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

Field-programmable gate arrays

Microcontrollers

Digital signal processors

Systems on a chip
Hardware/Software Boundaries

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

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

- Embedded systems require "design" optimization
  - heterogeneous target systems
    - processors, ASICs, FPGAs, systems-on-chip, ...
  - many design goals
    - performance, cost, power consumption, reliability, ...
  - adaptive functionality (sleep vs. active), different use scenarios

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

- Optimization of the “design process”

**classic design**

- hw
- sw

**co-design**

- hw
- sw

- system-level design
- concurrent hardware and software development
System Design

- Specification
- System Synthesis
- Estimation
- SW-Compilation
- Instruction Set
- HW-Synthesis
- Intellectual Prop. Code
- Machine Code
- Intellectual Prop. Block
- Net lists
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
  - **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