TEACHING GUIDE

Network Architecture

Bachelor's Degree in
Computer Science
Computer Engineering

University of Alcalá

Academic year 2019/2020

2nd Year – 1st Term

Universidad de Alcalá

TEACHING GUIDE

Subject Name:	**Network Architecture**
Code:	**780011**
Degree:	**Degree in Computer Science** **Degree in Computer Engineering**
Department and Area:	**Computer Engineering Dpt. (Automática)** **Computer Architecture and Technology Area**
Type:	**Mandatory**
ECTS Credits:	**6**
Course and Term:	**2nd Year – 1st Term**
Teaching Staff:	**To be posted at the appropriate time**
Tutoring hours:	**Refer to subject Webpage**
Language:	**English**

1. PRESENTATION

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

General skills:

CG2 Ability to direct the activities under the projects in the field of information technology in accordance with the knowledge acquired as provided in paragraph 5 of resolution BOE-A-2009-12977.

CG3 Ability to design, develop, evaluate and ensure the accessibility, ergonomics, usability and safety systems, services and applications, as well as the information they manage.

CG5 Ability to conceive, develop and maintain systems, services and applications using the methods of software engineering as a tool for quality assurance, according to the knowledge acquired as provided in paragraph 5 of resolution BOE-A- 2009-12977.

CG6 Ability to conceive and develop centralized or distributed computer systems or architectures integrating hardware, software and networks in accordance with the knowledge acquired as established in section 5 of annex II of resolution BOE-A-2009-12977.

CG8 Knowledge of basic materials and technologies that enable learning and development of new methods and technologies, as well as to equip them with great versatility to adapt to new situations.

CG9 Ability to solve problems with initiative, to make decisions, autonomy and creativity. Ability to communicate knowledge, skills and abilities of a technical computer engineer.

CG10 Knowledge to take measurements, to perform calculations, to estimate, survey, study, to create reports, to plan tasks and other such computing jobs, according to knowledge acquired following what is established in section 5 of annex II of resolution BOE-A-2009-12977

CB1 Demonstrate knowledge and understanding in a field of study stemming from the general secondary education and usually lies at a level which, although it can be supported by advanced text books, also includes some aspects which imply knowledge coming from the vanguard of their field of study.

CB2 Be able to apply their knowledge to their work or calling in a professional way, and to have the competence which can usually be shown when elaborating and defending a line of reasoning and solving problems in their field of study.

CB3 Have the ability to gather and interpret relevant data (usually within their field of study) to make judgements which include consideration of relevant topics of a social, scientific or ethical nature.

CB4 Be able to transmit information, ideas, problems and solutions to both a specialized and a non-specialized audience.

CB5 Have developed those learning skills which are necessary to embark on later studies with a high degree of autonomy.

Specific skills

CI1 Ability to design, develop, select and evaluate computer applications and systems, guaranteeing their reliability, safety and quality according to ethical principles and the current legislation and norms.

CI2 Ability to plan, design, deploy and manage projects, services and systems in all areas, leading its implementation and continuous improvement and assessing their economic and social impact.

CI5 Knowledge, management and maintenance systems, services and applications.

CI11 Knowledge and application of features, functionality and structure of Distributed Systems, Computer Networks and Internet design and implement applications based on them.

CI13 Knowledge and application of the necessary tools for storage, processing and access to information systems, including web-based.

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

Units (chapters shall be specified if necessary)	Number of lessons, credits or 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. LEARNING METHODOLOGY

4.1. Credits distribution (please specify hours)

Classroom hours:	• Large group lessons: 28 hours (2 hours x 14 weeks) • Reduced group lessons: 28 hours (2 hours x 14 weeks) • Tests and examinations: 4 hours Total: 60 in-class hours
Students work hours:	• Lesson preparation, self-learning, exercises development, tests, exams, and laboratory preparation: Total: 90 hours

Total hours	150 hours

4.2. Strategies, methods, materials and learning resources

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 and assessment and grading criteria

Assessment will be preferably continuous and formative providing frequent feedback to the student during the learning process. For this purpose, the following evaluation procedures are set[1]:

Assessment procedures

Ordinary call

In the ordinary call, the student will be evaluated using a **Continuous Assessment** (EC) process. In duly justified exceptional situations, it may benefit from a system of evaluation by **Final Exam**. To do this the student must apply in writing to the Dean in the first two weeks, indicating the reasons that prevent him to follow continuous assessment. In this case, the Dean will communicate the decision within a maximum of 15 days. If the student does not receive a response within that period, the request will be considered as accepted.

[1] Plagiarism of any given work will be penalized according to the rules of the regulatory processes University learning assessment (Article 34). More information: http://www2.uah.es/bibliotecaformacion/BECO/plagio/index.html

Extraordinary call

The extraordinary session will consist of a similar test to that arising in the evaluation system by **Final Exam.**

Assessment 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 instruments

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

- **Partial Tests** 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**. 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

Competences	Learning Outcomes	Evaluation Criteria	Evaluation Instrument	Weight
CG2-3, CG5-6, CG8-10, CB1-5, CI1, CI2, CI5, CI11, CI13	RA1-RA6	CE1-CE2, CE5-CE6	PE1	20%
CG2-3, CG5-6, CG8-10, CB1-5, CI1, CI2, CI5, CI11, CI13	RA7-RA8	CE1-CE2, CE5-CE6	PE2	20%
CG2-3, CG5-6, CG8-10, CB1-5, CI1, CI2, CI5, CI11, CI13	RA9, RA11-RA12	CE1-CE2, CE5-CE6	PE3	20%
CG2-3, CG5-6, CG8-10, CB1-5, CI1, CI2, CI5, CI11, CI13	RA1-RA6	CE1-CE3, CE6	PL1	15%
CG2-3, CG5-6, CG8-10, CB1-5, CI1, CI2, CI5, CI11, CI13	RA7-RA8	CE1-CE3, CE6	PL2	15%
CG2-3, CG5-6, CG8-10, CB1-5, CI1, CI2, CI5, CI11, CI13	RA9, RA11-RA12	CE1-CE4, CE6	PL3	10%

Ordinary call, Final Assessment

The final evaluation is designed only for those students who obtain the permission to skip the continuous evaluation process.

Competences	Learning Outcomes	Evaluation Criteria	Evaluation Instrument	Weight
CG2-3, CG5-6, CG8-10, CB1-5, CI1, CI2, CI5, CI11, CI13	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

BASIC

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

ADDITIONAL

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  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.