

Parallel Programming with MPI and OpenMP

University of Bremen, September 15-18, 2025

Instructors: Dr. Lars Nerger (AWI and BremHLR), Dr. Hinnerk Stüben (University of Hamburg)

| | | |
|------------------|---------------|--|
| Monday | 10:15 – 12:30 | Welcome and Overview |
| | | Thinking Parallel I: computer architectures, programming models |
| | | Computer setup |
| | | Programming: getting started – parallel <i>hello world</i> program |
| | 13:30 – 16:30 | Laplace equation I: theory |
| | | MPI: basic functions, communicators, messages, basic data types |
| | | Exercise: programming send and recv |
| | | |
| Tuesday | 9:15 – 12:30 | Review of programming exercises |
| | | MPI: point-to-point communication (send and receive modes) |
| | | MPI: collective communication, Communicator splitting |
| | | MPI: Reduction operations |
| | | Exercise: Communicate around a ring |
| | 13:30 – 17:00 | Review of programming exercise |
| | | MPI: non-blocking communication |
| | | Laplace equation II: implementation with MPI |
| | | Thinking Parallel II: Performance considerations |
| | | |
| Wednesday | 9:15 – 12:30 | Thinking Parallel (III): Finding parallelism, data dependence analysis |
| | | OpenMP (I) with exercises |
| | 13:30 – 17:00 | Laplace equation III: implementation with OpenMP |
| | | OpenMP (II) with exercises |
| | | Parallel programming bugs |
| | | |
| Thursday | 9:15 – 12:30 | MPI: Communicators & buffering |
| | | MPI: Derived data types |
| | | MPI: Virtual topologies |
| | | Exercise: Advanced ring communication |
| | 13:30 – 17:00 | Review of programming exercise |
| | | Hybrid programming (MPI plus OpenMP) |
| | | MPI: One-sided communication |
| | | Parallel I/O with MPI |
| | | Exercise: hybrid <i>hello world</i> program |



BremHLR

Kompetenzzentrum für Höchstleistungsrechnen Bremen