Energy-Aware Computing Systems

Energiebewusste Rechensysteme

XII. Research & Remarks

Timo Hönig

2019-07-25

EASY

Recap (I)

- **infrastructure**
  - indirect resource demand → costs
  - must be considered for design and operation of system
- **metrics**
  - use-case specific metrics (i.e., PUE)
  - correlation with heating, ventilation and air conditioning (HVAC)

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- **metrics**
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- **systems**
  - temperature-aware workload placement
  - building operating system services
  - runtime system for heterogeneous HPC clusters

Recap (II)

- uncharted lecture
- Topic: Energy-Efficient Optical Networks
- Speaker: Ralph Schlenk (technical manager in the software engineering department of the optical networks division at Nokia)

Agenda

Remarks

Evaluation

Research Projects and Thesis Topics

Postlude: "Three Dimensions"

Remarks

- Energy-Aware Computing Systems Lecture (SS 19)
  - General Topics and Basic Principles (Lecture 1 — 3)
  - Energy-Aware Components, Subsystems, and Systems (Lecture 5 — 7)
  - Energy-Aware System Software (Lecture 8 — 10)

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  - broad scope in topics and time
  - embedded software → power provisioning in warehouse-sized computers
  - from 1994 → 2019

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  - Energy Measurement
  - Energy Model
  - Energy Optimisation

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- Exercises
  - Energy Measurement
  - Energy Model
  - Energy Optimisation
- Excursion, Uncharted Lecture: Nokia

Major Course Assessment (Ger.) *Leistungsnachweis*

- achievable credit points
  - 5 ECTS (*European Credit Transfer System*)
  - corresponding to a face time of 4 contact hours per week
    - lecture and practice, with 2 SWS[1] (i.e., 2.5 ECTS) each
- German or English, **thirty-minute oral examination**
  - date by arrangement: send e-mail to `thoenig@cs.fau.de`
  - propose desired date within the official audit period
    - the exception (from this very period) proves the rule...

[1] abbr. for (Ger.) *Semesterwochenstunden*

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  - brought up in the manner of an "expert talk"
    - major goal is to find out the degree of understanding of inter-relations

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- **intermediate** participation rate

- **target** participation rate

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Evaluation

- Feedback and Discussion

Agenda

Power-Aware Critical Sections

PAX

[2] `http://univis.uni-erlangen.de` → Research projects → PAX

Power-Aware Critical Sections

- scalable synchronisation on the basis of **agile critical sections**
  - infrastructure: load-dependent and self-organised change of protection against race conditions
  - linguistic support: preparation, characterisation, and capturing of declared critical sections

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  - linguistic support: preparation, characterisation, and capturing of declared critical sections
- automated extraction of critical sections
  - notation language for critical sections
  - program analysis and LLVM integration/adaptation

PAX

- power-aware system programming
  - mutual exclusion, guarded sections, transactions
  - dynamic dispatch of synchronisation protocols or critical sections, resp.
- tamper-proof power-consumption measuring
  - instruction survey and statistics based on real and virtual machines
  - energy-consumption prediction or estimation, resp.
- DFG: 2 doctoral researchers, 2 student assistants

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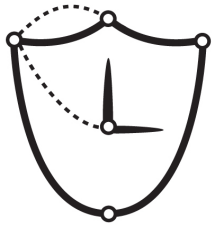
Latency- and Resilience-Aware Networking



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  - transport channel for cyber-physical systems
  - predictable transmission latency
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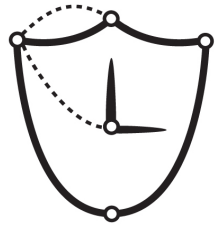

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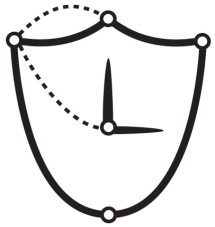

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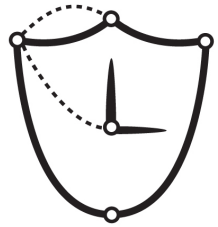

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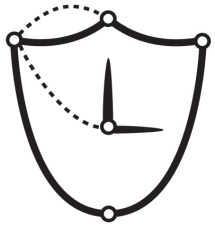

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Agenda

Three Dimensions

- Power, Time, ...

Three Dimensions

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...and Escher.

"Only those who attempt the absurd will achieve the impossible. I think it's in my basement... let me go upstairs and check."

– M.C. Escher