

PARALLEL COMPUTING

Summer Semester 2025



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Research Institute for Symbolic Computation (RISC)

LIT Cyber-Physical Systems Lab

Topics

Application of concurrency to speed-up computations.

- Multi-core processors, multi-processor systems, computer clusters, computational grids.
- Shared memory (multi-threaded) and distributed memory (message passing) programming.
- Task parallel and data parallel algorithms.
- Strategies for parallel program design.
- Performance measures and complexity models.
- Performance analysis and debugging.

Various interrelated aspects (many of which we will discuss).

Preliminary Schedule

- March 4 (Schreiner): Parallel Architectures and Performance.
- March 11 (Zoitl): Parallel Algorithms and Complexity.
- March 18 (Schreiner): Concurrency in Java and OpenMP.
- March 25 (Zoitl): Shared Memory Programming.
- April 1 (Zoitl): Lockless Data Structures and Work Stealing.
- April 8 (Schreiner): Designing Parallel Programs.
- April 29 (Schreiner): Presentations of Solutions 1.
- May 6 (Schreiner): Message Passing Programming with MPI.
- May 13 (Zoitl): Presentation of Solutions 2.
- May 20 (Zoitl): Parallel Computing With Modern C++.
- June 3 (Schreiner): Presentations of Solutions 3.
- June 17 (Zoitl): Presentation of Solutions 4.

Individual meetings for discussing the assignments.

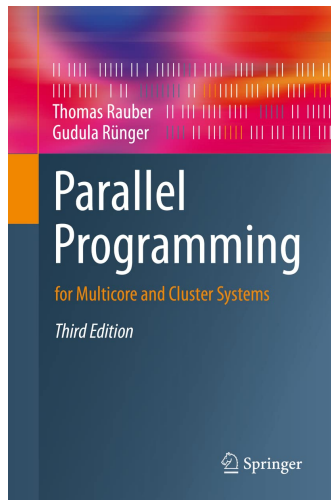
Organization and Grades

- Moodle Course
 - Materials and links.
 - Forums for announcements and Q&A.
 - Submission of assignments.
- Assignments
 - 4 programming assignments will be handed out.
 - At least 3 have to be turned in and graded positively.
 - Elaboration *individually*.
 - Selected submissions will be invited for presentation.

No exam, grade will be entirely based on assignments/presentations.

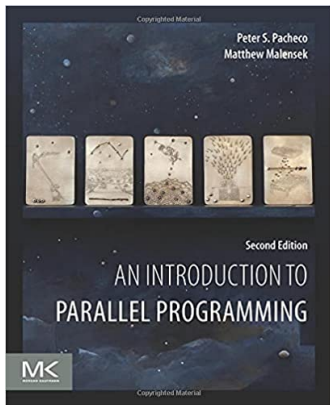
Literature

Thomas Rauber and Gudula Runger: *Parallel Programming: for Multicore and Cluster Systems*, Third Edition, Springer, 2023.



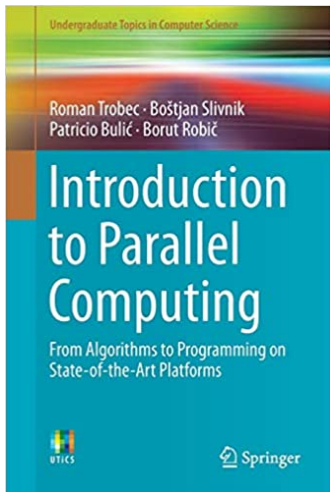
Literature

Peter Pacheco and Matthew Malensek: *An Introduction to Parallel Programming*, 2nd edition, Morgan Kaufmann, 2021.



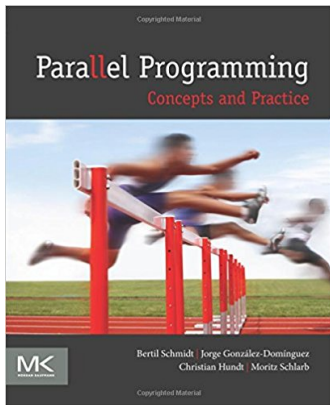
Literature

Roman Trobec, Boštjan Slivnik,
Patricio Bulić, Borut Robič:
*Introduction to Parallel
Computing: From Algorithms to
Programming on
State-of-the-Art Platforms*,
Springer, 2018.



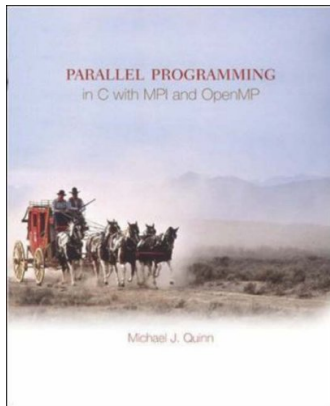
Literature

Bertil Schmidt, Jorge Gonzalez-Dominguez, Christian Hundt, Moritz Schlarb: *Parallel Programming: Concepts and Practice*, Morgan Kaufmann, 2017.



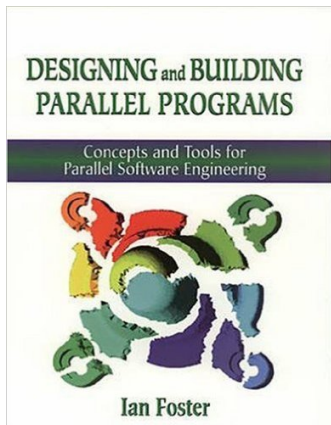
Literature

Michael J. Quinn: *Parallel Programming in C with MPI and OpenMP*, McGraw-Hill, 2003.



Literature

Ian Foster: *Designing and Building Parallel Programs*, Addison-Wesley, 1995.



Free online version at <http://www.mcs.anl.gov/~itf/dbpp>.

Literature

Kai Hwang: *Advanced Computer Architecture — Parallelism, Scalability, Programmability*, McGraw-Hill, 1993.

