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 \(\leftrightarrow\) compiler, operating system

- **Embedded systems**
  - design of *specialized* processors:
    - processor \(\leftrightarrow\) compiler, operating system
  - system design:
    - processors \(\leftrightarrow\) 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, ...

- 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

- SW-Compilation → SW-Compilation
- Instruction Set → Instruction Set
- HW-Synthesis → HW-Synthesis

- Intellectual Prop. Code
- Machine Code
- 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 E6

Exercises: Wednesday, 15 - 17, ETZ E8 or D96

People:
- Lecture: Lothar Thiele, ETZ G87, thiele@ethz.ch
- Exercises:
  - Rehan Ahmed, ETZ G76, phone: +41 44 632 70 41, rehan.ahmed@tik.ee.ethz.ch
  - Stefan Draskovic, ETZ G81, phone:+41 44 632 70 33, stefan.draskovic@tik.ee.ethz.ch
  - Yun Cheng, ETZ G77, phone: +41 44 632 70 02, chengyu@ethz.ch
- Web page:
  https://www.tec.ee.ethz.ch/education/lectures/hardware-software-codesign.html
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