Universidad de Alcalá

TEACHING GUIDE

Networks Architecture

Degree in
Computer Engineering (GIC)
Computer Science Engineering (GII)

Universidad de Alcalá

Academic Year 2021/2022

2nd Year - 1st Semester (GIC+GII)

Approved by the School Board on July 6, 2021

TEACHING GUIDE

Course Name:	**Networks Architecture**
Code:	**780011 (GIC+GII)**
Degree in:	**Computer Engineering (GIC)** **Computer Science Engineering (GII)**
Department and area:	**Automática** **Telematics Engineering**
Type:	**Compulsory (GIC+GII)**
ECTS Credits:	**6.0**
Year and semester:	**2nd Year - 1st Semester (GIC+GII)**
Teachers:	Dr. Antonio del Corte Valiente
Tutoring schedule:	Consultar al comienzo de la asignatura
Language:	English

1. COURSE SUMMARY

The subject of Computer Networks is divided into two courses: Architecture of Computer Networks and Communication Networks. The aim of these subjects is to transmit key concepts for the design and deployment of local networks.

The process of learning will follow a top-down approach, starting in this first course with the top levels of the communication protocols hierarchy: applications and transport layers. The rest of the hierarchy will be traversed downwards in the second course. A practical approach will guide the study all along, focusing on those applications which are most familiar to the student and stating the requirements standing at the different levels to operate in a distributed environment.

Specifically, the main topics covered in this course are: network elements (hosts, service model, access network and core network), physical media and multiplexing, switching paradigms (circuit switching vs. packet switching), network architectures (service model, network topologies and protocols), telematics services and applications and data transport.

The first part of the course provides an overview of the concepts that are essential to understand the operation of communication networks such as network elements, service model, protocol concept, basic features of physical transmission media that set up links and the concept of multiplexing. Then follows a broad overview of network technologies including physical media of the link used by the final user (wireless, wired) and its main features (fixed, mobile). The most common access technologies nowadays are presented and the two main switching paradigms (circuit switching vs. packet switching) are discussed. The concepts of standardization and regulation are also introduced, identifying the main agents involved in both processes.

After this first overview, the study continues, focused on packet switching networks, following a top-down approach to classical protocol architectures applied to a widely extended technology like TCP/IP, analyzing in depth:

- Distributed applications, application protocols and telematic services (web, email, domain name service, file transfer).
- Reliable and non-reliable data transport. End to end flow and error control. Retransmission techniques. Congestion control.

Practical experiences in the matter will include activities of configuration and programming communication channels as well as using a popular network traffic and protocol analyzers (sniffer) to observe the structure of messages and protocols.

In addition to the above, the class will be completely lectured in English, thus developing the language expression abilities of the students, which are strongly encouraged to use English literature as well.

2. SKILLS

Basic, Generic and Cross Curricular Skills.

This course contributes to acquire the following basic, generic and corss curricular skills:

en_CG2 - Ability to direct the activities object of the projects in the field of information technology in accordance with the knowledge acquired in accordance with the provisions of section 5, annex 2, of resolution BOE-A-2009-12977.

en_CG3 - Ability to design, develop, evaluate and ensure accessibility, ergonomics, usability and security of computer systems, services and applications, as well as the information they manage.

en_CG5 - Ability to conceive, develop and maintain computer systems, services and applications using software engineering methods as an instrument for quality assurance, in accordance with the knowledge acquired as established in section 5, annex 2, of the resolution BOE-A-2009-12977.

en_CG8 - Knowledge of the basic subjects and technologies, which enable them to learn and develop new methods and technologies, as well as those that provide them with great versatility to adapt to new situations.

en_CB1 - That students have demonstrated to possess and understand knowledge in an area of study that is based on general secondary education, and is usually found at a level that, although supported by advanced textbooks, also includes some aspects that involve knowledge from the forefront of their field of study.

en_CB2 - That the students know how to apply their knowledge to their work or vocation in a professional manner and possess the competencies that are usually demonstrated through the elaboration and defense of arguments and the resolution of problems within their area of study.

en_CB3 - That students have the ability to gather and interpret relevant data (usually within their area of study) to make judgments that include a reflection on relevant social, scientific or ethical issues.

en_CB4 - That students can transmit information, ideas, problems and solutions to both a specialized and non-specialized public.

en_CB5 - That the students have developed those learning skills necessary to undertake further studies with a high degree of autonomy.

en_TRU1 - Capacity of analysis and synthesis.

en_TRU2 - Oral and written competencies.

en_TRU3 - Ability to manage information.

en_TRU4 - Autonomous learning skills.

en_TRU5 - Team work.

Specific Skills

This course contributes to acquire the following specific skills:

en_CI2 - Ability to plan, conceive, deploy and direct projects, services and computer systems in all areas, leading its implementation and continuous improvement and assessing its economic and social impact.

en_CI5 - Knowledge, administration and maintenance of computer systems, services and applications.

en_CI11 - Knowledge and application of the characteristics, functionalities and structure of Distributed Systems, Computer Networks and Internet and to design and implement applications based on them.

en_CI13 - Knowledge and application of the necessary tools for storage, processing and access to Information Systems, including web-based ones.

Learning Outcomes:

Upon successful completion of this course, students will be able to:

RA1: Identify the physical and logical components of the architecture of a data network.

RA2: Explain and understand the operation of switching techniques used in data networks.

RA3: Identify the main bodies responsible for standardization on the Internet.

RA4: Explain the concept of communications protocol.

RA5: Know the main stratified architecture models used in data networks (OSI reference model and TCP / IP architecture) and distinguish the functions of each of their levels.

RA6: Obtain performance parameters and delays in data networks.

RA7: Explain the structure and operation of a Client / Server model.

RA8: Analyse and explain the main protocols of the application layer, using computer tools.

RA9: Analyse and explain the main protocols of the transport layer of the TCP / IP architecture, using computer tools.

RA10: Develop a simple application of a telematic service using standard interfaces of network communication.

RA11: Investigate new aspects of networks autonomously using search and information management tools.

RA12: Cooperate in Teamwork to solve problems related to networks and effectively communicate knowledge, procedures, results, and ideas in this regard, both in writing and orally.

3. CONTENTS

Contents Blocks	Total number of hours
Unit 1. Computer networks: elements, protocols, switching options, delay, service models, layered architectures.	14 hours (3,5 weeks)
Unit 2. Application level protocols: distributed applications, C/S model, common protocols (HTTP, DNS, FTP, SMTP, POP, IMAP), socket programming.	18 hours (4,5 weeks)
Unit 3. Transport layer: reliability, TCP, UDP, retransmission techniques, congestion control.	24 hours (6 weeks)

4. TEACHING - LEARNING METHODOLOGIES. FORMATIVE ACTIVITIES.

4.1. Credits Distribution

Number of on-site hours:	58 hours (56 hours on-site + 2 exams hours)
Number of hours of student work:	92
Total hours	150

4.2. Methodological strategies, teaching materials and resources

The teaching strategy of the course is divided into 3 sections: large groups, small groups and tutoring:

Theory lessons (large groups)

Learning of general aspects of the subject by means of:

- Oral presentations conducted by the teacher.
- Interactive and collaborative activities.
- Reading assignments and problem resolution assignments.

Practical lessons (small groups)

Learning of specific aspects of the subject and in- depth learning of matter covered in theory lessons by means of:

- Analysis of practical cases related to the subject.
- Resolution of problems.
- Use of laboratory tools such as protocol sniffers, network commands, intercommunication artifacts such as sockets to program client- server interactions using different flavors of communication protocols or programming with standard APIs.
- Oral presentations, interactive activities and other activities.

Tutoring (individual and groups, in-room, e-mail, etc.)

- Assessment to self-learning.
- Answer questions and resolve doubts.

5. ASSESSMENT: procedures, evaluation and grading criteria

Preferably, students will be offered a continuous assessment model that has characteristics of formative assessment in a way that serves as feedback in the teaching-learning process.

5.1. PROCEDURES

The evaluation must be inspired by the criteria of continuous evaluation (Learning Assesment Guidelines, LAG, art 3). However, in compliance with the regulations of the University of Alcalá, an alternative process of final evaluation is made available to the student in accordance with the Learning Assesment Guidelines as indicated in Article 10, students will have a period of fifteen days from the start of the course to request in writing to the Director of the Polytechnic School their intention to take the non-continuous evaluation model adducing the reasons that they deem convenient. The evaluation of the learning process of all students who do not apply for it or are denied it will be done, by default, according to the continuous assessment model. The student has two calls to pass the subject, one ordinary and one extraordinary.

Ordinary Call

Continous Assessment:

The main assessment tools will be:

1. **Problems (EP).** Solving practical problems individually or in small groups. Solving practical problems individually or in small groups.
2. **Laboratory Exercises (EL).** Performance of laboratory practices and delivery of the corresponding reports. The evaluation will consider systematic observation, where the teacher will record the main difficulties and skills observed in each student, and the realization of a single

memory by practice, by each of the groups of students who have done it.

3. **Assessment Tests (PE).** Performing written tests focused on both practical and theoretical aspects of the subject.

Students must attend 100% of the laboratory sessions and deliver the corresponding reports to all laboratory practices. Recovery sessions will be enabled for those students who have not attended any of the sessions and justify it documentarily.

The students, as a group, will deliver the reports of the laboratory practices following the established schedule. These practices will be evaluated by the professor responsible for the laboratory group, to assess if the objectives indicated in the script of the same have been met.

Assessment through final exam:

In the case of evaluation by means of a final exam, the evaluation elements to be used will be the following:

Extraordinary Call

The procedure will be the same as that described for the assessment by means of a final exam in the ordinary call.

5.2. EVALUATION

EVALUATION CRITERIA

Evaluation Criteria must address the extent of acquisition of skills by the student. For this purpose, the following are defined:

CE1. The student shows knowledge and understanding of the concepts specified in the blocks of contents section about Computer networks and protocols.

CE2. The student can solve practical problems related to the subject about performance and logic of protocols.

CE3. The student can properly use software analysis tools to work with the protocols used in the course.

CE4. The student is able to use a simple Applications Programming Interface to develop telematics applications

CE5. The student shows ability to work in teams during Small Group activities.

CE6. The student can work autonomously, searching, and properly managing information related to the contents of the subject.

In all above criteria, the student should address the appropriate matters and justify the method and procedures used in the solutions proposed to the problems.

GRADING TOOLS

This section specifies the evaluation tools to be applied to each of the evaluation criteria.

• **Partial Tests (PEx)** for the contents of the theory shall weight 60% of the final grade and no single test will weight more than 40% of the final grade. The purpose of these evaluations is to allow the students to acquire competences in an incremental way and assimilate the concepts of each learning unit as it gets covered in time. Although they are partial evaluations, a partial test does assume previously acquired knowledge evaluated in previous tests, thus, they are related. This permits to maintain cohesion in the evaluation in harmony with the aim of the learning process.

• **Deliverables and Lab Tests (PLx).** The continuous learning process of the student can be assessed by means of several tools: exercise assignments, quick quizzes, essays and deliverables in general. These can be carried out in the Big Group, the Small Group (Lab), or by the student on his/her own. Specific tests can be performed as evaluations of the experiences in the laboratory sessions, and their objective will be to ensure the correct and efficient acquisition of the practical contents and competences developed in the laboratory. In all, they weight 40% of the final grade.
Some of these Tests will be scheduled ahead of time but others may not be announced in advance as the students are expected to attend all classes..

More specific details about the evaluation (dates, number and type of tests, concrete % weight, etc.) will be defined at the beginning of the course.

GRADING CRITERIA

Students should obtain at least 50% of the total maximum score to pass the subject.

Before completing the first 60% cumulative evaluation a student may decide not to continue attending the subject and get a "Not-Presented" score in the final grades, but after this percentage has been evaluated the continuous evaluation cannot be withdrawn.

In a similar way, students should attend each important evaluation event (>=10% of total weight) and show a minimum acceptable performance.

Ordinary call, Continuous Assessment:

Skill	Learning Outcomes	Evaluation criteria	Grading Tool	Contribution to the final mark
CG2-CG5, CG8, CB1-CB5, CI2, CI5, CI11, CI13, TRU1-TRU3	RA1-RA6	CE1-CE2, CE5-CE6	PE1	20%
CG2-CG5, CG8, CB1-CB5, CI2, CI5, CI11, CI13, TRU1-TRU3	RA7-RA8	CE1-CE2, CE5-CE6	PE2	20%
CG2-CG5, CG8, CB1-CB5, CI2, CI5, CI11, CI13, TRU1-TRU3	RA9, RA11-RA12	CE1-CE2, CE5-CE6	PE3	20%
CG2-CG5, CG8, CB1-CB5, CI2, CI5, CI11, CI13, TRU1-TRU5	RA1-RA6	CE1-CE3, CE6	PL1	15%
CG2-CG5, CG8, CB1-CB5, CI2, CI5, CI11, CI13, TRU1-TRU5	RA7-RA8	CE1-CE3, CE6	PL2	15%
CG2-CG5, CG8, CB1-CB5, CI2, CI5, CI11, CI13, TRU1-TRU5	RA9, RA11-RA12	CE1-CE4, CE6	PL3	10%

Ordinary call, Final Assessment:

Skill	Learning Outcomes	Evaluation criteria	Grading Tool	Contribution to the final mark
CG2-CG5, CG8, CB1-CB5, CI2, CI5, CI11, CI13, TRU1-TRU3	RA1-RA9, RA11, RA12	CE1-3, CE6	PEF	100%

Extraordinary call:

Students who didn't pass the regular evaluation process (continuous or final) or who didn't concur (not-presented) to it still have the chance to make an exam to pass the subject in the Extraordinary Call which will be published by the School (EPS). This exam will follow the same specifications of the Final Exam described in the table above.

6. BIBLIOGRAPHY

6.1. Basic Bibliography

- Computer Networking: A Top-Down Approach. (7th Edition) J. Kurose & K.W. Ross. Pearson Education, International Edition, 2017.

6.2. Additional Bibliography

- Computer Networks (5ª International Ed.) A.S. Tanenbaum. Prentice-Hall International, 2010.
- Data and Computer Communications (9th International Ed.) W. Stalling. Prentice-Hall International, 2010.
- TCP/IPIllustrated, Volume1: The Protocols. First edition. W.Richard Stevens. Addison-Wesley, 1994.
- UNIX network programming, Volume 1: Networking API socket and XTI. Second edition. W.Richard Stevens. Prentice Hall, 1998.

Disclosure Note

The University of Alcalá guarantees to its students that, if due to health requirements the competent authorities do not allow the total or partial attendance of the teaching activities, the teaching plans will achieve their objectives through a teaching-learning and evaluation methodology in online format, which will return to the face-to-face mode as soon as these impediments cease.