Telematic Applications

Academic Year: (2023 / 2024) **Review date: 08-11-2023**

Department assigned to the subject: Telematic Engineering Department

Coordinating teacher: DIAZ SANCHEZ, DANIEL

Type: Compulsory ECTS Credits : 6.0

Year : 3 Semester : 1

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

The subject "Statistics I" and have clear knowledge on calculation as means, variance, stb deviation and probability models.

The subject "Access Networks and Shared Media" and have clear knowledge on local networks, Ethernet (802.3) and Wireless LAN (IEEE 802.11) and their architecture; last mile access networks and the basis of TCP/IP stack.

The subject "Communications Networks and Services" and have clear knowledge on local network and internet architecture, IP protocol IP, ICMP and routing.

The subject "Systems Architecture"and have clear knowledge on programming in C and Java, data structures, debuggers (memory leak detection and program optimization), processes and threads and concurrency.

OBJECTIVES

This course introduces the basic principles of the higher layers of communications networks: the transport layer and the application layer. Since the deployment of networks today is done in the context of Internet, this course will emphasize on the importance of end to end design, and the desirability of introducing other architectural elements beyond the traditional client-server.
The course requires the underlying levels (physical, link and network), and the important concepts introduced in them, to present the contributions in the higher levels in terms of congestion control, flow control, reliability of the communication, etc.. In addition, real applications and services wil be used to comprehensively demonstrate the incorporations of requirements into the design of protocols. To achieve this objective, the student must acquire certain knowledge, and exercise some abilities.

In relation to the objectives of the degree, this course contributes to the following:
- Ability to apply knowledge of mathematics, statistics, science, telecommunications technology, and engineering
- Ability to design and conduct experiments and analyze and interpret data
- Ability to identify, formulate, and solve engineering problems
- Knowledge of contemporary issues
- Ability to use techniques, skills and modern engineering tools necessary for the practice of engineering

At the end of the course the student will be able to:
- Understand the need, functions, levels and types of transport
- Understand advanced aspects of the Internet transport layer, and in particular TCP: algorithms, flow control, congestion control, timers, TCP challenges and alternatives.
- Understand advanced aspects of the Internet name service.
- Understand advanced aspects of popular Internet services, such as SMTP, HTTP, etc..

In terms of specific skills, at the end of the course, students will be able to:
- Perform and interpret detailed trace captures of different transport layer protocols and application.
- Calculate network requirements from assumptions regarding user populations and applications.
- Design new applications, services, and protocols for the Internet. Evaluate applications in connection with the use of the network: throughput, reliability, etc.

In terms of general abilities or skills during the course work:

- Ability to access and understand technical literature in both English and Castilian.
- Contact with technologies widely used in business.

DESCRIPTION OF CONTENTS: PROGRAMME

The objective of this course is to show advanced aspects of the transport layer in Internet and study in depth the application level in the communication architecture. To this end, we present in detail the various services offered on the Internet, such as email, file transfer, remote terminal, web and others. For each of these services we present the basics of its design and the protocols involved. The course program is as follows:

1. Advanced aspects of transport protocols
    - Introduction to TCP
    - Connection establishment and close. State Diagram
    - Interactive and bulk traffic. TCP algorithms: Nagle, slow start, congestion control, fast recovery / fast retransmit, and so on.
    - TCP timers: retransmission, persistence and keep-alive. Calculation and considerations
    - Other transport protocols: SCTP
2. Domain Name Server: DNS
3. Classical protocols: Study the design of classical protocols as telnet, rlogin, FTP or TFTP
4. Email: Encoding and formatting of emails (RFC 822, MIME), delivery protocols (SMTP) and final delivery protocols (POP as IMAP)
5. Web: HTTP and related protocols

Lab sessions (guided) will cover the following topics (note every item may span to several sessions)
1. Sockets programming (in C/Java): tools for accessing and using the socket API and notions about concurrency with sockets
2. Servers covering non concurrent and concurrent servers
3. Domain Name Service (DNS)
4. Email service
5. HTTP

Lab sessions (for mandatory assignment)
It is possible that up to 4 sessions will be devoted to the preparation of a mandatory assignment (in with teachers will assist and recommend in your development process or to answer technical questions).

LEARNING ACTIVITIES AND METHODOLOGY

The course will use three types of activities: classes of theory, problems and laboratory assignments.

Theory classes use traditional blackboard, transparencies, videos, etc. This traditional lectures introduce and illustrate the concepts of the course. Besides the theory, practical exercises are used to complement the explanations of theoretical concepts.

Problems activities are focused on applied problems and help to improve students' understanding of the theoretical concepts in a more applied way. They will help the students to self-evaluate their knowledge on the subject. This activities will provide students of high autonomy, providing access to problem statements and solutions gradually.

Problems activities include the sharing of individual solutions and joint correction, which should serve to consolidate knowledge and develop the capacity to analyze and communicate relevant information to solve problems. Besides sharing to promote the exchange of critical views both between teacher and students and between students.

The practical activities will be conducted in the laboratory and consist of well-defined experiments and designs. Lab assignments will offer the students a complementary point of view and provide them with valuable experience. Practices will encourage teamwork and project based learning.

ASSESSMENT SYSTEM

The assessment activities are now described in detail. Their weight on the overall grade is specified latter where ordinary and extraordinary evaluations are defined
*Theory assessment:
-Partial evaluation (E_1)[25%]: covers TCP, DNS. It will take place after finishing those contents (according to the planning) or agreed with students with enough time. Will contain theory and practical questions/problems (spanning to concepts explained in theory sessions and in lab sessions) and may contain a test (in which failed questions can subtract).
-Final evaluation (E_2)[25%]: covers the entire subject. It will take place as scheduled by the university

and consist on a test (in which failed questions can subtract) and several problems.

*Lab assesment:
-Guided lab assessment (PG): These assignments will be done by students following a script with the assistance of teachers during the term.
They will be evaluated by written exams in the lab (PG1 and PG2)[50%]. A PC will be available to the student.

*ORDINARY ASSESMENT
NOTE: Every assessment (E_1, E_2, and PG) should be passed individually (grade over the minimum, by default 5.0) to pass the subject. Teachers may assess individual cases or lower the minimum required to pass depending on the development of the subject.

The ordinary assessment encompasses the continuous assessment and the final exams and depends on the student following the continuous assessment or not:
- ORDINARY with continuous assessment (100%): the student should pass E_1 (25%) and PG1/PG2 (50%) during the term (PG2 may coincide with the final exam) and should also pass E_2 (25%) the day of the final exam.
- ORDINARY without continuous assessment (60%): the student should pass E_2 (40%) and PG_ORD (20%) (lab assesment) the day of the final exam.

*EXTRAORDINARY ASSESSMENT
NOTE: Every assessment (E_1, E_2, P0 or PG) should be passed individually (grade over the minimum, by default 5.0) to pass the subject. Teachers may assess individual cases or lower the minimum required to pass depending on the development of the subject.

Encompasses the continuous assessment and the final exams and depends on the student following the continuous assessment or not:
- EXTRAORDINARY if the student followed the continuous assesment (100%): Should pass E_2 (25%) and PG_EXTRA (50%) the day of the final exam. The grades of the continuous assesment passed during the term will be added to the result E_1 (25%)
- EXTRAORDINARY if the student did not follow the continuous assesment (100%): Should pass a written exam containing theory and lab E_EXTRA (65%) and pass a lab exam PG_EXTRA (35%) the day of the final exam.

% end-of-term-examination:	50
% of continuous assessment (assigments, laboratory, practicals…):	50

BASIC BIBLIOGRAPHY

- Forouzan, Behrouz A. TCP/IP protocol suite, McGraw-Hill Higher Education, 2006
- James F. Kurose Computer Networking, Pearson, 2010
- Stevens, W. R. TCP/IP Illustrated Vol. 1 The protocols, Prentice Hall, 1994

ADDITIONAL BIBLIOGRAPHY

- Ilya Grigorik High Performance Browser Networking. , O'Reilly, 2013

BASIC ELECTRONIC RESOURCES

- Ilya Grigorik . High Performance Browser Networking: https://hpbn.co/