ANX-PR/CL/001-01

LEARNING GUIDE

SUBJECT

593000506 - Distributed Systems For Iot

DEGREE PROGRAMME

59AH - Master Universitario en Internet Of Things (iot)

ACADEMIC YEAR & SEMESTER

2019/20 - Semester 1

Index

Learning guide

1. Description

1.1. Subject details

Name of the subject	593000506 - Distributed Systems For Iot
No of credits	4.5 ECTS
Type	Compulsory
Academic year ot the programme	First year
Semester of tuition	Semester 1
Tuition period	September-January
Tuition languages	English
Degree programme	59AH - Master Universitario en Internet Of Things (iot)
Centre	59 - Escuela Tecnica Superior de Ingenieria y Sistemas de Telecomunicacion
Academic year	2019-20

2. Faculty

2.1. Faculty members with subject teaching role

Name and surname	Office/Room	Email	Tutoring hours *
Sergio Arevalo Viñuales	4413	sergio.arevalo@upm.es	Sin horario.
Maria Isabel Muñoz Fernandez (Subject coordinator)	4412	isabel.munoz@upm.es	Sin horario.

* The tutoring schedule is indicative and subject to possible changes. Please check tutoring times with the faculty member in charge.

3. Prior knowledge recommended to take the subject

3.1. Recommended (passed) subjects

The subject - recommended (passed), are not defined.

3.2. Other recommended learning outcomes

- Programming languages, computer networks, operating systems

4. Skills and learning outcomes *

4.1. Skills to be learned

CB08 - Que los estudiantes sean capaces de integrar conocimientos y enfrentarse a la complejidad de formular juicios a partir de una información que, siendo incompleta o limitada, incluya reflexiones sobre las responsabilidades sociales y éticas vinculadas a la aplicación de sus conocimientos y juicios

CB10 - Que los estudiantes posean las habilidades de aprendizaje que les permitan continuar estudiando de un modo que habrá de ser en gran medida autodirigido o autónomo.

CE.05 - Diseñar y desarrollar sistemas distribuidos para dar soporte a aplicaciones IoT, evaluando las tecnologías mas apropiadas de acuerdo con los diferentes contextos de aplicación como son despositivos móviles, sistemas en tiempo real o sistemas ubícuos

CE.06 - Analizar el rendimiento, disponibilidad, escalabilidad y fiabilidad de los sistemas distribuidos empleados en aplicaciones IoT

CE.08 - Diseñar y desarrollar soluciones tecnológicas para implementar servicios IoT capaces de interactuar con diferentes fuentes de información y dispositivos distribuidos incluyendo el diseño de estructuras de intercambio de información eficientes

CG01 - Los alumnos demostrarán tener una visión del estado actual, las necesidades y los problemas que se plantean en el mundo de la IoT, así como de las arquitecturas y estándares más utilizados

CG02 - Los alumnos serán capaces de aplicar métodos y tecnologías avanzadas que les permitan abordar necesidades y problemas en aplicaciones IoT

CT.01 - Capacidad de uso de la lengua inglesa para el trabajo en contextos internacionales

4.2. Learning outcomes

RA12 - Coordinate IoT microservices using replicated state-machines services like Zookeeper.

RA10 - Design and implement a IoT microservice architecture based on Kafka stream processing platform.

RA11 - Choose the best replica consistency type for a IoT microservice.

RA13 - Apply CAP theorem principles to choose between availability and consistency

* The Learning Guides should reflect the Skills and Learning Outcomes in the same way as indicated in the Degree Verification Memory. For this reason, they have not been translated into English and appear in Spanish.

5. Brief description of the subject and syllabus

5.1. Brief description of the subject

The software that coordinates a set of connected computers in a communication network to get certain goal is denominated a Distributed System. This course will study the different models of interactions among devices, computing services and data services. It will also study the scalabilty and availability techniques to replicate services with different degrees of consistency. Finally it will apply this knowledge with Kafka and Zookeeper technologies.

5.2. Syllabus

1. Introduction

2. Stream processing

3. Direct Communication

4. Publishers-subscribers communication

5. Distributed transactions

6. Replica consistency

7. Process replication. Raft

8. Data replication. Spanner.

9. Lab 1. MQTT and Kafka

10. Lab 2. Zookeeper.

6. Schedule

6.1. Subject schedule*

Week	Face-to-face classroom activities	Face-to-face laboratory activities	Other face-to-face activities	Assessment activities
1	**Lesson 1** Duration: 02:30	**Lab 1. MQTT and Kafka** Duration: 03:00		
2	**Lesson 2** Duration: 02:30	**Lab 1. MQTT and Kafka** Duration: 03:00		
3	**Lesson 3** Duration: 02:30	**Lab 1. MQTT and Kafka** Duration: 03:00		
4	**Lesson 4** Duration: 01:30	**Lab 1. MQTT and Kafka** Duration: 02:30		**Theory middle term exam.** Continuous assessment Duration: 01:00 **MQTT and Kafka lab MId Term Exam** Continuous assessment Duration: 00:30
5	**Lesson 5** Duration: 02:30	**Lab 2. MQTT and Kafka** Duration: 03:00		
6	**Lesson 6** Duration: 02:30	**Lab 2. Zookeeper** Duration: 03:00		
7	**Lesson 7** Duration: 02:30	**Lab 2. Zookeeper** Duration: 03:00		
8	**Lesson 8** Duration: 01:30			**Theory end of term exam** Continuous assessment Duration: 01:00 **MQTT, Kafka and Zookeeper Exam** Continuous assessment Duration: 00:30 **Kafka-MQTT lab work presentation.** Continuous assessment Duration: 02:30
9				**Kafka-MQTT lab work presentation.(II)** Continuous assessment Duration: 03:00

10				**Kafka-MQTT lab work presentation (III)** Continuous assessment Duration: 03:00
11				
12				
13				
14				
15				
16				**Theory final exam.** Final examination Duration: 01:00 **Kafka-MQTT labs presentation** Final examination Duration: 02:00 **MQTT, Kafka, Zookeeper Exam** Final examination Duration: 00:30
17				

The independent study hours are training activities during which students should spend time on individual study or individual assignments.

Depending on the programme study plan, total values will be calculated according to the ECTS credit unit as 26/27 hours of student face-to-face contact and independent study time.

* The subject schedule is based on a previous theorical planning of the subject plan and might go to through experience some unexpected changes along throughout the academic year.

7. Activities and assessment criteria

7.1. Assessment activities

7.1.1. Continuous assessment

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
4	Theory middle term exam.		Face-to-face	01:00	25%	3 / 10	
4	MQTT and Kafka lab MId Term Exam		Face-to-face	00:30	15%	4 / 10	CE.06 CG01 CE.08 CE.05
8	Theory end of term exam		Face-to-face	01:00	25%	3 / 10	CB10 CE.06 CG01 CG02 CE.08 CT.01 CE.05
8	MQTT, Kafka and Zookeeper Exam		Face-to-face	00:30	15%	4 / 10	CE.08 CE.05 CE.06 CG01
8	Kafka-MQTT lab work presentation.		Face-to-face	02:30	20%	4 / 10	CG02 CB08 CE.08 CE.05
9	Kafka-MQTT lab work presentation.(II)		Face-to-face	03:00	%	/ 10	CG02 CB08 CE.08 CE.05
10	Kafka-MQTT lab work presentation (III)		Face-to-face	03:00	%	/ 10	CG02 CB08 CE.08 CE.05

7.1.2. Final examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills

16	Theory final exam.		Face-to-face	01:00	50%	5 / 10	CB10 CE.06 CG01 CG02 CE.08 CT.01 CE.05
16	Kafka-MQTT labs presentation		Face-to-face	02:00	20%	5 / 10	CB10 CE.06 CG01 CG02 CB08 CE.08 CT.01 CE.05
16	MQTT, Kafka, Zookeeper Exam		Face-to-face	00:30	30%	4 / 10	CE.08 CE.05 CE.06 CG01

7.1.3. Referred (re-sit) examination

Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
Theory final exam		Face-to-face	01:00	50%	5 / 10	CB10 CE.06 CG01 CG02 CE.08 CT.01 CE.05
Kafka -MQTT labs presentation		Face-to-face	01:00	50%	5 / 10	CG02 CB10 CE.06 CG01 CB08 CE.08 CT.01 CE.05

7.2. Assessment criteria

Course evaluation on Regular period.

a) On-going evaluation system.

Block I. Theory. 2 individual written exams (50%)

Block II. Laboratory (50%) that consists of:

- 2 individual written exams (30%)

- 1 Group project (20%)

- It is necessary to obtain at least a 5 over 10 in both blocks to pass the course.

- In case the student fails the on-going evaluation but gets 5 or more in one of the blocks he/she will be able to do only the failed block in the extra period exam in July.

Notice: In the course schedule (cronogram), the activity of oral presentation and evaluation of student lab projects lasts three weeks, from week #8 to week #10. Therefore, the weight of the evaluation of this activity only appears in week #8.

b) Final evaluation System.

Students can follow this final evaluation system. In this case the student must request the teachers this option nor later than the second week of the course. One exam per block will be done at the end of the course.

No exams during the course will be considered for the final evaluation. Again in this exam it is necessary to obtain at least a 5 over 10 in both blocks to pass the course.

In case the student fails the final exam evaluation but gets 5 or more in one of the blocks he/she will be able to do only the failed block in the extra period exam in July.

Course evaluation on Extra period (July exam).

- Students will do one exam per failed block. Again in this exam it is necessary to obtain at least a 5 over 10 in both blocks to pass the course.

8. Teaching resources

8.1. Teaching resources for the subject

Name	Type	Notes
Distributed Systems, concepts and design, 4th Edition. G. Coulouris. J. Dollimore, T. Kindberg, G. Blair. Addison Wesley, 2012.	Bibliography	
Introduction to Reliable and Secure Distributed Programming Authors: Cachin, Christian, Guerraoui, Rachid, Rodrigues, Luís. Springer (2011)	Bibliography	
Communication and Agreement Abstractions for Fault Tolerant Asynchronous Distributed Systems. Michel Raynal. Morgan & Claypool Publishers 2010	Bibliography	

Making Sense of Stream Processing. By Martin Kleppmann Publisher: O'Reilly Released: May 2016	Bibliography	
D. Ongaro, J. Ousterhout. In Search of an Understandable Consensus Algorithm. USENIX Annual Technical Conference (ATC), Philadelphia, PA, 2014	Bibliography	
Database Replication: A Tutorial. Bettina Kemme, Ricardo Jiménez-Peris, Marta Patiño-Martínez, and Gustavo Alonso B. Replication, LNCS 5959, pp. 219?252, 2010.	Bibliography	
Spanner: Google?s Globally-Distributed Database. James C. Corbett et al. Proceedings of OSDI 2012, pp. 1-14.	Bibliography	
Apache Kafka Documentation	Web resource	https://kafka.apache.org/
Moodle de la asignatura	Web resource	moodle upm
Laboratorio de ordenadores con sistema operativo tipo Unix.	Equipment	
MQTT	Web resource	http://mqtt.org/ MQTT is a machine-to-machine (M2M)/"Internet of Things" connectivity protocol. It was designed as an extremely lightweight publish/subscribe messaging transport. It
Zookeeper	Web resource	https://zookeeper.apache.org/