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Smart Systems for Data Acquisition

Course Presentation

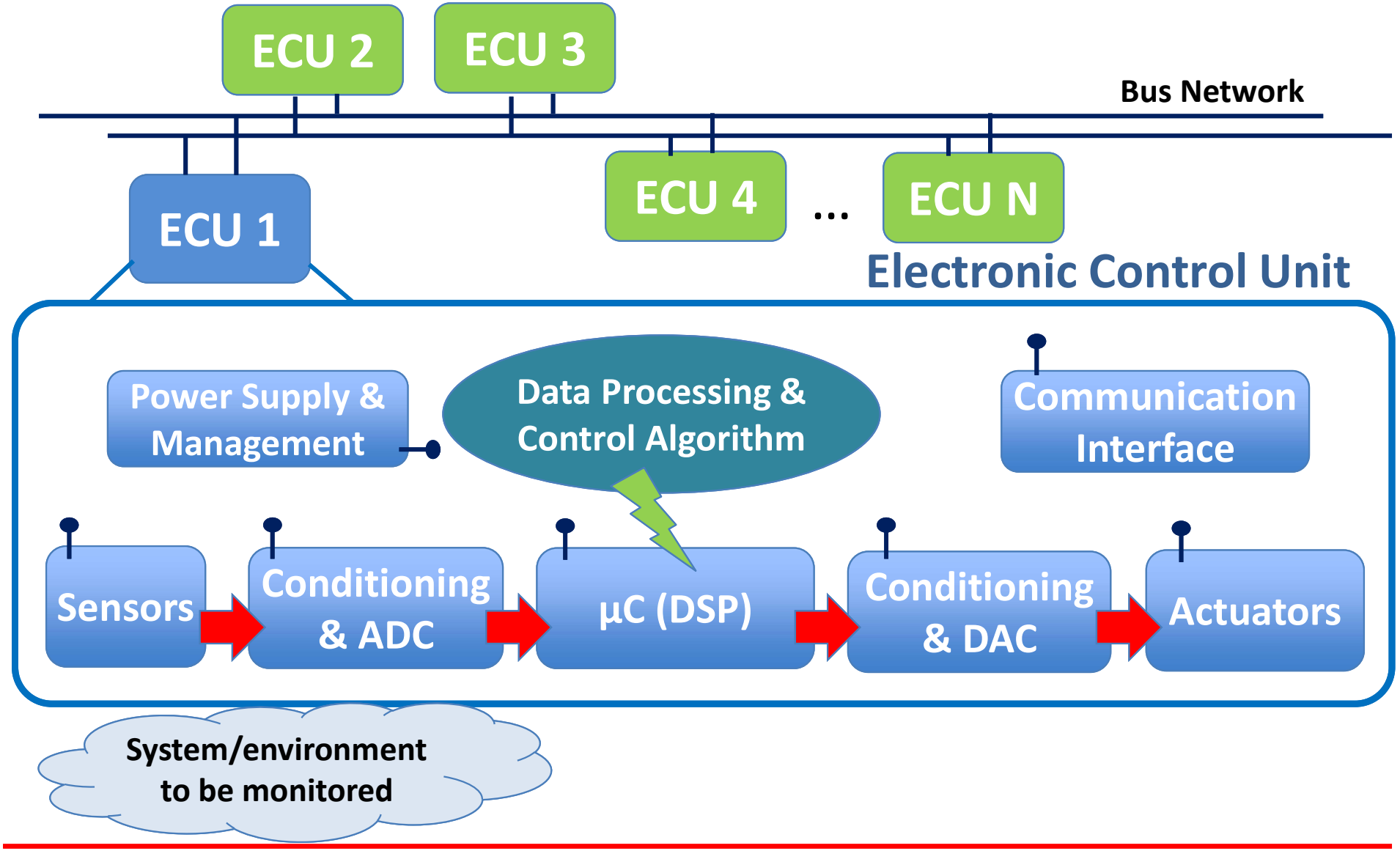
UniMORE - LM Digital Automation Engineering

Alessandro Bertacchini alessandro.bertacchini@unimore.it

Fabrizio Pancaldi fabrizio.pancaldi@unimore.it

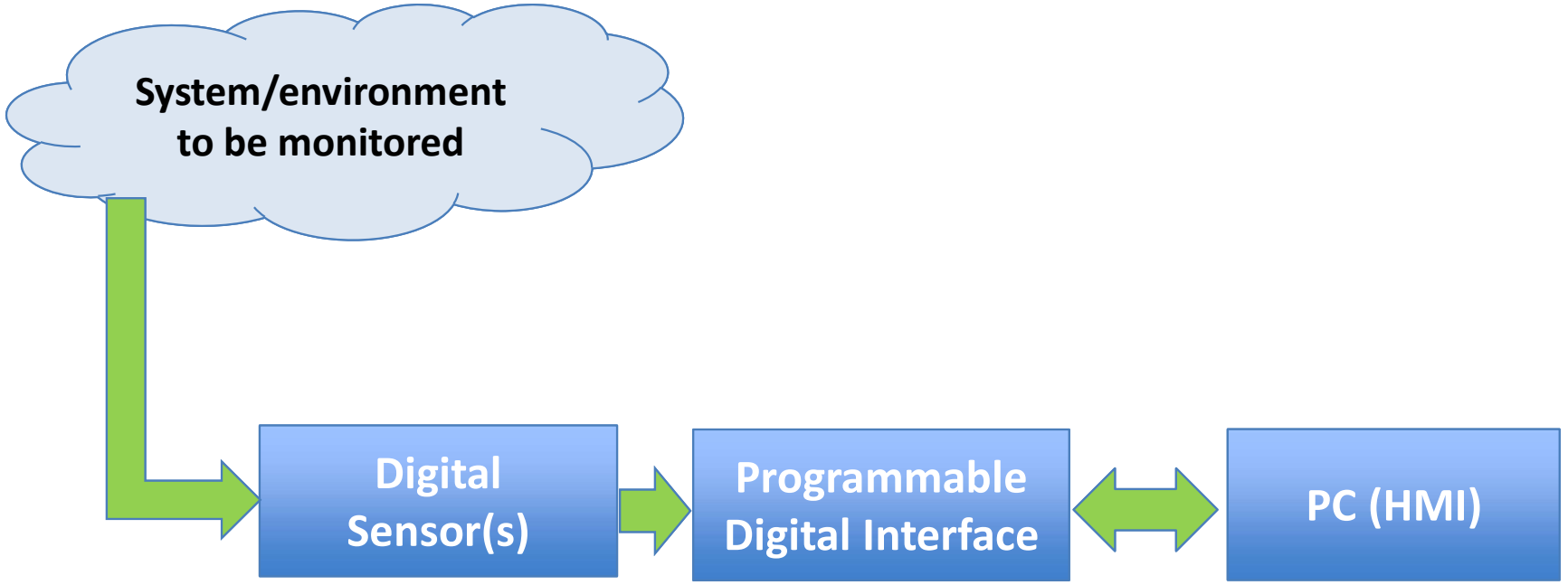
What is a Data Acquisition System?

GENERAL Scenario



What is a Data Acquisition System?

SIMPLIFIED Scenario



Goal & ToC

GOAL: ***developing specific skills in the electronic design of data acquisition systems for real industrial applications***

1. Sensors & Transducers: definitions, operation principles of the main sensors used in industrial applications, calibration
2. Analog-to-Digital converters (ADC): Fundamentals of A/D conversion, main topologies and operation principles
3. On-Board and Board-to-Board communication protocols: UART, SPI, I2C, CAN
4. Sampling theorem and quantization. Discrete Fourier Transform (DFT). Finite impulse response (FIR) digital filters.
5. Laboratory activities aiming at the practical implementation of the exam project

Practical Information - 1

- **Prerequisites**
  - Circuit theory, basic knowledge of programming
  - Attitude to develop multidisciplinary projects and real-world prototypes
- **Course teaching** consists of
  - Face-to-face lectures
  - Laboratory activities
- **Teaching & Supporting Material**
  - slides, handouts, source codes, datasheets, etc… will be available on the Moodle's courses page
  - **Moodle is the only OFFICIAL REPOSITORY of the course**

Practical Information - 2

- Student consultation:
  - **by appointment** (via e-mail)
  - at the end of the lectures

- Each communication must be
  - **Sent ONLY by using your account @studenti.unimore.it**
  - **Addressed to both the teachers** with the only exception of technical requests on a specific topic of the program

The Exam -1

- Two options
  - **OPTION 1** (written midterm exam + project)
  - **OPTION 2** (oral discussion + project)
- The written midterm exam
  - is OPTIONAL
  - can be taken ONLY DURING THE BREAK BETWEEN CLASSES OF THE SEMESTER IN WHICH THE COURSE IS OFFERED.
- **If the student does not participate to the midterm exam, implicitly he/she chooses OPTION 2**

The Exam -2

- **The Project (0-30 points)**
  - **Design and Implementation of a simple data acquisition system**
  - Individual project proposed by the student inspired by a real applications
  - The proposed system must use **at least one sensor with a digital interface** (e.g. UART/USART, SPI, I2C)

Required outputs

  - **Short report** containing system description, adopted design choices, description of the tests carried out to verify the proper operation of the prototype
  - **Source codes**
  - **Live Demo of the prototype on duty**
  - **Project and the live demo can be presented only on official exam date**
  - The project's grade will consider **completeness of the report, project files and live demo** to prove the proper operation of the prototype

Important note about the use of AI

- The use of AI is permitted as a tool for support, reflection, conceptual clarification, self-assessment, brainstorming, and code generation, but…
- **AI should never replace individual cognitive processing and critical thinking**
- **Students are always required to explicitly state in their assignments whether, to what extent, and for what purposes they have used AI tools**

The Exam -3

- **Oral OR Midterm exam (0-32 points)**
  - **4 questions about the course's contents** (i.e. about sensors and transducers, Analog-to-Digital converters, communication protocols, sampling theorem and quantization, discrete Fourier transform, finite impulse response (FIR) digital filters)
  - Each question will receive a score from 0 to 8 points
  - The duration of the written midterm exam (option 1) is 2 h
  - The typical duration of the oral discussion (option 2) is 30 min

Final Grade

- The overall grade is the **weighted average** of the grades obtained in the two PARTS
  - **PART 1- Project 60%**
  - **PART 2- Oral OR Midterm exam 40%**
- The final grade will be rounded to the nearest integer number
- **The exam is passed if overall grade ≥ 18/30**
- Honor if overall grade > 30/30

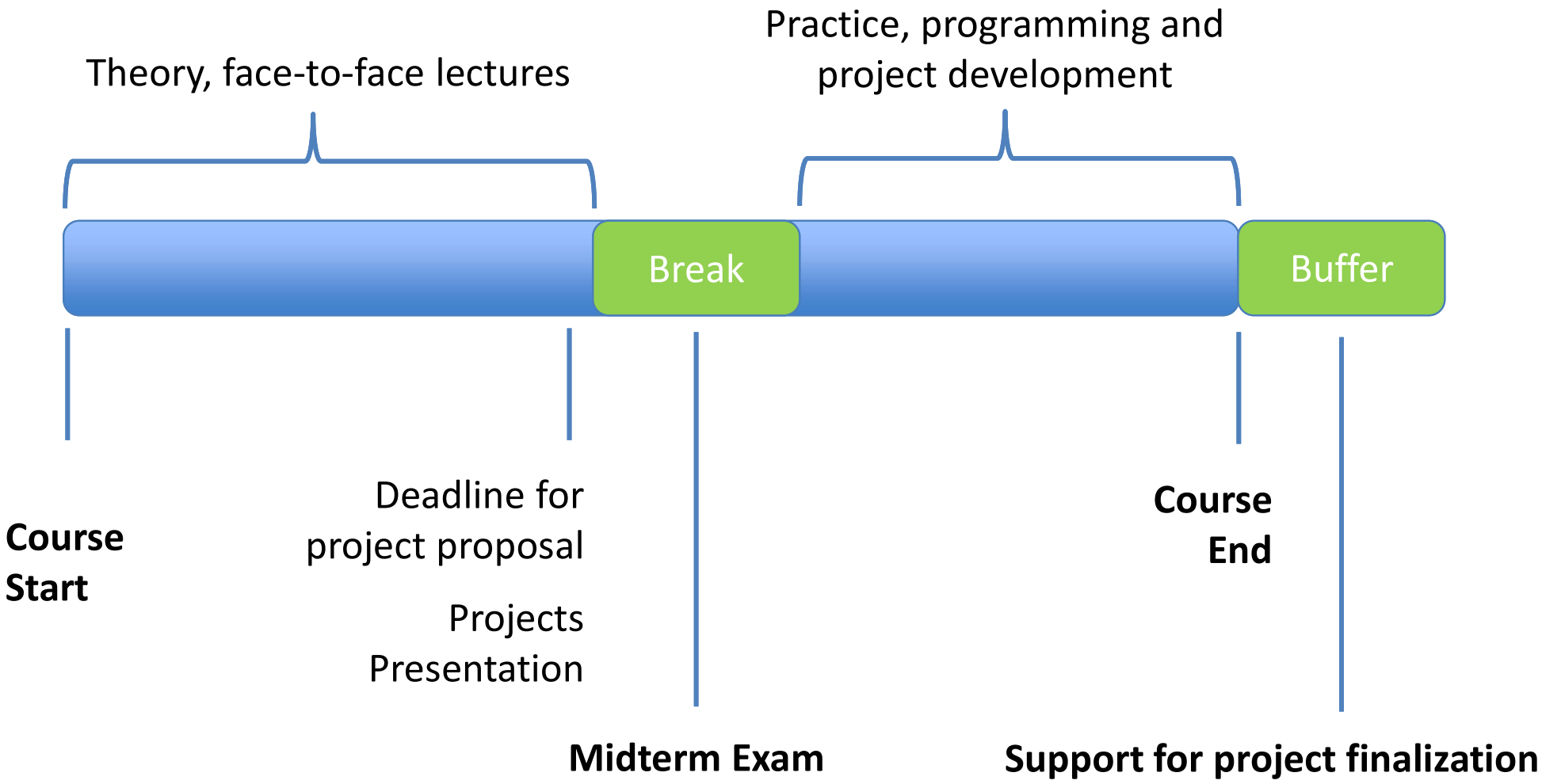
Practical Example

- Project: **28/30**
- Oral exam (or midterm exam): **32/30**
- Final grade: **28*0.6 + 32*0.4 = 29.60 rounded to 30/30**

Exam Sessions

- Technical discussion, live demo and oral examination **will take place the same day**
- **Enrollment on www.esse3.unimore.it is MANDATORY and list closes ONE WEEK BEFORE the scheduled date**
- Report and all the project's files must be sent to both the lecturers **AT LEAST ONE WEEK BEFORE the chosen date**
- Exam sessions in the scheduled dates ONLY (communicated through the normal channels)
  - **WINTER (Jan – Feb): 3 dates** (scheduled as soon as possible)
  - **SUMMER (Jun – Sept): 3 dates** (to be defined)
  - **1st SEMESTER BREAK 2027/28: 1 date** (to be defined)

Timeline


Theory, face-to-face lectures
Practice, programming and project development
Break
Buffer
Course Start
Deadline for project proposal
Projects Presentation
Midterm Exam
Course End
Support for project finalization