AD HOC TEACHING MODULE Announcement

UNIVERSITÀ DEGLI STUDI DI NAPOLI FEDERICO II

PHD IN INFORMATION AND COMMUNICATION TECHNOLOGY FOR HEALTH

PHD IN INFORMATION TECHNOLOGY AND ELECTRICAL ENGINEERING

Module Title: Real-Time Embedded Systems for I4.0 and IIoT

Lecturer: Alessandro Cilardo

Università degli Studi di Napoli Federico II

Dipartimento di Ingegneria Elettrica e delle Tecnologie dell'Informazione

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CV: Alessandro Cilardo is an associate professor at the University of Naples Federico II. He received a five-year degree in Electronics Engineering cum laude, in 2003, and a PhD degree in Computer Science in November 2006. He is the single or main author of around 90 peer-reviewed papers published in leading scientific journals and conferences, including various IEEE and ACM transactions, as well as top conferences like DATE and FPL. His research focuses on computer architecture, digital design methodologies, computer arithmetic as well as security and cryptography-related processing. He is involved in a number of funded projects at both the national level and the European level (7FP and H2020 projects). He is a Senior Member of the Institute of Electrical and Electronics Engineers (IEEE) and the European Network of Excellence on High Performance and Embedded Architecture and Compilation (HiPEAC).

Lecturer: Marcello Cinque

Università degli Studi di Napoli Federico II

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CV: Marcello Cinque is associate professor at the University of Naples Federico II. He graduated cum laude in Computer Engineering in 2003 and received a PhD in Computer and System Engineering in 2006. He is a chair and/or technical program committee member for several conferences on dependable systems, including PIMRC, DEPEND, and DSN. He is co-author of over 90 peer-reviewed papers in computer engineering. His interests include system monitoring and field failure data analysis of distributed and real time systems. He teaches operating systems and real time systems.

ECTS Credits: 5

Lectures are online on the University platform Microsoft Teams.

Team Code:

https://teams.microsoft.com/l/team/19%3a08fdfd71127f42feaf9b6a0bf2065871%40thread.tacv2/conversations?groupId=77895b5b-6bd6-49ca-939a-158fa73e67f9&tenantId=2fcfe26a-bb62-46b0-b1e3-28f9da0c45fd

AD HOC TEACHING MODULE Announcement

Overview

The course provides an overview of real-time embedded systems concepts and related key enabling technologies for current and future industrial systems and according to emerging paradigms, such as Industry 4.0 and the Industrial Internet of Things. The course is organized in two modules: basic and advanced. The basic module is intended for PhD students in science and engineering disciplines who need to improve their knowledge and skills on operating systems and computer architectures used for real-time embedded systems. The advanced module is intended for PhD students in science and engineering disciplines who need to experiment with time sensitive services on the cloud and/or deeply embedded devices, e.g., microcontrollers, as part of their research.

There will be a final assessment.

Dates

Date	Hours	Lecturer(s)
May 13th 2021 – 15:30-17:30	**2**	**Cinque/Cilardo**
May 20th 2021 – 15:30-17:30	**2**	**Cinque**
May 27th 2021 – 15:30-17:30	**2**	**Cilardo**
June 3rd 2021 – 15:30-17:30	**2**	**Cinque**
June 10th 2021 – 15:30-17:30	**2**	**Cilardo**
June 16th 2021 – 15:30-17:30	**2**	**Cinque**
June 24th 2021 – 15:30-17:30	**2**	**Cilardo**
July 1st 2021 – 15:30-17:30	**2**	**Cinque**
July 8th 2021 – 15:30-17:30	**2**	**Cilardo**
July 15th 2021 – 15:30-17:30	**2**	**Cinque/Cilardo**
TBD	**Assessment**	

Basic Module

I Lesson - Introduction: Introduction to the industrial internet of things: challenges and opportunities. Basic notions of real-time systems, predictability, the role of real-time operating systems and real-time hypervisors.

II Lesson – Scheduling of real-time tasks: cyclic executives, rate monotonic, earliest deadline first, scheduling of aperiodic and periodic tasks.

III lesson – Computer architectures for embedded systems: Microcontrollers and Application processors. Introduction to memory management. Peripherals. Interrupts. The ARM processor families.

IV Lesson – Programming real-time systems on high-end devices: Examples and best practices to program real-time tasks in Linux

AD HOC TEACHING MODULE Announcement

V Lesson – Programming real-time systems on embedded devices: Bare-metal programming. Software stack in typical embedded systems. Introduction to FreeRTOS. Examples and best practices for programming real-time tasks in FreeRTOS.

Advanced Module

VI Lesson – Real-time hypervisors: Introduction to virtualization and hypervisors. The example of Real-time XEN.

VII Lesson – MPSoC and advanced architectural features: Multi-Processors Systems on Chips. Basic concepts on parallel architectures. Advanced aspects: memory management, coherence, support for virtualization, etc. Introduction to Intel and ARM virtualization technologies.

VIII lesson – Mixed criticality and virtualization: hierarchical scheduling and hypervisors. Creating real-time mixed-criticality cloud services with Real-time XEN and Linux with Preempt-rt.

IX Lesson – Advanced programming in FreeRTOS: Hands-on experiences with FreeRTOS programming: task, queue, interrupt, resource management, communication, etc.

X Lesson – Case study: Experimental realization of an Industrial Internet of Things scenario: requirements and building blocks.

Notes

Doctoral Students with significant experience on this Module topics can participate as Tutors.
Participants to the module (including those interested to the Tutorship positions) are requested to send an e-mail to prof. Cinque or Cilardo with the following: Student name, name of the PhD course, PhD cycle.

Info: **Prof. MARCELLO CINQUE -** tel. 081 7683874 – marcello.cinque@unina.it
Prof. ALESSANDRO CILARDO - tel. 081 7683852 – alessandro.cilardo@unina.it