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# Parallel Processing

Winter Term 2023/24

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## 6 Summary / Important Topics



## 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)

# 6 Summary / Important Topics ...



## 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



### 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

