

Data Management

This guide illuminates the intricate relationship between data management, computer architecture, and system software. It traces the evolution of computing to today's data-centric focus and underscores the importance of hardware–software codesign in achieving efficient data processing systems with high throughput and low latency. The thorough coverage includes topics such as logical data formats, memory architecture, graphics processing unit (GPU) programming, and the innovative use of ray tracing in computational tasks. Special emphasis is placed on minimizing data movement within memory hierarchies and optimizing data storage and retrieval. Tailored for professionals and students in computer science, this book combines theoretical foundations with practical applications, making it an indispensable resource for anyone wanting to master the synergies between data management and computing infrastructure.

Xiaodong Zhang is Robert M. Critchfield Professor in Engineering and University Distinguished Scholar at the Ohio State University. He specializes in data management in computer and distributed systems. His influential research is broadly adopted in various sectors. He received the ACM MICRO Test of Time Award in 2020 and the VLDB Test of Time Award in 2024. He is a Fellow of both ACM and IEEE.

Rubao Lee is a distinguished computer scientist who has made significant contributions to GPU-accelerated database systems and data processing. His innovations, like RCFfile and YSmart, are widely adopted in industry. He received the ICDCS Best Paper Award in 2011, the Lumley Research Award of The Ohio State University in 2018, and the VLDB Test of Time Award in 2024. He is a Senior Member of IEEE.

“Data Management: Interactions with Computer Architecture and Systems is a must-have for any software engineer. This comprehensive book distills decades of research and engineering practices into a clear and insightful guide. Readers will gain a systematic understanding of cutting-edge advancements, making it an invaluable resource for solving real-world problems.”

Kaibo Wang, Uber Technologies

“This textbook is a timely and comprehensive resource that explores the strong interactions among data management, memory hierarchy, computation, and applications. It strikes an elegant balance between fundamental knowledge and advanced topics, illustrating how data-centric algorithms, architectural and system designs, and software stacks should work together to achieve the high efficiency critically needed in the modern era of computing. This textbook is a natural sequel to conventional architectural books, designed for data applications ranging from computer graphics and databases to machine learning. It is far-reaching and future-proof!”

Deming Chen, University of Illinois Urbana-Champaign

“This book breaks down the barriers between two fundamental computer science subjects that have always been taught separately: database systems and computer architectures. The book is a great read, needed to see the full picture and the interplay between these two important subjects. Highly recommended for those seeking the understanding of system-internal decisions and how they impact various system components.”

Mohamed Mokbel, University of Minnesota

Data Management

Interactions with Computer Architecture and Systems

XIAODONG ZHANG

The Ohio State University

RUBAO LEE

The Ohio State University



CAMBRIDGE
UNIVERSITY PRESS



Shaftesbury Road, Cambridge CB2 8EA, United Kingdom

One Liberty Plaza, 20th Floor, New York, NY 10006, USA

477 Williamstown Road, Port Melbourne, VIC 3207, Australia

314–321, 3rd Floor, Plot 3, Splendor Forum, Jasola District Centre, New Delhi – 110025, India

103 Penang Road, #05–06/07, Visioncrest Commercial, Singapore 238467

Cambridge University Press is part of Cambridge University Press & Assessment, a department of the University of Cambridge.

We share the University's mission to contribute to society through the pursuit of education, learning and research at the highest international levels of excellence.

www.cambridge.org

Information on this title: www.cambridge.org/9781009123310

DOI: [10.1017/9781009122115](https://doi.org/10.1017/9781009122115)

© Xiaodong Zhang and Rubao Lee 2025

This publication is in copyright. Subject to statutory exception and to the provisions of relevant collective licensing agreements, no reproduction of any part may take place without the written permission of Cambridge University Press & Assessment.

When citing this work, please include a reference to the DOI [10.1017/9781009122115](https://doi.org/10.1017/9781009122115)

First published 2025

A catalogue record for this publication is available from the British Library.

A Cataloging-in-Publication data record for this book is available from the Library of Congress.

ISBN 978-1-009-12331-0 Hardback

Cambridge University Press & Assessment has no responsibility for the persistence or accuracy of URLs for external or third-party internet websites referred to in this publication and does not guarantee that any content on such websites is, or will remain, accurate or appropriate.