DTC-SAP-247 Internet of Things (IoT)

SEMESTER: Summer

CREDITS: 3 ECTS (Lecture: 16 hours; Lab: 14 hours)

LANGUAGE: English

DEGREES: SAPIENS program

Course overview

This course is an introduction to the Internet of Things concepts and paradigm including from the current state of the art to future expansion and development lines. Hence, it is based on an end-to-end approach considering the most used architectures, components as well as business and industrial practical applications.

Considering that the Internet of Things has been expanding in recent years to other different areas, this course introduces other issues closely related to the IoT, such as big data, advanced analytics, artificial intelligence or blockchain.

This course uses both a theoretical and practical approach based on master classes as well as labs. Thereby, at the end of the course, the student will be able to understand the application of IoT-based systems, define and design high level approaches and architectures as well as design and develop such systems.

Prerequisites

Having passed a first year of Bachelor degree in Engineering

Course contents

Theory:

1. **Introduction**. In this module, approaches and basic concepts regarding the IoT are shown.
2. **Stakeholders**. It explains the landscape, approaches and roles to be played by the different stakeholders and vendors.
3. **Continuous Engineering**. It shown the different uses and concepts regarding continuous engineering, emphasizing the CLM (Collaborative Lifecycle Management) project approach used to support the IoT cases and implementations.
4. **Internet of Things Solutions: Concepts, architecture and components**. This module deals with the most common IoT architectures, also including all their different components.

5. **Physical devices, nodes and endpoints**. This module deals with the main concepts regarding the hardware layer from the device and node point of view. Also, it deepens into the case of open hardware used for this purpose, being focused on Arduino and Raspberry PI as examples of IoT device for prototyping.
6. **Communication layers**. Explanation of this architecture layer regarding the communication requisites to support IoT implementations.
7. **Standards overview**. This module shows the different standards and scope regarding the IoT as well as deepens specifically in the case of the MQTT standard.
8. **Backend**. Introduction to backend systems and applications which support IoT projects.
9. **Industry use cases**. Introduction to different industry use cases (e.g. smart cities, industry 4.0) to show IoT practical applications and real cases.
10. **Value-added technology**. Introduction to collateral technologies (e.g. advanced big data, analytics, artificial intelligence, blockchain), added to the IoT which complement typical and basic use cases only based on IoT.

Laboratory:

Labs are used to see in a practical way all the concepts seen in the theoretical classes, being split into the following main modules:

P1. Open hardware basics.
P2. Open hardware management under an IoT structure.
P3. Internet of things end-to-end practical applications.

Technology courses:

In order to acquire the knowledge of those support technologies and complement the IoT basics, different practical courses will be used to introduce those technologies (e.g. big data, blockchain). All those courses deal with innovative technological concepts as well as support real industrial use cases.

Textbooks

- McEwen, A., Cssimally H. (2014). *Designing the Internet of Things*. Wiley.
- Bahga, A., & Madisetti, V. (2014). *Internet of Things: A Hands-On Approach.* Arsdepp Bahga & Vijay Madisetti.
- Slama, D., Puhlmann, F., Morrish, J., Bhatnagar R. M. (2015). *Enterprise IoT: Strategies and Best Practices for Connected Products and Services*. O'Reilly.

- Balani, N. (2015). *Enterprise IoT: A Definitive Handbook.* CreateSpace Independent Publishing Platform.
- Greengard, S. (2015). *The Internet of Things (The MIT Press Essential Knowledge*
- *series)*. MIT Press.
- Hersent, O., Boswarthick, D., Elloumi, O. (2012). *The Internet of Things: Key Applications and Protocols*. Wiley.
- Uckelmann, D., Harrison, M., Michahelles, F. (2011). *Architecting the Internet of Things*. Wiley.
- Chaouchi, H. (2010). *The Internet of Things: Connecting Objects*. Wiley.
- Lampkin, V., Leong, W. T., Olivera, L., Rawat, S., Subrahmanyam, N., Xiang, R. (2012). *Building Smarter Planet Solutions with MQTT and IBM WebSphere MQ Telemetry*. IBM Redbooks.
- Margolis, M. (2011). *Arduino Cookbook*. O'Reilly.

Grading

The following conditions must be accomplished to pass the course:

- A minimum overall grade of at least 5 over 10. The overall grade is obtained as follows:
    - *Participation [10%]*
        - This concept shows how active, collaborative and successful is the student's class participation for each student. Concepts such as attitude, active participation or understanding of the concepts taught will be part of this block.
    - *Labs [25%]*
        - Labs will be carried out during the classes (labs) with specific scripts which allow to learn and apply all the concepts taught in class.
        - Also, this includes several guided business cases carried out in class.
    - *Works and deliveries [35%]*
        - This group consists on several works to be delivered, based on the reviewed technologies, labs performed as well as practical and real use cases.
    - *Technical courses [30%]*
        - Short courses (each one with a grade exam) to show the basics of different additional technologies which complement the IoT.

In case the student does not pass the course by the indicated way, he/she will have the option to submit a final work that will include the great majority of the content of the subject which will be marked and assigned as an extraordinary retake.