



Parallel Processing

Winter Term 2025/26

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6 Summary / Important Topics



2 Basics of Parallel Processing

- ➔ 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 (👉 5.1)
- ➔ **Organisation forms** (manager/worker, task pool, divide and conquer, SPMD, fork/join, ...)
- ➔ Design process (classes of partitioning, communication, mapping)
- ➔ **Performance** (speedup, efficiency, performance modeling)



3 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



4 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

5 Optimization Techniques

- ➔ **Organization of caches**
- ➔ **Rules for optimal use of caches**
- ➔ **False sharing**