Course guide
270639 - CNANM - Computer Network Architectures and Network Management

Unit in charge: Barcelona School of Informatics
Teaching unit: 701 - DAC - Department of Computer Architecture.
Degree: MASTER'S DEGREE IN INNOVATION AND RESEARCH IN INFORMATICS (Syllabus 2012). (Optional subject).
Academic year: 2022
ECTS Credits: 6.0
Languages: English

LECTURER

Coordinating lecturer: JORDI DOMINGO PASCUAL
Others: Primer quadrimestre: JORDI DOMINGO PASCUAL - 10

PRIOR SKILLS

Bachelor Degree. Admission to MIRI.
For exchange students: a basic course on computer networks is a requisite.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTE

Specific:
CEE2.1. Capability to understand models, problems and algorithms related to distributed systems, and to design and evaluate algorithms and systems that process the distribution problems and provide distributed services.
CEE2.2. Capability to understand models, problems and algorithms related to computer networks and to design and evaluate algorithms, protocols and systems that process the complexity of computer communications networks.
CEE2.3. Capability to understand models, problems and mathematical tools to analyze, design and evaluate computer networks and distributed systems.

Generical:
CG1. Capability to apply the scientific method to study and analyse of phenomena and systems in any area of Computer Science, and in the conception, design and implementation of innovative and original solutions.
CG3. Capacity for mathematical modeling, calculation and experimental designing in technology and companies engineering centers, particularly in research and innovation in all areas of Computer Science.
CG5. Capability to apply innovative solutions and make progress in the knowledge to exploit the new paradigms of computing, particularly in distributed environments.

Transversal:
CTR3. TEAMWORK: Capacity of being able to work as a team member, either as a regular member or performing directive activities, in order to help the development of projects in a pragmatic manner and with sense of responsibility; capability to take into account the available resources.
CTR4. INFORMATION LITERACY: Capability to manage the acquisition, structuring, analysis and visualization of data and information in the area of informatics engineering, and critically assess the results of this effort.
CTR5. APPROPRIATE ATTITUDE TOWARDS WORK: Capability to be motivated by professional achievement and to face new challenges, to have a broad vision of the possibilities of a career in the field of informatics engineering. Capability to be motivated by quality and continuous improvement, and to act strictly on professional development. Capability to adapt to technological or organizational changes. Capacity for working in absence of information and/or with time and/or resources constraints.
CTR6. REASONING: Capacity for critical, logical and mathematical reasoning. Capability to solve problems in their area of study. Capacity for abstraction: the capability to create and use models that reflect real situations. Capability to design and implement simple experiments, and analyze and interpret their results. Capacity for analysis, synthesis and evaluation.
Basic:
CB6. Ability to apply the acquired knowledge and capacity for solving problems in new or unknown environments within broader (or multidisciplinary) contexts related to their area of study.
CB7. Ability to integrate knowledges and handle the complexity of making judgments based on information which, being incomplete or limited, includes considerations on social and ethical responsibilities linked to the application of their knowledge and judgments.
CB8. Capability to communicate their conclusions, and the knowledge and rationale underpinning these, to both skilled and unskilled public in a clear and unambiguous way.
CB9. Possession of the learning skills that enable the students to continue studying in a way that will be mainly self-directed or autonomous.

TEACHING METHODOLOGY
Theoretical sessions will be complemented by discussion sessions based on assigned readings. Studying some selected research papers will provide the flavor of research work.

LEARNING OBJECTIVES OF THE SUBJECT
1. The main goal is to understand the basic concepts of the network architecture, the fundamental principles of network design and of the most relevant algorithms used in protocols and network functions.
2. The main goal will be achieved via discussion sessions based on selected readings. This approach fosters autonomous learning and teamwork skills.

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours large group</td>
<td>24,0</td>
<td>16.00</td>
</tr>
<tr>
<td>Hours small group</td>
<td>24,0</td>
<td>16.00</td>
</tr>
<tr>
<td>Self study</td>
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<td>64.00</td>
</tr>
<tr>
<td>Guided activities</td>
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<td>4.00</td>
</tr>
</tbody>
</table>

Total learning time: 150 h

CONTENTS

**Evolution of the Network Architecture**

**Description:**
Internet Design Principles.
Key protocols and their evolution.
Internet structure. Exchange Points.
Economic relationships among stakeholders.

**Trends in the Evolution of the Network Architecture**

**Description:**
Naming and Addressing.
Addressing and Routing. Mobility.
New Network Architectures.
Routing and Inter-Networking

Description:
Routing Algorithms.
Classless Inter-domain Routing.
Inter-domain Routing. IDR.
BGP. IBGP. BGP attributes. Scalability of BGP.

Transport Network (Backbone)

Description:
Optical Transport Network.
IP over SDH.
IP over WDM/ASON.
IP over WDM/GbEthernet.
MPLS.
From MPLS to GMPLS.
SDN.

New Network and Transport Protocols

Description:
IPv6. IPv4-IPv6 coexistence.
Mobile IP.
IP Multicast.
Other IP protocols (HIP).
Multipath TCP.
Other Transport protocols (QUIC).

Resource Management

Description:
Quality of Service principles.
Quality of Service and Quality of Experience (QoS and QoE).
Integrated Services Architecture.
Differentiated Services Architecture.

5G Network Architecture

Description:
5G Network Characteristics. Key Performance Indicators (KPI).
Virtualization technologies (NFV).
Software Defined Networks (SDN).
Orchestration and management. Slicing.
5G projects and Initiatives.
6G initiatives.
ACTIVITIES

**Evolution of the Network Architecture**

**Description:**
Internet Design Principles.
Key protocols and their evolution.
Internet structure, Exchange Points.
Economic relationships among stakeholders.

**Specific objectives:**
1, 2

**Related competencies:**
CG1. Capability to apply the scientific method to study and analyse of phenomena and systems in any area of Computer Science, and in the conception, design and implementation of innovative and original solutions.
CG5. Capability to apply innovative solutions and make progress in the knowledge to exploit the new paradigms of computing, particularly in distributed environments.
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CB9. Possession of the learning skills that enable the students to continue studying in a way that will be mainly self-directed or autonomous.
CB6. Ability to apply the acquired knowledge and capacity for solving problems in new or unknown environments within broader (or multidisciplinary) contexts related to their area of study.
CB8. Capability to communicate their conclusions, and the knowledge and rationale underpinning these, to both skilled and unskilled public in a clear and unambiguous way.
CB7. Ability to integrate knowledges and handle the complexity of making judgments based on information which, being incomplete or limited, includes considerations on social and ethical responsibilities linked to the application of their knowledge and judgments.

**Full-or-part-time:** 36h
Theory classes: 12h
Self study: 24h
Trends in the Evolution of the Network Architecture

Description:

Specific objectives:
1, 2

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Full-or-part-time: 18h
Theory classes: 6h
Self study: 12h
Routing and Inter-networking

Description:

Specific objectives:
1, 2

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Full-or-part-time: 18h
Theory classes: 6h
Self study: 12h
Transport Networks (Backbone)

**Description:**
Optical Transport Network. IP over SDH. IP over WDM/ASON. IP over WDM/GbEthernet. MPLS. From MPLS to GMPLS. SDN.

**Specific objectives:**
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Theory classes: 6h
Self study: 12h
New Network and Transport Protocols

Description:

Specific objectives:
1, 2

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Theory classes: 8h
Self study: 16h
Network Resource Management

Description:

Specific objectives:
1, 2

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Full-or-part-time: 24h
Theory classes: 8h
Self study: 16h

5G Network Architecture

Description:
Características de la red 5G. Indicadores clave de rendimiento (KPI). Marco para redes 5G. Redes de núcleo, borde y acceso. Tecnologías de virtualización (NFV). Redes definidas por software (SDN). Orquestación y gestión. Rebanar Proyectos e iniciativas 5G.

Full-or-part-time: 18h
Theory classes: 6h
Self study: 12h
**GRADING SYSTEM**

Midterm/Assignments: 25%
Discussion sessions: 25%
Active Participation in Class: 10%
Final Exam / Final project: 40%

**BIBLIOGRAPHY**

**Basic:**

**Complementary:**