

Sistemas Embebidos e de Tempo-Real

Course Presentation

Prof. António Casimiro

Course objectives

- Study of **advanced topics** in the area of **distributed real-time and embedded systems**
 - System architect perspective: concern with paradigms, models and frameworks to build real-time systems
 - System developer perspective: knowledge of the technologies and how they can be used to build current and future distributed real-time and embedded systems
- **Consolidation** of fundamental knowledge in the area of embedded systems technologies, addressing:
 - Embedded computing platforms
 - Real-Time operating systems
 - Real-Time networking

Course topics

- Real-Time Systems Foundations
 - Definition of Real-Time Computing
 - Real-Time Networks
 - Distributed Real-Time Architectures
- Paradigms for Real-Time
 - Temporal specifications
 - Timing failure detection
 - Entities and representatives
 - Time-value duality
 - Real-Time communication and flow control
 - Scheduling
 - Clock synchronization
 - Input/Output

Course topics

- Models for distributed real-time computing
 - A generic real-time system model
 - The event-triggered and time-triggered approaches
 - Real-time control
 - Quality-of-Service models
- Distributed real-time systems and technologies
 - Cyber-Physical Systems (CPS)
 - Embedded computing platforms
 - Embedded operating systems technologies
 - Real-Time networking technologies

Lecture classes

- Objectives:
 - Exposing the course matters
 - Guide to further study in the textbook, complementary textbooks, papers, manuals and annotations
- Organization:
 - 13 weekly theoretical sessions, 2 hours each

TPs and laboratory

- Objectives:
 - Exercise course subjects
 - Address specific technologies and platforms
 - Recitations about project work
 - Project support
 - Quizzes
- Organization:
 - 13 weekly TP sessions, 1.5 hours each
 - On classroom or laboratory

Grading

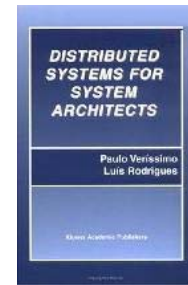
- **2 Assignments (10% - 5% each)**
 - Paper reading and 10 minute oral presentation
- **3 Mini-projects (30% - 10% each)**
 - Using tools, programming, preparing demonstrations
 - Lowest grade on this component is 8 (out of 20)
- **3 Quizzes (30% - 10% each)**
 - General questions and short problems
 - One hour duration
- **Final exam (30%)**
 - Lowest grade on this component is 8 (out of 20)

Grading

- **Presentation assignment:**
 - Individual
 - Paper reading and preparation of a 10 min presentation
- **Projects:**
 - Groups of 3 students
 - Using tools, writing a report, programming, preparing a demo
 - Project 1: Performing schedulability analysis
 - Project 2: Using and programming sensor nodes that communicate with ZigBee
 - Project 3: Programming in Xenomai RTOS (C language)

Bibliography

- Textbooks:
 - P. Veríssimo and L. Rodrigues, *Distributed Systems for System Architects*, Kluwer Academic Publishers, 2001, 650pp., Part III – Real-Time.
 - Hermann Kopetz, *Real-Time Systems: Design Principles for Distributed Embedded Applications*, Kluwer International Series in Engineering and Computer Science, 395, ISBN: 0792398947, Kluwer Academic Publishers, 1997.
- Lectures documentation:
 - Slides and annotations



Complementary bibliography

- Alan Burns and Andy Wellings, *Real-Time Systems and Programming Languages*, Pearson Education / Addison Wesley, ISBN: 0201729881, 2001.
- Waine Wolf, *Computers as Components: Principles of Embedded Computer System Design*, Elsevier Science & Technology Books, 544pp., ISBN-13 9780123743978, 2008.
- Waine Wolf, *High-Performance Embedded Computing: Architectures, Applications, and Methodologies*, 1st edition, Elsevier Morgan Kaufmann Publishers, 544 pp., ISBN-13 978-0123694850, 2006.
- N.P. Mahalik, *Fieldbus Technology: Industrial Network Standards for Real-Time Distributed Control*, 590pp, ISBN: 3540401830, Springer-Verlag, 2003.
- Edward A. Lee and Sanjit A. Seshia, *Introduction to Embedded Systems, A Cyber-Physical Systems Approach*, Second Edition, <http://LeeSeshia.org>, ISBN 978-1-312-42740-2, 2015.

Communication



- Course Web page:
 - <https://moodle.ciencias.ulisboa.pt> - Sistemas Embebidos e de Tempo-Real
 - Registration of groups
 - Rules, grading, plan, slides, docs
- Forums:
 - **News forum**: news, announcements
 - **General forum**: general questions
- Course e-mail:
 - docentes-setr@listas.di.ciencias.ulisboa.pt: individual questions

Course instructor



- Prof. António Casimiro
 - e-mail: casim@di.fc.ul.pt
 - Office: Room 6.3.45
 - Student contact hours: Thursdays/14:30-16:00

Also with a little help from...



HAGAR, O TERRÍVEL... and other nice guys

