Concurrent Systems

Nebenläufige Systeme

XIV. Pickings

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Outline

Recapitulation
Concurrent Systems

Perspectives
Parallel Systems
Computing Equipment
Further Education

Content of Teaching and Cross-References

guarded sections
PFP
elementary operations
critical sections
simultaneous (concurrent/interacting) processes
deadly embrace
non-blocking synchronisation
concurrent data structures
transactional memory

lock
semaphore
monitor
deadly embrace
non-blocking synchronisation
concurrent data structures
guarded sections
transactional memory
Main Research at the Chair

- **composability** and **configurability**
  - application-oriented (varying, type-safe) system software

- **specialisation**
  - dedicated operating systems: integrated, adaptive, parallel

- **reliability**
  - gentle fault and intrusion tolerance

- **thriftiness**
  - resource-aware operation of computing systems

- **timeliness**
  - migration paths between time- and event-triggered real-time systems

- **concurrency**
  - coordination of cooperation and competition between processes

→ “concurrent systems” is more or less **cross-cutting** thereto...

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Latency Awareness in Operating Systems

- **latency prevention**
  - lock- and wait-free synchronisation
  - integrated generator-based approach

- **latency avoidance**
  - interference protection
  - race-conflict containment

- **latency hiding**
  - operating-system server cores
  - asynchronous remote system operation
  - experiments with different operating-system architectures
    - process-/event-based and hardware-centric operating-system kernels
    - LAKE, Sloth

- DFG: 2 doctoral researchers, 2 student assistants

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Coherency Kernel

- **event-based minimal kernel**
  - cache-aware main-memory footprint
  - hyper-threading of latent actions

- featherweight **agreement protocols**
  - overall kernel-level synchronisation
  - families of consistency kernels

- **problem-oriented consistency**
  - sequential, entry, release consistency
  - functional hierarchy of consistency domains
  - memory domains for NUMA architectures

- implementation as to different processor architectures
  - partial or total, resp. {in,}coherent shared memory

- DFG: 2 doctoral researchers (1 FAU, 1 BTU)

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1[http://univis.uni-erlangen.de → Research projects → LAOS](http://univis.uni-erlangen.de → Research projects → LAOS)

2[http://univis.uni-erlangen.de → Research projects → COKE](http://univis.uni-erlangen.de → Research projects → COKE)
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
- Automated extraction of critical sections
  - Notation language for critical sections
  - Program analysis and LLVM integration/adaptation
- 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

Latency- and Resilience-Aware Networking

- Real-time capable network communication
- Transport channel for cyber-physical systems
- Predictable transmission latency
- In a certain extent guaranteed quality criteria
- Deterministic run-time support
  
  
  
  
  
  Auffassung von der kausalen [Vor]bestimmtheit aller Geschehens bzw. Handelns (Duden)

- Latency-aware communication endpoints, optimised protocol stack
- Specialised resource management, predictable run-time behaviour
  - In time (phase 1) and energy (phase 2) respect
- DFG: Doctoral researchers, 2 student assistants (1 FAU, 1 Uni SB)

Run-Time Support System for Invasive Computing

Octo

- Borrowed from the designation of a creature that:
  - Is highly parallel in its actions and
  - Excellently can adapt oneself to its environment
- The kraken (species Octopoda)
  - Can operate in parallel by virtue of its eight tentacle
  - Is able to do customisation through camouflage and deimatic displays and
  - Comes with a highly developed nervous system
    - In order to attune to dynamic ambient conditions and effects

POS

- Abbrev. for parallel operating system
- An operating system that not only supports parallel processes
  - But that also functions inherently parallel thereby
- DFG: 2.5 doctoral researchers, 1 research/3 student assistants

Multi/Many-Core Processor Pool

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DFG: 2 doctoral researchers, 1 research/3 student assistants