UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Internet of Things Lab

2526-2-F1801Q152

Aims

Knowledge and understanding
The student will acquire fundamental knowledge of the concepts, architectures, and protocols in the Internet of Things (IoT) domain, with particular focus on communication technologies, messaging protocols (such as MQTT and HTTP), sensors/actuators, and architectural models of the Web of Things.

Applying knowledge and understanding
The student will be able to design and implement working prototypes of IoT systems by integrating sensors, actuators, and embedded devices with middleware platforms in real-world application scenarios (e.g., home automation, smart manufacturing, metering), including the use of hardware boards such as Arduino and ESP.

Making judgements
The student will develop the ability to critically assess the technologies and protocols adopted in an IoT solution, analyzing their effectiveness, scalability, interoperability, and suitability to the specific application context.

Communication skills
The student will be able to clearly and effectively present the developed IoT solutions, documenting their functionality, design choices, and results through oral presentations, technical reports, and online repositories.

Learning skills
The student will develop the ability to independently explore emerging IoT technologies and keep up to date with evolving standards and tools, supported by the hands-on experience gained during the course.

Contents

The course consists of a theoretical part and a part of exercises. The theoretical part aims at exploring the main IoT

communication architectures and protocols and exploring the main technologies that define the so-called Web of Things ecosystem (WoT). The part of the exercises aims to deepen the IoT and IoWT ecosystem from a practical point of view: smart sensor networks, embedded systems, network protocols.

Detailed program

- IoT Introduction: Overview of IoT concepts, applications, and potential impacts on society and industry.
- Internet Principles: Fundamental internet technologies that underpin IoT including TCP/IP protocols and DNS.
- Communication Technologies: Exploration of various communication technologies used in IoT such as WiFi, ZigBee, and cellular networks.
- Messaging Protocols: Detailed study of IoT messaging protocols including MQTT, CoAP, and HTTP.
- The Web of Things: Integration of IoT devices with the web; understanding how devices can use web protocols to interact.
- IoT Boards for Prototyping: Hands-on sessions with popular IoT boards like Arduino and ESP8266 for developing prototypes.
- Sensors and Actuators: Practical work with various sensors and actuators to collect data and trigger actions.
- Data Management and Analytics: Techniques for managing and analyzing data from IoT devices, including the use of databases and data analytics tools.

Prerequisites

Foundations of computer networks, internet stack, programming languages C/C++, web programming

Teaching form

The teaching includes a part of theoretical lectures and a part of exercises in the lab and/or classroom and will require the use of one's own PC. The exercise and laboratory part will involve hands-on, hands-on type of lectures, during which the student can experiment with his or her own hands some application scenarios specially configured by the lecturer. The two parts will be based both on delivery mode and interactive mode.

This part of the activity is functional to understand basic notions of Internet of Things and Embedded Systems.

It is expected to share all the necessary teaching materials for the study of the teaching topics and the preparation of the exam through elearning tools.

The course will be delivered in Italian, except for the English terms which will be in English and attendance is mandatory.

Textbook and teaching resource

- *Internet of Things: A Hands-on Approach*, by Arshdeep Bahga and Vijay Madisetti, 2015, Publisher:

Universities Press, ISBN: 978-8173719547 ()
- *Building the Web of Things - With examples in Node.js and Raspberry Pi,* by Dominique D. Guinard and Vlad M. Trifa, 2016, Publisher: Manning, ISBN: 9781617292682 ()
- GitHub of the course (https://github.com/)
- Teachers' slides (http://elearning.unimib.it/).

Semester

Second Semester

Assessment method

The exam consists in the design and realization of project assigned by the teachers. The project will be discussed as oral presentation and teachers can ask questions about theoretical parts of the course program.

Office hours

Flavio De Paoli, Wednesday from 10 to 12

Paolo Napoletano, Monday from 14 to 16

Davide Marelli, Monday from 14 to 16

Sustainable Development Goals

INDUSTRY, INNOVATION AND INFRASTRUCTURE