Integrating Parallel and Distributed Computing into Early Computing Classes

New Course exemplars for CS1 and CS2

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https://CDERcenter.org



TCPP Curriculum Initiative

What should every Computer Science and Engineering Student know about Parallel and Distributed Computing (PDC)?
https://CDERcenter.org/

- **Areas:** Programming, Architecture, & Algorithms
  - Version 1 – 2012
- **New Aspects:** Big Data, Energy, Distributed Computing, Pervasive topics
  - Version-2-beta released 2020

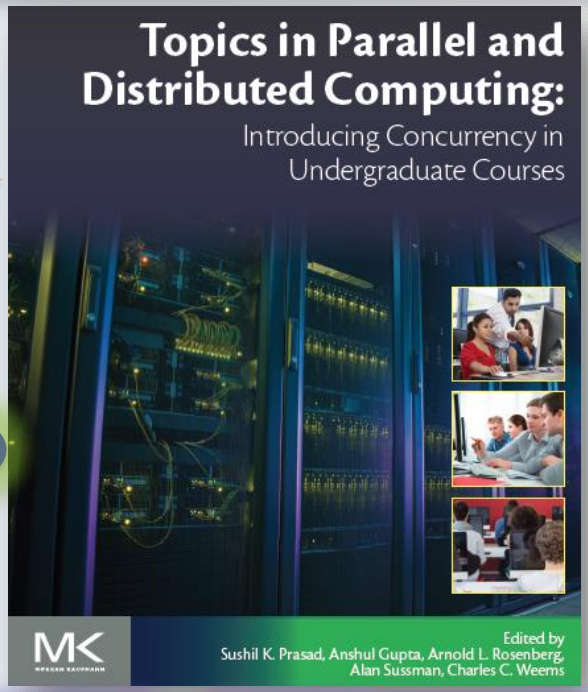
Companion Activities:

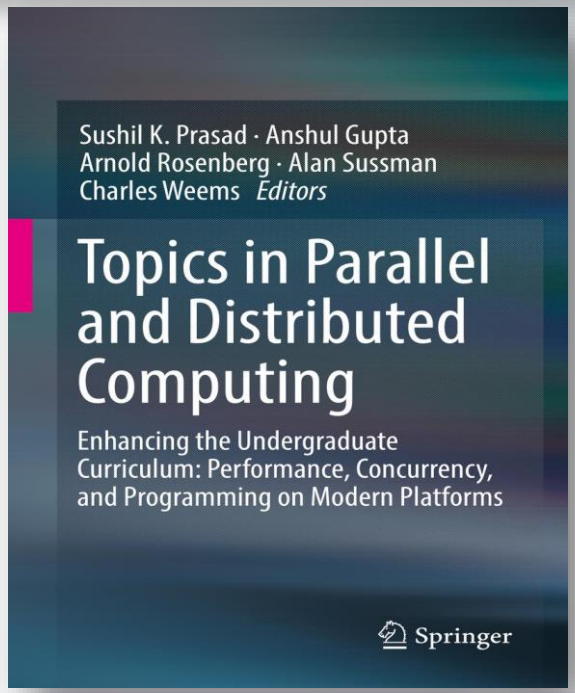
- CE-oriented TCPP Curriculum
- CDER Book Vol 3 - with Springer
  - Experience of Adopters
    - Exemplars + Resources
- Modernizing CS1/CS2 Exemplars
- Instructor Training at UMASS

CDER Books - Topics in Parallel and Distributed Computing for Undergraduates

67K Chapter Downloads

Free Download





PART 1 FOR INSTRUCTORS
5 Chapters

- ✓ Hands-on Parallelism with no Prerequisites and Little Time Using Scratch
- ✓ Parallelism in Python for Novices
- ✓ Modules for Introducing Threads
- ✓ Introducing Parallel and Distributed Computing Concepts in Digital Logic
- ✓ Networks and MPI for Cluster Computing

PART 2 FOR STUDENTS
4 Chapters

- ✓ Fork-join Parallelism with a Data-Structures Focus
- ✓ Shared-Memory Concurrency Control with a Data-Structures Focus
- ✓ Parallel Computing in a Python-Based Computer Science Course
- ✓ Parallel Programming Illustrated through Conway's Game of Life

PART 1 FOR INSTRUCTORS
5 Chapters

- ✓ What do we need to know about parallel algorithms and their efficient implementation?
- ✓ Models for Teaching Parallel Performance Concepts
- ✓ Scalability in Parallel Processing
- ✓ Energy Efficiency Issues in Computing Systems
- ✓ Scheduling for fault-tolerance: an introduction

PART 2 FOR INSTRUCTORS
5 Chapters

- ✓ MapReduce - The Scalable Distributed Data Processing Solution
- ✓ The Realm of Graphics Processing Unit (GPU) Computation
- ✓ Managing Concurrency in Mobile User Interfaces with Examples in Android
- ✓ Parallel Programming for Integrative GUI Applications

CDER Book Vol 3 - with Springer - 11 chapters on Experience of Adopters, Resources

NSF-funded Modernizing CS1/CS2 Exemplar Project (Award #2321015)

Vision: Create modern course exemplars for CS1 and CS2 courses to serve as national models	• Systems are more networked, parallel, and graphical than traditional courses • Software uses more libraries and APIs

2 Development teams	• Knox College (Java version)
	• Tennessee Tech (C/C++ version)
	• Piloted
	  • CS1 Fall'24 -
	  • CS2 Spring'25 -

6 Testing Teams	• U. Nebraska Lincoln (R1); Montclair State; U. Southern Indiana, Webster (Pvt.), Hawaii Pacific U. (Pvt); Casper (Comm. College) • Evaluation of the new courses in 2025-26

What Does PDC in CS1/CS2 Actually Look Like?

CS1
Concrete, low-barrier entry points

Flag Maker
Data parallelism + decomposition

Greenfoot
Event handling + asynchronous computation

Earthquake Tracker / APIs
Distributed data + remote access

CS2
Build on algorithms and data structures

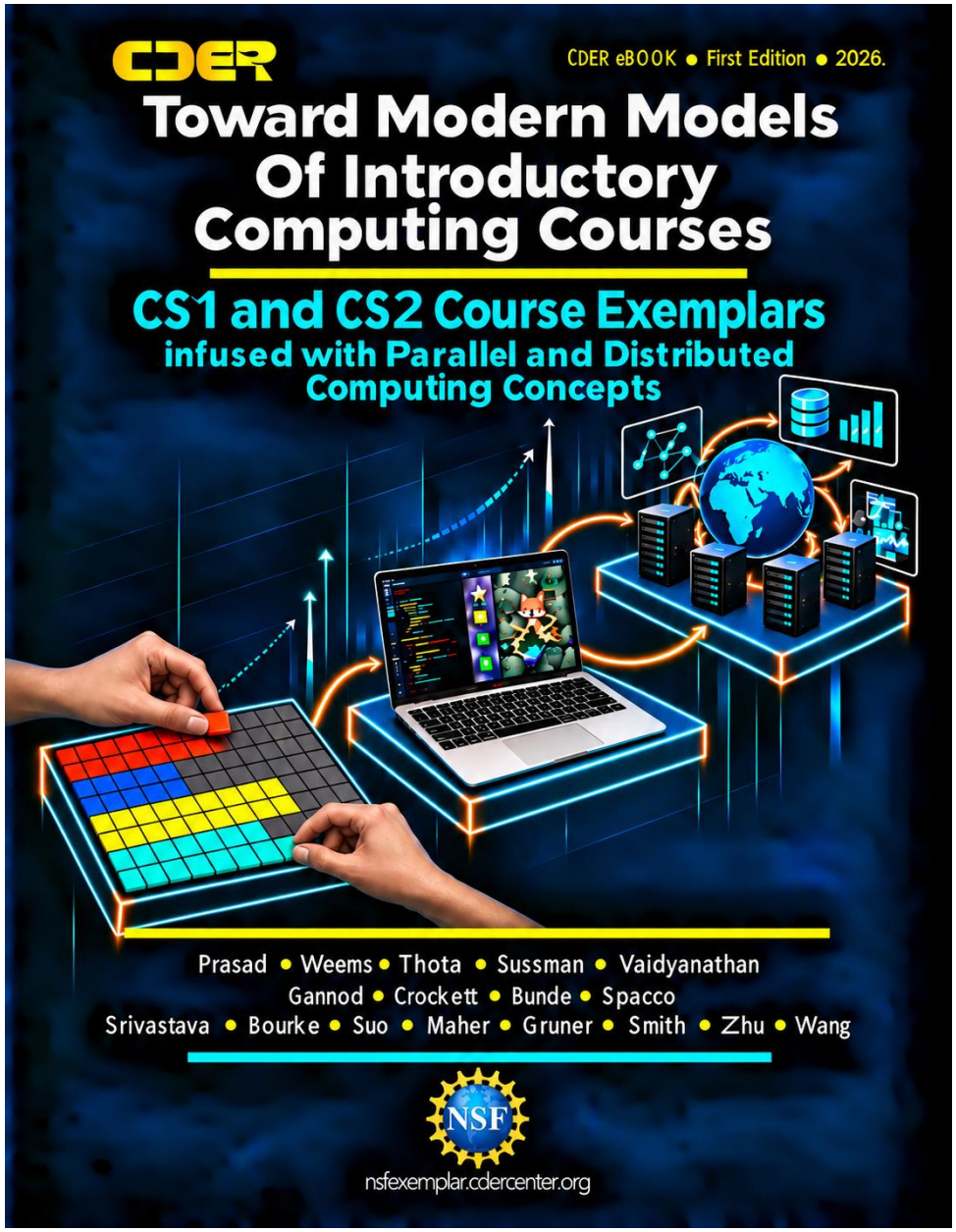
Fork–Join
Task parallelism + synchronization

OpenMP Sorting
Shared memory + speedup / overhead

Parallel Image Processing
Data decomposition + benchmarking

Start small:

one activity → one lab/module → broader course infusion



- 16 institutional exemplars
- 8 institutions
- Java, C++, Python
- **Released today!**


CDER
Center for Parallel and Distributed Computing
Curriculum Development and Educational Resources
NSF Grant and Training Program for incorporating Parallel and Distributed Computing, Big Data, and AI into intro CS Courses
June 21-25, 2027
Applications Due: Jan. 11
See how to integrate PDC, Big Data, and AI into the first CS classes and to gather data to evaluate experimental pedagogical approaches
Learn about PDC, Big Data, AI from experts
Network with other instructors
Gain insights for teaching these topics in your courses, to meet the needs of your students
Become a leader in preparing students for careers that require these concepts as a fundamental aspect of computational thinking
Get special opportunities to publish findings from your work
Where?
University of Massachusetts, Amherst
What?
$4000 stipend (awarded in two parts) to attend, learn about how to incorporate PDC, Big Data, and AI into an intro course, to instrument changes, and report evaluation
Who?
Instructors teaching intro CS courses (CS0, CS1) at colleges and universities in the US. Must be US Citizen or Permanent Resident
Application Instructions:
https://cdercenter.org/cybertraining-program-2027/
Sponsored by:
UT San Antonio, University of Maryland, University of Massachusetts, Tennessee Tech, Louisiana State University, Knox College
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