particular) are shown, both from the point of view of the network interconnection and from the perspective of the relationship between end computers and applications providing services to users.

The formative objectives of the course are, on the one hand, that students get a general vision of the concepts related to computer networks and with the interconnection of heterogeneous networks; that they thoughfully know the issues and protocols related with the joint operation of heterogeneous systems over a set of interconnected networks and the main distributed application in these systems, with a notion of their development. On the other hand, students have to be able to design extensible and robust internet networks, to configure connections to internet networks, and to detect and solve network problems due to missconfigurations or protocol attacks.

Competences

- Design efficient algorithmic solutions to computational problems, implement them in the form of robust software developments which are structured and easy to maintain, and verify their validity.

- Develop critical thinking and reasoning and know how to communicate it effectively in both your own language and in English.
- Generate innovative and competitive proposals in professional activity and research.
- Handle large volumes of heterogeneous data.
- Prevent and solve problems, adapt to unforeseen situations and take decisions.
- Search, select and manage information and knowledge responsibly.
- Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
- Transmit data with efficiency, precision and security.
- Work cooperatively in complex and uncertain environments and with limited resources in a multidisciplinary context, assuming and respecting the role of the different members of the group.

Learning Outcomes

1. Analyse and evaluate the advantages and disadvantages of a lossy, a lossless and a quasi-lossless compression.
2. Apply the characteristics, functions and structure of computer networks to design and implement applications based on them.
3. Develop critical thinking and reasoning and know how to communicate it effectively in both your own language and in English.
4. Distinguish between local and wide-area networks and apply international standards and interconnection mechanisms.
5. Formulate methods for information compression and encoding for error correction.
6. Generate innovative and competitive proposals in professional activity and research.
7. Identify the concepts related to computer networks, placing them within a hierarchical system of protocols.
8. Perform queries on databases.
9. Prevent and solve problems, adapt to unforeseen situations and take decisions.
10. Scale the databases needed for a specific designed service.
11. Search, select and manage information and knowledge responsibly.
12. Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
13. Work cooperatively in complex and uncertain environments and with limited resources in a multidisciplinary context, assuming and respecting the role of the different members of the group.

Content

Unit 1. Introduction

- Computer networks and network of networks
- The TCP/IP protocol family
- Basic networks typologies and technologies

Unit 2. Netork interconnection protocols

- Principles of network interconnection
- Addressing
- Local address resolution
- IP protocol
- Basic routing
- ICMP Protocol

Unit 3. End-to-end protocols

- Principles of end-to-end communications
- User Datagram Protocol UDP

- Reliable byte stream protocol TCP

Unit 4. Apploication protocols

- Principles of TCP/IP applications
- Application access to lower layers. Socket of Berkeley interface
- Domain Name System DNS
- Configuration Protocol DHCP

Unit 5. Advanced protocols for network interconnections

- Internet architecture
- Autonomous Systems and Neutral Points
- Routing protocols within Autonomous Systems (RIP, OSPF)
- Routing protocols between Autonomous System (BGP)

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Laboratory sessions	12	0.48	2, 5, 6, 8, 9, 10, 12, 13
Problem resolution sessions	12	0.48	1, 4, 5, 7
Theory classes	26	1.04	1, 3, 4, 5, 7
Type: Supervised			
Supervised activities proposed in class	7	0.28	3, 5, 7, 9, 12, 13
Type: Autonomous			
Course problems writing	30	1.2	1, 3, 4, 6, 7, 9, 11, 12
Preparation and autonomous work for the laboratory sessions	24	0.96	2, 5, 6, 9, 11, 13
Study and preparation for the assessment tests	30	1.2	1, 3, 4, 5, 6, 7, 9, 11, 12

These activities will be carried out during the course:

- Lectures (theory sessions), where the teacher will provide information about the knowledge of the course and about strategies to obtain, extend, and organize this knowledge. Student active participation will be encouraged during these sessions, for example by proposing a debate where multiple technological approaches are accepted.
- Problem-solving sessions, where students will have to actively participate to consolidate their knowledge by resolving, presenting and debating related problems.
- Laboratory practical sessions, where small projects are proposed to be developed by groups of two students. These sessions will be prepared, documented, and programmed by the teacher beforehand, and students will have to prepare them before attending to the lab, reviewing theory technological aspects about the development.
- Resolution of problems related to the theory sessions to be discussed during the problem resolution sessions, as a continuous activity during the course.
- Several supervised activities proposed by the teachers during the course to consolidate the knowledge on the subject and to explore its practical application.

There will not be differentiated treatment for students who repeat the subject.

The UAB virtual platform (Campus Virtual, https://cv.uab.cat/) will be used for communication between teachers and students, and between students. It will also be used to deliver activities and accessing working documents of the course.

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

Assessment

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Class activities	10%. No minimum mark is required for this part	2	0.08	1, 3, 4, 7, 9, 11, 12
Final validation test	35%. The minimum grade required by this part is 5 out of 10	2	0.08	3, 4, 5, 7, 9
Mid-term controls	20%. No minimum mark is required for this part	2	0.08	4, 7
Practical laboratory session follow up, with the possibility of undertaking a validation test	35%. The minimum mark required by this part is 5 out of 10	3	0.12	2, 3, 5, 6, 8, 9, 10, 11, 12, 13

Evaluation criteria

The evaluation will be continuous and formative based on the learning evidence generated by the students in the participatory activities in class, the control and final knowledge validation exams and the practice development reports.

Activities and instruments that will be used to evaluate:

Activities and problems

These are activities (problems or exercises) that can be carried out within the theory and problem sessions, without regular periodicity. They are not compulsory (it is not necessarily necessary to take them to pass the subject, although they are part of the evaluation). Examples of these activities can be: a comment on a short documentary passed in class, the description of a dramatized activity carried out in class, some test questions about the theory session or problems recently carried out in class, analyzing the operation of an exchange protocol routing information, etc.

Mid-term controls and final knowledge validation exams

Mid-term controls are individual written tests that aim to validate whether each student has minimally acquired the knowledge of the subject worked up to that point. These controls are carried out during the semester according to the planning of the subject's agenda. They do not eliminate material for the final exam nor is a minimum grade necessary for these controls. The final knowledge and practice validation exams are individual written tests that aim to validate whether each student has attained a minimum of the overall knowledge and

skills of the subject. These exams are motivated by the high importance attached to a correct achievement of the knowledge and skills of the subjects in the engineering environment where the degree is framed. The final knowledge validation exam is mandatory for everyone.

Practices (labs)

The practices will consist of carrying out one or more projectswith which it is intended to achieve knowledge and skills related to the subject. The specific details about the organization of the practices (projects, groups, calendar, weighting,...) and about their follow-up (reports, attendance requirements, code originality policy,...) can be downloaded from the Virtual Campus. Attendance at the practical sessions (closed laboratory) will be required. For its evaluation, a minimum attendance at the laboratory sessions will be essential. It will be necessary to overcome the different elements of the practices so that they do average. Specific validations may be carried out to guarantee authorship and the acquisition of skills.

Indicators that will be used to qualify the learning achieved

In the problems and supervised work, the indicators that we are going to use will be the individual perseverance in the work, the cooperation between the members of each team, the quality of the work carried out and the degree of participation in the set of evidences. Quality indicators are the correct use of technical terms, the correct wording of the paragraphs and the good structure of the content delivered. We will also value constancy in work. We will value that the resolutions of the problems are well argued and corrected in your case. In class activities we will value the participation of the students and the reports or documents delivered. In the practical part we will use as indicators the preparation (previous reports) and active participation in the practical sessions and in the evaluation and quality session in the elaboration of the complete development reports. In the control and final exams for validation of knowledge and validation of practices, the main indication will be the degree of correctness of the answers to the questions raised.

Note on copies, plagiarism, and other irregularities

Without prejudice to other disciplinary measures deemed appropriate, and in accordance with current academicregulations, irregularities committed by a student that may lead to a grade variation in an evaluable activity will be graded with a zero (0). The evaluation activities qualified in this way and by this procedure will not be recoverable. If it is necessary to pass any of these evaluation activities to pass the subject, this subject will be directly suspended, with no opportunity to recover it in the same course. These irregularities include, among others:
- the total or partial copy of a practice, report, or any other evaluation activity;
- let copy;
- present a group work not carried out entirely by the members of the group (applied to all members, not only to those who have not worked);
- unauthorized use of AI (eg Copilot, ChatGPT or equivalent) to solve exercises, practices and/or any other evaluable activity;
- Submit as your own materials prepared by a third party, even if they are translations or adaptations, and generally works with non-original and exclusive elements of the student;
- have communication devices (such as mobile phones, smart watches, camera pens, etc.) accessible during individual theoretical-practical assessment tests (exams);
- talk with classmates during individual theoretical-practical evaluation tests (exams);
- copy or try to copy from other students during the theoretical and practical evaluation tests (exams);
- Use or attempt to use writings related to the subject during the theoretical-practical evaluation tests (exams), when these have not been explicitly allowed.

In case of not passing the subject due to the fact that any of the evaluation activities does not reach the minimum required grade, the numerical grade of the file will be the lowest value between 4.5 and the weighted average of the grades. With the exceptions that the qualification of "Not Evaluable" will be granted to students who do not participate in any of the evaluation activities, and that the numerical grade of the file will be the lower value between 3.0andthe weighted average of the grades in case of that the student has committed irregularities in an evaluation act (and therefore the approval by compensation will not be possible). In future editions of this subject, students who have committed irregularities in an evaluation act will not have the possibility to validate evaluation activites.

In summary: copying, allowing copying or plagiarism (or the attempt to) in any of the evaluation activities is equivalent to a failing, not compensable and without validation of parts of the subject in subsequent courses.

Final score

The final grade for the subject, which includes an assessment of the acquisition of knowledge, skills and competencies, will be computed as the maximum of Option A and Option B

Option A:

The following weighted average:

- In 35%, the qualification of the final knowledge validation exam. The minimum grade required for this part will be 5 out of 10.
- In 35%, the final qualification of the practical part. The minimum grade required for this part will be 5 out of 10.
- In 20%, the qualification of the mid-course knowledge controls. There is no minimum mark required for this part.
- In 10% the qualification of the work carried out in the activities and problems. There is no minimum mark required for this part.

Option B:

The following weighted average:

- 65%: the grade of the final exam. The minimum grade required for this part will be 5 out of 10.
- 35%: the final qualification of the practical part (labs). The minimum grade required for this part will be 5 out of 10.

The second option is made possible by the fact that the final exam allows evaluation all relevant competencies.

In case of not passing the subject because any of the evaluation activities does not reach the minimum required grade, the numerical grade of the file will be the lower value between 4.0 and the weighted average of the grades. With the exceptions that the qualification of "not evaluable" will be granted to students who do not participate in any of the evaluation activities, and that the numerical mark of the file will be the lower value between 3.0 and the weighted average of the marks in in the event that the student has committed irregularities in an evaluation act (and, therefore, it will not be possible to pass by compensation).

The granting of honors will be made taking into account the active participation in the development of the subject, for example collaborating in the resolution of problems in the forum of the subject, obtaining non-assessable merits indicated during the course, the final grade of the subject, and the mark of the final knowledge test.

Students will have the opportunity to review the grades of the different assessment activities

Evaluation schedule:

- Continuosly:: class activity and laboratory practices, with the corresponding reports.
- After each practice: evaluation session.
- During the course: knowledge checks.
- At the end: knowledge validation exams.

The evaluation dates will be published on the Virtual Campus and may be subject to scheduling changes for reasons of adaptation to possible incidents. These changes will always be reported on the Virtual Campus, since it is understood that it is the usual mechanism for exchanging information between professors and students.

It is planned to make a recovery of the final knowledge validation exam for those students who do not pass it at the first opportunity.

It is also planned to carry out a recovery of the practices of the subject by those students who, despite having done them continuously throughout the course, have not been able to deliver them on timewith the requested quality.

It is not possible to recover the class activities, nor the mid-course controls, because they are parts of the evaluation that cannot be suspended (a minimum grade is not necessary) and because they are part of the continuous evaluation (they do not make sense outside the temporary context in which they are performed).

Repeaters and Validations

There will be no automatic validation or special treatment for repeating students. The validations will have to be requested explicitly following the procedure that will be indicated on the first day of class.

Single evaluation

This subject does not foresee the single evaluation system.

Bibliography

Basic references:

- Comer, Douglas E. *Internetworking with TCP/IP Volume One*. 6th ed. Harlow: Pearson Education UK, 2013. Print.
  Available:
  https://bibcercador.uab.cat/permalink/34CSUC_UAB/1c3utr0/cdi_proquest_ebookcentral_EBC5137558

Supplementary references:

- G. Tomsho (2011). Guide to Networking Essentials, 6th Edition. Cengage.
- W. R. Stevens (1993). TCP/IP Illustrated, Volume I. Addison-Wesley.
- A.S. Tanenbaum (2002). Computer Networks, 4th Edition. Prentice Hall.
- W. Stallings (2004). Comunicaciones y redes de computadores, 7a Edición. Pearson Prentice Hall.
- N. Barcia, C. Fernández, S. Frutos, G. López, L. Mengual, F.J. Soriano, F.J. Yágüez (2005). Redes de computadores y arquitecturas de comunicaciones. Supuestos prácticos. Pearson Prentice Hall.

Web links:

- cv.uab.cat
- http://www.cs.purdue.edu/homes/dec/netbooks.html

Software

Main software:

- Linux
- Bash
- Python
- Netcat
- Lxc
- Ns-3

- Wireshark

Language list

Name	Group	Language	Semester	Turn
(PAUL) Classroom practices	811	Catalan/Spanish	second semester	morning-mixed
(PAUL) Classroom practices	812	Catalan/Spanish	second semester	morning-mixed
(PLAB) Practical laboratories	1	Catalan/Spanish	second semester	morning-mixed
(PLAB) Practical laboratories	2	Catalan/Spanish	second semester	morning-mixed
(PLAB) Practical laboratories	3	Catalan/Spanish	second semester	morning-mixed
(PLAB) Practical laboratories	4	Catalan/Spanish	second semester	morning-mixed
(TE) Theory	81	Catalan/Spanish	second semester	morning-mixed