Real Time Systems

Programme course

6 credits

Realtidssystem

TDDD07

Valid from: 2021 Spring semester

Determined by
Board of Studies for Computer Science
and Media Technology

Date determined
2020-09-29

Main field of study
Computer Science and Engineering, Computer Science

Course level
Second cycle

Advancement level
A1X

Course offered for
- Master's Programme in Computer Science
- Master's Programme in Electronics Engineering
- Master of Science in Computer Science and Engineering
- Master of Science in Industrial Engineering and Management - International
- Master of Science in Industrial Engineering and Management
- Master of Science in Information Technology
- Master of Science in Computer Science and Software Engineering
- Computer Science and Engineering, M Sc in Engineering
- Information Technology, M Sc in Engineering
- Computer Science and Software Engineering, M Sc in Engineering

Specific information
Overlapping course contents: TDDA47, TDDB47, TDDC47, TTIT62.

Prerequisites
First and second programming courses. A course on concurrent programming and operating systems.

Intended learning outcomes

After finishing this course the student is able to:

- Choose, apply and implement CPU scheduling algorithms for hard real-time systems and their response time analysis, including mechanisms for sharing of multiple resources, and describe their relationship to deadlock avoidance.
- Identify and analyze characteristics of real-time operating systems in terms of predictability compared to ordinary operating systems.
- Explain implications of dependability requirements, identify and apply methods for fault tolerance in real-time systems development.
- Describe and exemplify implications of predictability requirements for distributed real-time systems, and quality of service (QoS) requirements in soft real-time applications. Analysis of conflicting demands such as energy efficiency and responsiveness.
- Analyze and implement methods for real-time communication in hard real-time applications, including event-triggered and time-triggered techniques.
- Describe and exemplify design and modelling issues related to real-time systems.
- Identify and model applications that require the use of real-time systems techniques and predict the outcomes for application of task/message scheduling and resource sharing methods.
- Structure a real-time system and evaluate its performance based on application of different algorithms and methods.
- Evaluate information from different research articles and books used as course material, and relate the information to the goals above.

Course content

Introduction to real-time systems applications. Resource allocation and in particular allocation of CPU as a resource (scheduling). Algorithms for static and dynamic scheduling: cyclic executive, rate-monotonic, earliest deadline first. Deadlock related problems in a real-time context and ceiling protocols for management of multiple resources. Overview of real-time operating systems. Dependability and its implications in real-time system development, fault tolerance, and exception handling. Interaction between resource allocation and performance demands in different systems, including approaches for assuring networked applications' quality of service (QoS), e.g. Intserv and Diffserv. Managing datacentre requirements with respect to energy efficiency and responsiveness. Design and application modelling in real-time systems. Distributed real-time systems and issues related to time, clocks and shared state. Real-time communication and support in time-triggered (TTP) and event-triggered (CAN) buses.

Teaching and working methods

The theory is presented during the lectures. Lessons help to solve exercises within the theoretical areas and prepare for the laboratory assignments. Resource sessions are used for discussing questions raised by students.

Examination

LAB1	Laboratory work	2 credits	U, G
TEN1	Written examination	4 credits	U, 3, 4, 5

Lab assignments lead to a written report within the group. Credit is given after a verbal examination of, and demonstration by, individual group members.

Grades

Four-grade scale, LiU, U, 3, 4, 5

Course literature

Articles and e-book chapters recommended on the course web pages.

Other information

About teaching and examination language

The teaching language is presented in the Overview tab for each course. The examination language relates to the teaching language as follows:

- If teaching language is Swedish, the course as a whole or in large parts, is taught in Swedish. Please note that although teaching language is Swedish, parts of the course could be given in English. Examination language is Swedish.
- If teaching language is Swedish/English, the course as a whole will be taught in English if students without prior knowledge of the Swedish language participate. Examination language is Swedish or English (depending on teaching language).
- If teaching language is English, the course as a whole is taught in English. Examination language is English.

Other

The course is conducted in a manner where both men's and women's experience and knowledge are made visible and developed.

The planning and implementation of a course should correspond to the course syllabus. The course evaluation should therefore be conducted with the course syllabus as a starting point.

Department
Institutionen för datavetenskap

Director of Studies or equivalent
Ola Leifler

Examiner
Simin Nadjm-Tehrani

Course website and other links
http://www.ida.liu.se/~TDDD07

Education components
Preliminary scheduled hours: 50 h
Recommended self-study hours: 110 h

Course literature

Books
Burns & Wellings, (2009) *Real-Time Systems and Their Programming Languages* 4:e upplagan

Articles

Compendia