Hardware-Software Codesign

0. Organization

Lothar Thiele
Overview

- *Introduction and motivation*

- Course synopsis

- Administrativa
What is HW-SW Codesign?

... integrated design of systems that consist of hardware- and software-components

- Analysis of HW/SW boundaries and interfaces
- Evaluation of design alternatives
Review: Target Architectures

- general-purpose processors
- microcontrollers
- digital signal processors
- systems on a chip
- field-programmable gate arrays
Hardware/Software Boundaries

- **General purpose systems** (PC, workstation)
  - processor design:
    - processor ↔ compiler, operating system

- **Embedded systems** (cell phone, automotive electronics)
  - design of *specialized* processors:
    - processor ↔ compiler, operating system
  - system design:
    - processors ↔ dedicated hardware devices
Why Codesign? (1)

- Modern embedded systems require "design" optimization
  - many functions, great variability, high flexibility
  - heterogeneous target systems
    - processors, ASICs, FPGAs, systems-on-chip, ...
  - many design goals
    - performance, cost, power consumption, reliability, ...

- **Advances in formal / automated design methods**
  - automation on the system level becomes possible
  - reduction of cost and time-to-market
Why Codesign? (2)

Optimization of the “*design process*”

classic design

```
  hw
 /   \
sw   sw
```

coop-design

```
  hw
 /   \
hw   sw
```
System Design

- Specification
- System Synthesis
- SW-Compilation
- Instruction Set
- HW-Synthesis
- Estimation

- Intellectual Prop. Code
- Machine Code
- Instruction Set
- Net lists
- Intellectual Prop. Block
System Design
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Course Synopsis

- Specification and Models of Computation (Section 2)
  - State-Charts
  - Kahn Process Networks

- System Design
  - Mapping (Section 3)
  - Partitioning (Section 4)
  - Multi-Criteria Optimization (Section 5)
  - Design Space Exploration (Section 7)

- Estimation
  - Simulation-based Methods (Section 6)
  - Performance Estimation (Section 8)
  - Worst-Case Execution Time Analysis (Section 9)
  - Performance Analysis of Distributed Systems (Section 10)
  - Thermal-aware Design (Section 11)
Benefits? Learn about …

- ... challenges and approaches in modern system design
- ... useful optimization methods
- … performance estimation of distributed systems
- ... *a current research area*
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Organization (1)

- **Lecture:** Wednesday, 10 - 12, ETZ E8
- **Exercises:** Wednesday, 15 - 17, ETZ E8 or D96
- **Team:**
  - Lecture: Lothar Thiele, ETZ G87, thiele@ethz.ch
  - Exercises: Rehan Ahmed, ETZ G76, rehan.ahmed@tik.ee.ethz.ch
    Stefan Draskovic, ETZ G81, stefan.draskovic@tik.ee.ethz.ch
    Andres Gomez, ETZ J68.2, gomeza@iis.ee.ethz.ch
    Pengcheng Huang, ETZ G77, pengcheng.huang@tik.ee.ethz.ch
- **Web page:** www.tik.ee.ethz.ch/tik/education/lectures/hscd
Organization (2)

Course materials:
- slide copies, exercise sheets, papers
- the slides contain material from Marco Platzner, Peter Marwedel, Ryan Kastner, and others

References:

Recommendation: submit/participate 9 out of 11 exercises, participate in the practical simulation exercises.

Exam: written, 120 minutes, English