Internet of Things

Code: 104421
ECTS Credits: 6

2025/2026

Degree	Type	Year
Computational Mathematics and Data Analytics	OP	4

Contact

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Teachers

Marc Codina Barbera

Teaching groups languages

You can view this information at the end of this document.

Prerequisites

The course is self-contained and therefore there are no specific pre-requisites.

(this subject is given together with the Internet of Things subject of the Bachelor's Degree in Computer Engineering)

Objectives and Contextualisation

The ICT world is being structured on various concepts. One of them is the Internet of Things, which is based on expanding the computing domain to connected objects (devices) of small size and energy consumption that interact with the real world via sensors and actuators in different areas: personal / wearables, health, home automation, environment, energy and water distribution, automotive, etc. These connect through various protocols to a fixed or mobile intermediate platform (edge) that manages, filters and processes part of the data locally. In turn, it is connected to the cloud where the data is stored, processed and displayed. The implementation of these systems requires integrating the various concepts, acquired in previous courses, in this new device-edge-cloud paradigm associated with different types of computing platforms (single-, multi-, many-core processors) with different requirements of functionality, power, latency, bandwidth and cost; different programming and communication models; and different cloud options for back-end and front-end, so a higher level of abstraction is required at the interface level (APIs and Middleware) and virtualization (computing and communications).

Goals:
Establish the fundamentals of the internet of things (IOT): device, periphery (edge) and cloud (cloud).
Learn to classify embedded processors, sensors, actuators, and systems, and select communications

protocols and cloud options.
Evaluate the functional requirements and the performance in terms of cost, real time comnditio and energy efficiency.
Evaluate the cost of data structures based on sensors, computing, communication, storage and visualization at each level.
Select embedded and mobile platforms for the edge and cloud solutions for back-end and front-end.
Manage the virtualization of computing and communications.
Design a theoretical and practical example case of the entire IoT chain for a specific application.

Learning Outcomes

1. CM46 (Competence) Efficiently integrate heterogeneous data from various interconnected devices and systems.
2. KM36 (Knowledge) Select the most appropriate components, technologies, platforms and datasets to develop environmentally friendly solutions to Internet of Things problems.

Content

Lectures contents are strongly linked to the development to the project and labs such that they provide the fundamentals required for the design decisions and implementation code.

Lectures

1. Global View of the Internet of Things & Virtualization

- IoT Systems: Functionality & Architecture. Device, edge, cloud, UI
- IoT Value Chain
- AI & IoT

2. IoT devices

- Examples and Use Cases
- HW Components: processors, sensors, actuators, batteries
- Selection criteria: cost, real-time (latency, throughput), and energy efficiency

3. Introduction to Wired & Wireless Device-to-Edge Communications

- Communications standardization
- Wired Protocols for device, edge & cloud
- Device to Edge Wireless Networks: WBAN, WPAN, WLAN, LPWAN
- Communications data frames

4. Embedded and mobile Edge platforms

- Embedded platforms: open & industrial
- Mobile platforms
- Platform examples

5. Virtualization of cloud & comms

- Cloud back-end & front-end
- Virtual platforms for cloud systems: IaaS, PaaS, SaaS
- Virtual platforms for embedded systems
- Communications Virtualization

Guided project: Design of an (original) IoT system
P1. Original ideas for the design of an IoT system and preliminary market study
P2. Functional and performance specifications of the project
P3. Block and communications architecture of the IoT system and implementation alternatives
P4. System implementation. Selection of components and platforms
P5. Estimation of planning, costs and business model
P6. Document, presentation and defense of the project
Labs: Prototyping the (original) IoT system
L1. Introduction to programming on a SoC MCU-BLE
L2. Sensor +MCU + Bluetooth dataflow emulation.
L3. Android APP Programming I: Bluetooth Low energy Data Acquisition.
L4. Android Programming II: Computation and JSON application to a server.
L5. Cloud application: back-end & front-end
L6. Final presentation

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Lessons and Seminars	30	1.2	
Study & Homework	90	3.6	
Type: Supervised			
Laboratories & Design Project	28	1.12	

The learning methodology will combine: master classes, activities in tutored sessions, project based-learning and use cases, debates and other collaborative activities; and laboratory sessions.

Attendance will be mandatory for the Design of the IoT project and Laboratory sessions, which will be organized on the same multidisciplinary groups of 2 or 3 people from the different degrees that take the subject.

The laboratory sessions will use a supervised format (not guided) to offer greater autonomy to students and a more personalized support.

Any lack of attendance must be communicated in advance to the teacher in charge, attaching the corresponding reasonable justified reasons.

This course will use UAB's virtual campus at https://cv.uab.cat.

The use of AI is allowed in this course and it is recommended to validate its result before submitting any report since it can make serious errors that may imply negative evaluations.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Assessment

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Evaluation of activities developed in tutored sessions (laboratories)	40%	0	0	CM46, KM36
Individual activities (i.e. exercices)	20%	0	0	CM46, KM36
Report and defence of the design project	40%	2	0.08	CM46, KM36

This course does not provide for the single assessment system (No exam).

The evaluation of the course will follow the rules of the continuous evaluation and the final grade for the course, is calculated in the following way:
A - 20% from the mark obtained by the student through the evaluation of activities (i.e. exercises). When an evaluation activity is scheduled, the evaluation indicators will be reported and its weight in this qualification.
B - 40% from the mark obtained through the evaluation of the IoT design project.
C - 40% from the mark obtained by the student of the laboratory work and reports. It is necessary to exceed 5 (out of 10) in this item to pass the subject.

To obtain MH it will be necessary that the students have an overall qualification higher than 9 with the limitations of the UAB (1MH/20students). As a reference criterion, they will be assigned in descending order.

All activities will require delivering report through the virtual campus.
- Type A individual activities will be proposed along the course for groups of lectures.
- Type B group activities, will require delivering partial reports of a global IoT project document every 2 weeks.
- Type C group activities, will require delivering two partial reports (one by mid semester and a 2nd one at the end).

A final weighted average mark not lower than 50% is sufficient to pass the course, provided that a score over one third of the range is attained in every one of the Marks for first 2 items (A and B). If not reached, the mark will be 4.0.

Plagiarism will not be tolerated. All students involved in a plagiarism activity will be failed automatically. A final mark no higher than 30% will be assigned.

Open source code or available libraries can be used but they must be referred in the corresponding reports.

An student not having achieved a sufficient final weighted average mark, may opt to apply for remedial activities (individual work or additional synthesis examination) the subjectunder the following conditions:
- the student must have participated in the laboratory activities and design project, and
- the student must have a final weighted average higher than 30%, and
- the student must not have failed any activity due to plagiarism.

The student will receive a grade of "Not Evaluable" if:
- the student has not been able to be evaluated in the laboratory activities due to notattendance or not deliver the corresponding reports without justified cause.
- the student has not carriedout a minimum of 50% of the activities proposed.
- the student has not done the design project.

For each assessment activity, the student or the group will be given the corresponding comments. Students can make complaints about the grade of the activity, which will be evaluated by the teaching staff responsible for the subject.

Repeating students will be able to "save" their grade in laboratory activity.

Bibliography

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Software

Students will use the SoC-BLE from Nordic Semiconductors as a device; the Android smartphone as Edge; and an server cloud option (selected by the students) with front-end i back-end.

Improvements are expected in this whole chain (that will keep the same structure).

Groups and Languages

Please note that this information is provisional until 30 November 2025. You can check it through this link. To consult the language you will need to enter the CODE of the subject.

Name	Group	Language	Semester	Turn
(PLAB) Practical laboratories	411	English	first semester	morning-mixed
(PLAB) Practical laboratories	412	English	first semester	morning-mixed

(TE) Theory	410	English	first semester	morning-mixed