

# PARALLEL COMPUTING

**Summer Semester 2023**



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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 7 (Schreiner): Parallel Architectures and Performance.
- March 14 (Zoitl): Parallel Algorithms and Complexity.
- March 21 (Schreiner): Concurrency in Java and OpenMP.
- March 28 (Zoitl): Shared Memory Programming.
- April 18 (Zoitl): Lockless Data Structures and Work Stealing.
- April 25 (Schreiner): Presentations of Solutions 1.
- May 2 (Schreiner): Message Passing Programming with MPI.
- May 9 (Schreiner): Designing Parallel Programs.
- May 16 (Zoitl): Presentation of Solutions 2.
- May 23 (Zoitl): Parallel Computing With Modern C++.
- June 6 (Schreiner): Presentations of Solutions 3.
- June 27 (Zoitl): Presentations of Solutions 4.

Individual meetings for discussing the assignments.

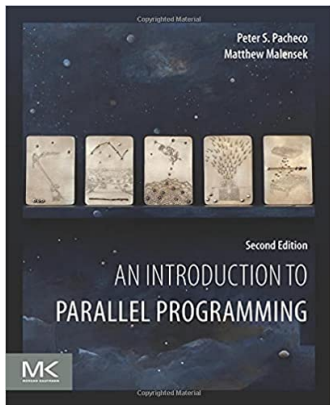
# Organization and Grades

- 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.

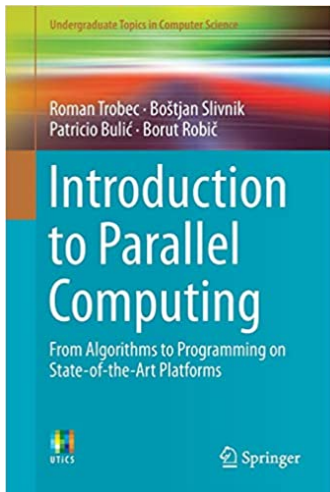
# Literature

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



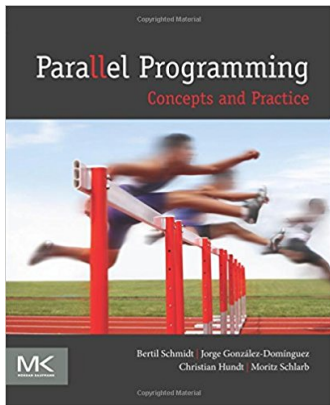
## Literature

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



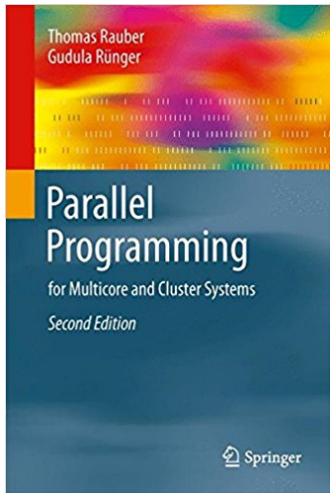
# Literature

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



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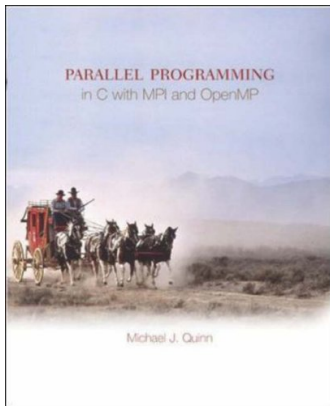
Thomas Rauber and Gudula Runger: *Parallel Programming: for Multicore and Cluster Systems*, Second Edition, Springer, 2013.





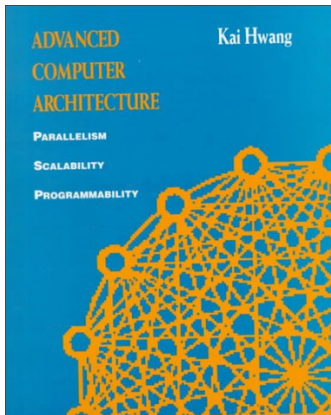
# Literature

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



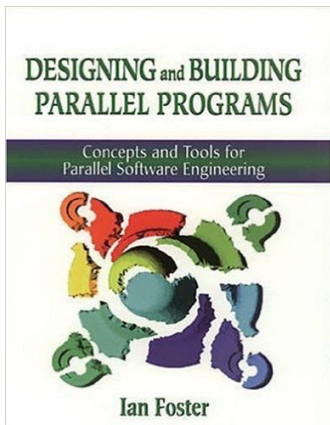
# Literature

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



## Literature

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



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