Real Time Systems -- 5 & 10hp

People who will help you:

- **Lecturers:**
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  - Wang Yi, office: 1235
    - Professor of Embedded Systems

- **Assistant:**
  - Xiaoyue Pan, office: 1217
A Real-Time System

65-70 ECU's/micro-processors in some model of S80

What are "Real-Time Systems"?

Real-time systems will guarantee to give a result within a specified time --- Wiki

Real-Time Systems also known as "Embedded Systems"
Real-Time/Embedded Systems

Computers that do not look like a computer

- The primary applications are not for “information processing”, but “control”
- Majority of these systems must reply ... timely
- Mass production: a single bug = millions of dollars

Main Goal of this course:

Study Techniques for constructing Real-Time/Embedded Systems that behave as you “wanted” –

- no bug
- no stop
- no waste (of resources)
Further details ...

- To understand the basic requirements of real-time systems, and how to program such systems so that the requirements are realized.

- To understand how these requirements have influenced the design of real-time programming languages and real-time operating systems.

- To understand the design, analysis and implementation techniques which guarantee the requirements to be met.

Prerequisites

- Basic understanding of Prog. Languages e.g. C
- Basic understanding of Computer Architecture.
- Basic understanding of Operating Systems
Course Form

- Lectures
- Programming assignments (Ada, C, OS kernel/OSEK)
- Playing with Legos!

Examination
- 4 assignments and
- final written exam

Course Outline (lectures)

- Introduction
  - Characteristics of RTS
- Real Time Operating Systems (RTOS)
  - OS support: tasking, scheduling, resource handling, OSEK
- Real Time Programming Languages
  - Language support, e.g. Ada tasking
- Scheduling and Timing Analysis of RT Software
  - Worst-case execution and response time analysis
- Reliability and Fault-Tolerance
  - Fault tolerant, failure recovery, exception handling
- Distributed real time systems
  - Real Time Communication: CAN Bus
- Multiprocessor real-time systems (advanced topics)
  - Architectures and real-time scheduling
- Design and Validation (advanced topics)
  - Workload models, Modeling, Verification
Lab assignments & Software
(blue=5hp)

- Real Time Programming (Ada)
- Response Time Analysis (FpsCal)
- Real-Time OS Kernel (C, Lego NXT/OSEK)
- Modeling and Analysis (UPPAAL)

Literature

- On-line materials (slides for lectures)
- Notes (pdf) by Hanssoon and Tindell

Further readings:
M.Sc Program in Embedded System: Overview

M.Sc. Thesis Work
- Embedded Computer Systems
- Wireless Communication & Networked Embedded Systems
- Advanced Computer Architectures

Real Time Systems
- Model-Based Design of Embedded Systems

Applied Mathematics
- Embedded Systems Software
- Hardware and Software Co-Design
  - Digital Design Techniques

Signal Processing & Automatic Control