

Concurrent Systems

Nebenläufige Systeme

XIV. Pickings

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Agenda

Recapitulation
Concurrent Systems

Perspectives
Parallel Systems
Computing Equipment
Further Education

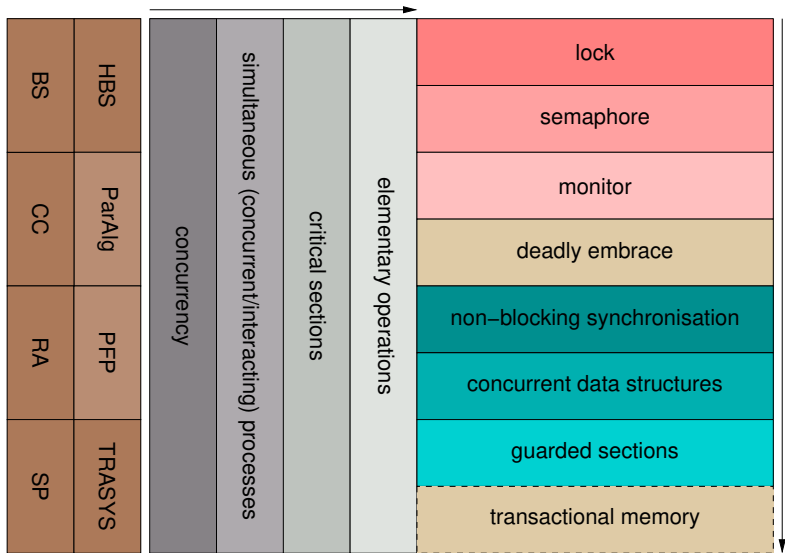


Recapitulation
Concurrent Systems

Perspectives
Parallel Systems
Computing Equipment
Further Education



Content of Teaching and Cross-References



Recapitulation
Concurrent Systems

Perspectives
Parallel Systems
Computing Equipment
Further Education



- **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. . .



■ latency prevention

- lock- and wait-free synchronisation
- integrated generator-based approach

■ latency avoidance

- interference protection
- race-conflict containment

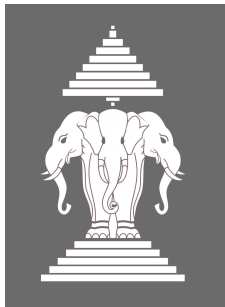
■ latency hiding

- 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



¹<http://univis.uni-erlangen.de> → Research projects → LAOS

- **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)



²<http://univis.uni-erlangen.de> → Research projects → COKE

- 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



³<http://univis.uni-erlangen.de> → Research projects → PAX



■ real-time capable network communication

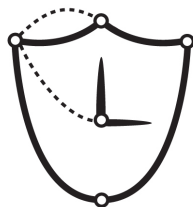
- transport channel for cyber-physical systems
- predictable transmission latency
- in a certain extent guaranteed quality criteria

■ deterministic run-time support

*Auffassung von der kausalen [Vor]bestimmtheit
allen 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)



⁴<http://univis.uni-erlangen.de> → Research projects → LARN

Octo

- borrowed from the designation of a creature that:
 - i is highly parallel in its actions and
 - ii 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

- abbrv. 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

⁵<http://univis.uni-erlangen.de> → Research projects → iRTSS



Multi/Many-Core Processor Pool

fau4*	clock	cores per domain		domain		#	
		physical	logical	NUMA	tile		
*8e *8f	2.9 GHz	8	16	2	1	32	Xeon
*9big01	2.5 GHz	6	6	8	1	48	Opteron
*9big02	2.2 GHz	10	20	4	1	80	Xeon
*9big03	2.1 GHz	12	24	4	1	96	Xeon
*9big04	2 GHz ⁶	64	128	2	1	256	Epyc
*9big05	2.5 GHz	16	128	2	4	1024	ThunderX2
*9phi01	1.2 GHz	6	12	2	1	24	Xeon
	1.1 GHz	57	228	2	1	456	Xeon Phi
*scc	1.5 GHz	4	8	1	1	8	Xeon
	800 MHz	2	—	—	24	48	Pentium
fastbox	3.5 GHz	4	8	1	1	8	Xeon TSX
<i>InvasIC</i>	50 MHz	5	5	16		80	LEON/SPARC

2160

⁶mit boost 3.35 GHz



Bachelor, Master, or Doctoral Thesis

