Parallel Processing

Winter Term 2023/24

Roland Wismüller
Universität Siegen
roland.wismueller@uni-siegen.de
Tel.: 0271/740-4050, Büro: H-B 8404

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6 Summary / Important Topics

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1 Basics

- Parallelism: concurrency/pipelining, data/task parallelism
- **Data dependences** (true, anti, output) and synchronisation
- SIMD computers
- **MIMD computers:** UMA, NUMA, NORMA
  - architectural properties, programming
- **Caches**, cache coherency (☞ **4.1**)
- Design process (classes of partitioning, communication, mapping)
- **Organisation forms** (manager/worker, task pool, divide and conquer, SPMD, fork/join, ...)
- **Performance** (speedup, efficiency, performance modeling)

2 Parallel Programming with Shared Memory

- **OpenMP programming model (fork/join)**
- `parallel` **directive**: syntax, semantics
  - shared, private, firstprivate variables
- `for` **directive**: syntax, semantics
  - scheduling and scheduling options
- **Parallelization of loops**
  - condition, handling of dependences
- **Parallelization of Jacobi and Gauss/Seidel**
- **Synchronization**: `barrier`, `critical`/`atomic`, `ordered`, reduction
- Task parallelism: `sections` / `task` directive, task synchronization

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3 Parallel Programming with Message Passing

- **MPI programming model (SPMD)**
- **Point-to-point communication**: `Send`, `Recv`
- Nonblocking communication
- Derived data types
- **Communicators**
- Collective operations: `Bcast`, `Scatter`, `Gather`, `Reduce`

4 Optimization Techniques

- Organization of caches
- False sharing