

Urgent Computing Across the Device-Edge-Cloud Continuum

Concepts, Applications and Future Directions

This book explores how the Computing Continuum — spanning edge devices, cloud infrastructures, and high-performance computing systems — can empower a new generation of urgent analytics applications. Through cutting-edge scientific contributions and real-world case studies, it examines how dynamic, data-driven workflows can seamlessly integrate heterogeneous data sources, AI/ML models, and distributed computational resources to react to rapidly evolving situations and support time-critical decision-making across diverse application domains.

At the core of this book lies a bold vision: to enable the ephemeral and intelligent composition of data, services, and computational resources based on urgency, cost, energy constraints, and the ever-changing context of the environment. The chapters delve into the fundamentals of Urgent Science and the Computing Continuum, explore platforms for natural hazards and critical infrastructure resilience, and present real-life case studies on earthquake, public health, and emergency department triage. The book concludes with future directions in interactive and urgent HPC.

Bridging systems research, distributed AI, and domain sciences, this volume serves as both a reference and an inspiration for researchers, practitioners, and innovators seeking to shape the future of responsive, intelligent computing. By bringing together advances at the intersection of edge computing, cloud systems, HPC, and urgent analytics, the book offers a compelling perspective on how next-generation infrastructures can transform the way society responds to complex, time-sensitive challenges.

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