linfo2315

2024

Design of Embedded and real-time systems

5.00 credits	30.0 h + 30.0 h	Q2

Teacher(s)	Pelsser Cristel ;
Language :	English > French-friendly
Place of the course	Louvain-la-Neuve
Main themes	• Embedded processors • Standard peripherals • Multi-core architecture and communication between cores • Real-time operating systems: characterization and comparison • In-depth study of a real-time OS • Programming methods of applications on top of a real-time OS • Embedded Linux • Security of embedded systems • Secure programming with Rust for embedded systems
Learning outcomes	**At the end of this learning unit, the student is able to :** Given the learning outcomes of the "Master in Computer Science and Engineering" program, this course contributes to the development, acquisition and evaluation of the following learning outcomes: • INFO1.1-3 • INFO2.2-4 • INFO5.2, INFO5.4-5 • INFO6.3 Given the learning outcomes of the "Master [120] in Computer Science" program, this course contributes to the development, acquisition and evaluation of the following learning outcomes: 1 • SINF1.M1 • SINF2.2-4 • SINF5.2, SINF5.4-5 • SINF6.3 Students completing this course successfully will be able to • implement a multi-core system on FPGA using a Nios or MicroBlaze soft-core including peripherals, memories, caches, ... • make an argued choice between RTOS running on a multi-core system • use an RTOS running on a multi-core systems by taking advantage of his strengths • program effectively an application with real-time constraints by implementing a rigorous methodology.
Evaluation methods	The evaluation is based on 2 evaluations: (1) a project, with its demonstration, during the semester and (2) a written exam in June. • The project and its demonstration count for 7 points. During the demo the students will be asked to implement new functionalities and connect additional sensors to demonstrate the acquired skills. • The written exam counts for 13 points. In case of second session, the result obtained during the session replaces all preceding grades. The use of generative AI is not authorized for this course.
Teaching methods	The teaching methods includes lecture sessions where the main issues are explained. The implementation is done through assignments that students perform individually. Material will be lent to each student in the course so that she/he can develop a personal expertise.
Content	• At the end of this course, the students will be able to: • Design and implement a small application for a Baremetal environment • Understand the concepts of RTOS • Design and implement applications on RTOS • Program in Rust for embedded systems • Design and implement systems that make use of multi-core architecture and communication between cores

	• Each student will have at his disposal an ESP32-LoRa-v3 with a dual-core Xtensa.
Inline resources	https://moodle.uclouvain.be/course/view.php?id=558
Bibliography	• Real-time Operating Systems Book 1 - The Theory Jim Cooling - Lindentree Associates 2017 - ISBN: 9781 5496 0894 0
Other infos	Background: Preliminary knowledge of computer architecture and programming.
Faculty or entity in charge	INFO

Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Learning outcomes
Master [120] in Electrical Engineering	ELEC2M	5		🔍
Master [120] in Computer Science and Engineering	INFO2M	5		🔍
Master [120] in Computer Science	SINF2M	5		🔍
Master [120] in Electro-mechanical Engineering	ELME2M	5		🔍