Embedded System Design and Synthesis

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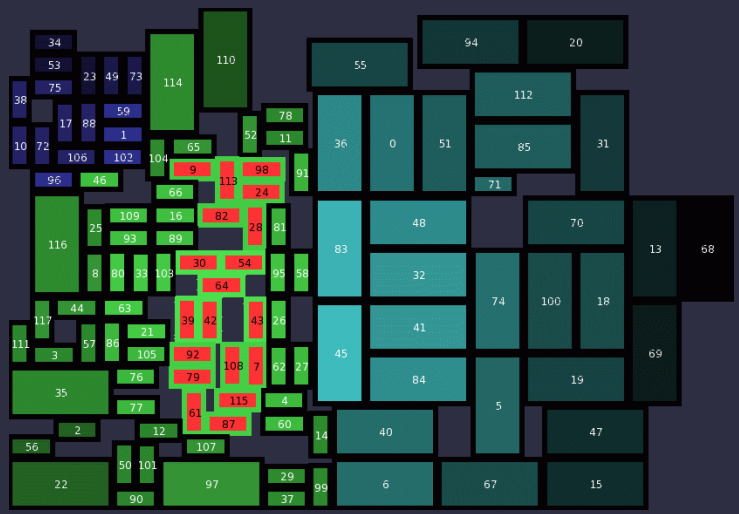

Outline

What is embedded system research?

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- Hardware and software
- Design and automation
- Multiobjective (power, performance, reliability, etc.)
- Rich with applications and theory

What topics are central?

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- Algorithm design
- Software systems and software engineering
- Analog and digital hardware design
- Low-power design
- Synthesis
- Scheduling
- Distributed systems
- Real-time systems
- and many more

What techniques are used?

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- Optimization
- Complexity analysis
- Simulation
- Compression
- Prediction
- Architectural and circuit design
- Compiler design
- Operating system design
- and many more

What applications are important?

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- Personal communication
- Multimedia
- Transportation
- Sensor networks
- Home automation
- Medicine
- Military
- and many more

Outline

Multiprocessor system-on-chip synthesis

- Working on complete flow from verifiable specification to HW/SW system
- Must consider temperature, performance, reliability, and power
- The Ph.D. students to finish this should start a company when they graduate

Thermal analysis and temperature-aware design of integrated circuits

- Fast thermal modeling and analysis techniques
- Determining which thermal problems are most critical in real industrial integrated circuits and solving them
- E.g., via reliability and on-line thermal management

Optimizing computer systems subject to user satisfaction

- Design embedded systems that understand and adapt to the needs of their users
- Start with explicit commands from users
- Move to automatic, implicit understanding of user needs

Sensor network synthesis: opening the use of wireless sensor networks to application experts

Design compact, verifiable specification languages tailored to sensor network application domains

Automatically compile/synthesize to sensor network hardware and applications

Thermal modeling, management, and optimization for high-performance integrated circuit testing

Thermal modeling, sequential test generation, and test scheduling to prevent chips from burning up during test

Hardware-software techniques to eliminate off-chip voltage regulation circuitry from embedded systems

Build a hardware–software system to prove that deregulation works

Industry liaisons

- AMD
- Cadence
- Intel
- Mentor Graphics
- Texas Instruments
- HP
- Freescale
- LSI Logic
- IBM
- NEC Labs America

Collaboration

If you are interested in working on these topics, or other topics in embedded systems, CAD, or VLSI, I may be able to help

Three options for collaboration

- Can collaborate from Tsinghua
- Can participate in Tsinghua–Northwestern exchange program
  - Come work with us for a year, then return to your group at Tsinghua and continue collaboration throughout your Ph.D.
  - Working on allowing students in the program to receive a Northwestern Master's degree without cost
- If you are about to graduate with a Bachelor's or Master's degree, may be able to join us for a Ph.D.
- If you are about to finish your Ph.D. degree, may be able to spend a year as a visiting scholar

Outline

Project presentation

5–10 minutes per person

1. Motivation
2. Problem definition
3. Proposed solution
4. Method of evaluating solution

Outline

Project report

- Due 6 September by email
- Can give to me in person on 5 September

1. Motivation
2. Related work
3. Problem definition
4. Proposed solution
5. Method of evaluating solution
6. Evaluation results