INTERNET
OF THINGS
Anything, Anywhere, Anytime!

Hello dear participant,

Welcome to the oficial Autumn Course 2017 Sylabus. In this document you can find everything you need to know about the academic activities you will be experiencing here, including classes, round tables and workshops. For every activity you can find information about the type of activity, the number of working hours, the lecturer, a sumary of it's content, all the bibliography indicated by the professors, and what's expected you learn from it. In other words, everything you need to prepare yourself to learn a lot with us.

Good luck! See you in september!

Your academic responsible of Autumn Course 2017,

Maria Brandão

Name of activity	Developing a small application
Type of Activity	Lecture/Tutorial
Working hours	1 hour and 30 minutes
Responsable	Francisco Monsanto
Summary of content	Presentation about the development of an IoT-based project and its challenges. Tutorial on developing a small application (using an IoT device)
Bibliography	Not applied
Expected effect	It is expected that, with this presentation, the potentialities of IoT related technologies will be explored.

Name of activity	Sensors
Type of Activity	Lecture
Working hours	1 hour and 30 minutes
Responsable	Diogo Gomes
Summary of content	¬ Sensor Nodes - Architecture ¬ Sensors and Actuators ¬ Data acquisition (i2c, 1-wire) ¬ LoPy architecture and development environment (Arduino IDE) ¬ Building a weather station (temperature + humidity)
Bibliography	¬ Bob Zulinski, "Introduction to Electronics", http://www.ece.mtu.edu/faculty/ljbohman/online text/elint200.pdf ¬ https://www.thethingsnetwork.org/labs/story/program-your-lopy-from-the-arduino-ide-using-lmic ¬ Pycom and Lopy documentation, https://docs.pycom.io/
Expected effect	The students are expected to learn about the development of sensor nodes using low-cost microcontrollers and off-the-shelf discrete sensors.They will obtain knowledge on the basic building blocks of a sensor network, sensing devices and actuators.This class will cover basic digital electronic concepts and introduce a myriad of protocols commonly used to connect discrete sensors to microcontrollers such as i2c, serial, 1-wire.

Name of activity	Sensor development
Type of Activity	Laboratory
Working hours	1 hour and 30 minutes
Responsable	Diogo Gomes João Paulo Barraca
Summary of content	The laboratory class will focus in creating a simple program that can read temperature and humidity and display information through the serial port attach to a computer.
Bibliography	¬ Bob Zulinski, "Introduction to Electronics", http://www.ece.mtu.edu/faculty/ljbohman/online text/elint200.pdf ¬ https://www.thethingsnetwork.org/labs/story/pr ogram-your-lopy-from-the-arduino-ide-using-lmic ¬ Pycom and Lopy documentation, https://docs.pycom.io/
Expected effect	Students are expected to learn and go through all the steps, from a void breadboard to fully assembled and programmed LoPy with humidity and temperature sensor.

Name of activity	Networking
Type of Activity	Lecture
Working hours	1 hour and 30 minutes
Responsable	Diogo Corujo
Summary of content	¬ Generic wireless networking perspective and procedures ¬ IoT-based networking technologies ¬ Low-powered Wide Area Network solution: LoRa ¬ Sensor networks in the future
Bibliography	¬ LoRa Alliance, "LoRaWAN 101 - A Technical Introduction", Slideset, online: https://docs.wixstatic.com/ugd/eccc1a_20fe7603 34f84a9788c5b11820281bd0.pdf ¬ "The Internet of Things: An Overview - Understanding the Issues and Challenges of a More Connected World", White Paper, Internet Society, October 2015, online: https://www.internetsociety.org/doc/iot-overview ¬ "Towards a definition of the Internet of Things (IoT)", IEEE, IEEE Internet Initiative, May 2015, online: https://iotbusinessnews.com/download/white-papers/IEEE-IoT-Towards-Definition-Internet-Of-Things.pdf ¬ "M2M growth necessitates a new approach to network planning and optimisation", White Paper, Machina Research, May 2015, online: https://iotbusinessnews.com/download/white-papers/MACHINA-RESEARCH-M2M-growth-necessitates-a-new-approach-to-network-planning-and-optimisation.pdf ¬ Mats ANdersson, "Short range low power wireless devices and Internet of Things (IoT)", White Paper, u-blox, February 2015, online: https://iotbusinessnews.com/download/white-papers/UBLOX-Short-Range-Low-Power-Internet-Of-Things.pdf

Expected effect	The students will explore and analyse the procedures and control mechanisms of the most common communication technologies associated to the Internet of Things, they will be expected to compare them and expose appropriate usage scenarios.

Name of activity	Sensor Networking
Type of Activity	Laboratory
Working hours	2 hours
Responsable	Carlos Guimarães Rui Ferreira José Quevedo
Summary of content	The practical laboratories will build upon the remaining lectures, and will explore the use of a commercial platform providing wide scale connectivity through LoraWAN.
Bibliography	¬ LoRa Alliance, "LoRaWAN 101 - A Technical Introduction", Slideset, online: https://docs.wixstatic.com/ugd/eccc1a_20fe7603 34f84a9788c5b11820281bd0.pdf ¬ "The Internet of Things: An Overview - Understanding the Issues and Challenges of a More Connected World", White Paper, Internet Society, October 2015, online: https://www.internetsociety.org/doc/iot-overview ¬ "Towards a definition of the Internet of Things (IoT)", IEEE, IEEE Internet Initiative, May 2015, online: https://iotbusinessnews.com/download/white-papers/IEEE-IoT-Towards-Definition-Internet-Of-Things.pdf ¬ "M2M growth necessitates a new approach to network planning and optimisation", White Paper, Machina Research, May 2015, online: https://iotbusinessnews.com/download/white-papers/MACHINA-RESEARCH-M2M-growth-necessitates-a-new-approach-to-network-planning-and-optimisation.pdf ¬ Mats ANdersson, "Short range low power wireless devices and Internet of Things (IoT)", White Paper, u-blox, February 2015, online: https://iotbusinessnews.com/download/white-papers/UBLOX-Short-Range-Low-Power-Internet-Of-Things.pdf

Expected effect	Students are expected to learn and go through all the steps, from a void breadboard to fully assembled and programmed LoPy with humidity and temperature sensor.

Name of activity	Platforms
Type of Activity	Lecture
Working hours	1 hour and 30 minutes
Responsable	João Paulo Barraca
Summary of content	¬ IoT architecture, reference models and existing solutions ¬ Pub/sub architectures and service APIs ¬ Management of IoT devices through LWM2M and OneM2M ¬ Challenges and future prospects for direct sensor integration
Bibliography	¬ The things network Labs, https://www.thethingsnetwork.org/labs/ ¬ HomeAssistant, https://home-assistant.io/ ¬ Z. Shelby et al, RFC 725 - The Constrained Application Protocol (CoAP), IETF RFC, 2014 ¬ ISO/IEC 20922:2016 Information technology -- Message Queuing Telemetry Transport (MQTT) v3.1.1. iso.org. International Organization for Standardization. June 15, 2016.
Expected effect	Students are expected to learn introductory concepts about the role, architecture and operation of an IoT platform. IoT platforms are what enables devices to be utilized, in the sense that they behave as the management point, data collection and data routing platform, connecting low power sensors to high level services. There is a set of commercial products, as well as several research solutions available, developed around standardized protocols such as MQTT and CoAP, and standardized by efforts such as OneM2M. The class will consider the most recent solutions available, with focus on the management interfaces, and communication protocols.

Name of activity	IoT Platforms
Type of Activity	Laboratory
Working hours	3 hours
Responsable	Hélder Moreira

Summary of content	¬ IoT Messaging Patterns:
	    - Publish-Subscribe (MQTT)
	    - Request-Reply (CoAP)
	¬ Exchanging Data with the Cloud:
	    - LoRaWAN
	    - Wi-Fi
	¬ Applications:
	    - Rules
	    - IoT Dashboards

Bibliography	¬ The things network Labs, https://www.thethingsnetwork.org/labs/ ¬ HomeAssistant, https://home-assistant.io/ ¬ Z. Shelby et al, RFC 725 - The Constrained Application Protocol (CoAP), IETF RFC, 2014 ¬ ISO/IEC 20922:2016 Information technology -- Message Queuing Telemetry Transport (MQTT) v3.1.1. iso.org. International Organization for Standardization. June 15, 2016.
Expected effect	The practical laboratories will build upon the remaining lectures, and will explore the use of a commercial platform providing wide scale connectivity through LoraWAN. Students will be expected to be able to develop a simple solution that is able to collect data, transmit it through a standardized IoT platform, and processing of such information by a simple service.

Name of activity	Use case Analysis of Cooperative ITS Applications and Services
Type of Activity	Workshop
Working hours	2 hours
Responsable	Joaquim Ferreira
Summary of content	After a brief presentation of the PASMO project, an open platform for the development and experimentation of mobility solutions, some elementar use cases will be presented to be further detailed during the second part of the lecture. Project PASMO is a living lab for intelligent mobility, open to participative experimentation of companies that can effectively collaborate to test equipment, protocols, processes, applications, standards and services. In order to fulfill these objective, PASMO is a platform composed by three subsystems, mirroring the different layers of intelligent transport systems: data collection (roads, public spaces and vehicular resources), data transfer (telecommunications and data infrastructure), and applications. These components, with equipment, interfaces and open data, are being integrated and will be made available in the near future. The pilot installation will be installed in the municipalities of Ílhavo and Aveiro, integrating the access routes to the port of Aveiro and the beaches of Barra and Costa Nova. The pilot facility will support, among other things, multi-modal mobility applications, including soft mobility, logistics, collective and individual road transport, and priority vehicles. It is planned to include support applications for intelligent parking systems, especially in the areas surrounding the beaches and to provide coverage of multi-technology wireless networks that allow interactive communication between personal devices (smart phones, tablets, smart watches, etc.) and equipment from the PASMO infrastructure. It will also be considered a corridor Aveiro/Ílhavo-Beaches to support the new paradigms of soft mobility, providing support for new approaches of bike sharing, both for conventional and electric bicycles.

Bibliography	Not applicable
Expected effect	Through the analysis of this use case the students will have direct contact with the impact, challenges and solutions for both ITS and smart cities. Students will learn how sensors can impact local communities, the technologies used for different sensor types, and will acquire insight regarding the construction of a living lab that empowers local citizens and companies.

Name of activity	Storage and Data Management
Type of Activity	Lecture
Working hours	1 hour and 30 minutes
Responsable	Óscar Narciso Mortágua Pereira
Summary of content	¬ Brief introduction to NoSQL databases ¬ Brief introduction to Hadoop HDFS ¬ IoT and Databases ¬ Introduction to MongoDB
Bibliography	¬ Pramod J. Sadalage, Martin Fowler. NoSQL Destilled: A Brief Guide to the Emerging World of Polyglot Persistence. Adison-Wesley, 2009. ISBN: 978-0321826626 ¬ Tom White. Hadoop – The Definitive Guide. O'Reilly Press, 3rd Edition, 2012. ISBN: 978-1-449-31152-0. ¬ Kristina Chodorow. MongoDB – The Definite Guide. O´Reilly, 2013. ISBN: 978-1449344689
Expected effect	The students are expected to learn about data storage solutions for IoT environments. IoT environments are getting ubiquitous as every deployed electronic device is capable of sending information to a network. Eventually, mobile phones and TelCo operators are some of the most well-known IoT scenarios. IoT scenarios are characterized by creating huge amounts of data with specific structure. Namely data are generated as documents and they can also have an associated time stamp. These features require specialized data storage infra-structures.

Name of activity	Data Storage and Analysis 1
Type of Activity	Laboratory
Working hours	1 hour and 30 minutes
Responsable	Diogo Domingues Regateiro
Summary of content	Exercises with MongoDB
Bibliography	¬ Pramod J. Sadalage, Martin Fowler. NoSQL Destilled: A Brief Guide to the Emerging World of Polyglot Persistence. Adison-Wesley, 2009. ISBN: 978-0321826626 ¬ Tom White. Hadoop – The Definitive Guide. O'Reilly Press, 3rd Edition, 2012. ISBN: 978-1-449-31152-0. ¬ Kristina Chodorow. MongoDB – The Definite Guide. O´Reilly, 2013. ISBN: 978-1449344689
Expected effect	Students are expected to learn how to operate with MongoDB and apply the knowledge given about this topic.

Name of activity	Data Storage and Analysis 2
Type of Activity	Laboratory
Working hours	1 hour and 30 minutes
Responsable	Diogo Domingues Regateiro
Summary of content	Exercises with MongoDB
Bibliography	¬ Pramod J. Sadalage, Martin Fowler. NoSQL Destilled: A Brief Guide to the Emerging World of Polyglot Persistence. Adison-Wesley, 2009. ISBN: 978-0321826626 ¬ Tom White. Hadoop – The Definitive Guide. O'Reilly Press, 3rd Edition, 2012. ISBN: 978-1-449-31152-0. ¬ Kristina Chodorow. MongoDB – The Definite Guide. O´Reilly, 2013. ISBN: 978-1449344689
Expected effect	Students are expected to learn how to operate MongoDB in an IoT scenario.

Name of activity	Data Visualization
Type of Activity	Tutorial
Working hours	2 hours
Responsable	Beatriz Santos Paulo Dias
Summary of content	Visualization is a field within Computing that has as main goal to foster insight of phenomena thought visual and interactive representations of large amounts of data taking advantage of the human perceptual and cognitive capacities. While it uses concepts and methods from other fields as Computer Graphics, Human-Computer Interaction, Image Processing, Statistics and Software Engineering, it has its own body of knowledge and a very active research community. This module will introduce very briefly the main concepts, models and methods needed to create an effective visualization or visualization application. Examples will be presented and discussed.
Bibliography	Not applicable
Expected effect	Students are expected to have a first insight on the complexity of data visualization and information visualization. They will acquire knowledge regarding how to process, analyse and visualize information that is able to convey the effective message.

Name of activity	Smart Vending
Type of Activity	Lecture
Working hours	1 hour and 30 minutes
Responsable	Andreia Abreu
Summary of content	Smart Vending is a 100% web telemetry solution with decentralized management, which aims to simplify the process of managing vending machines. It allows users to enjoy products from vending machines without having to worry about money or spare changes. Based on a pre-paid balance or salary discount, the access to the vending machine is made through RFID card, SMS or wallet that identifies the user, and accesses his/her account. The loading of this account can be done in the company (kiosk, Sale's Point) or by e-banking. This solution allows the integration of existing cards and connects to the company databases. The class will focus on this theme, aproaching what lies behind it and analysing it's advantages, discussing what it can represent in an ever evolving, fast passing society.
Bibliography	Not applicable
Expected effect	Students are expected to understand what smart vending and similar projects could represent in an IoT environment, encouraging them to think about how IoT can improve resource optimization and efficiency.

Name of activity	Evaluation
Type of Activity	Written exam
Working hours	1 hour and 30 minutes
Responsable	João Paulo Barraca
Summary of content	What was taught throughout the course will be tested in the form of a written exam.
Bibliography	Bibliography of all the academic activities
Expected effect	Students are expected to consolidate what they learnt throughout the course