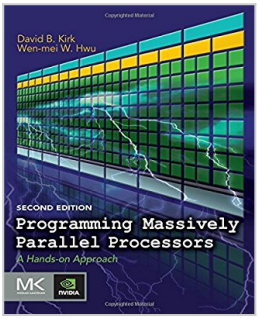

Programming Massively Parallel Processors, Second Edition: A Hands-on Approach

By David B. Kirk, Wen-mei W. Hwu

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Programming Massively Parallel Processors: A Hands-on Approach, Second Edition, teaches students how to program massively parallel processors. It offers a detailed discussion of various techniques for constructing parallel programs. Case studies are used to demonstrate the development process, which begins with computational thinking and ends with effective and efficient parallel programs.

This guide shows both student and professional alike the basic concepts of parallel programming and GPU architecture. Topics of performance, floating-point format, parallel patterns, and dynamic parallelism are covered in depth. This revised edition contains more parallel programming examples, commonly-used libraries such as Thrust, and explanations of the latest tools. It also provides new coverage of CUDA 5.0, improved performance, enhanced development tools, increased hardware support, and more; increased coverage of related technology, OpenCL and new material on algorithm patterns, GPU clusters, host programming, and data parallelism; and two new case studies (on MRI reconstruction and molecular visualization) that explore the latest applications of CUDA and GPUs for scientific research and high-performance computing.

This book should be a valuable resource for advanced students, software engineers, programmers, and hardware engineers.

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Editorial Review

Review

"For those interested in the GPU path to parallel enlightenment, this new book from David Kirk and Wen-mei Hwu is a godsend, as it introduces CUDA (tm), a C-like data parallel language, and Tesla(tm), the architecture of the current generation of NVIDIA GPUs. In addition to explaining the language and the architecture, they define the nature of data parallel problems that run well on the heterogeneous CPU-GPU hardware ... This book is a valuable addition to the recently reinvigorated parallel computing literature." **--David Patterson, Director of The Parallel Computing Research Laboratory and the Pardee Professor of Computer Science, U.C. Berkeley. Co-author of *Computer Architecture: A Quantitative Approach***

"Written by two teaching pioneers, this book is the definitive practical reference on programming massively parallel processors--a true technological gold mine. The hands-on learning included is cutting-edge, yet very readable. This is a most rewarding read for students, engineers, and scientists interested in supercharging computational resources to solve today's and tomorrow's hardest problems." **--Nicolas Pinto, MIT, NVIDIA Fellow, 2009**

"I have always admired Wen-mei Hwu's and David Kirk's ability to turn complex problems into easy-to-comprehend concepts. They have done it again in this book. This joint venture of a passionate teacher and a GPU evangelizer tackles the trade-off between the simple explanation of the concepts and the in-depth analysis of the programming techniques. This is a great book to learn both massive parallel programming and CUDA." **--Mateo Valero, Director, Barcelona Supercomputing Center**

"The use of GPUs is having a big impact in scientific computing. David Kirk and Wen-mei Hwu's new book is an important contribution towards educating our students on the ideas and techniques of programming for massively parallel processors." **--Mike Giles, Professor of Scientific Computing, University of Oxford**

"This book is the most comprehensive and authoritative introduction to GPU computing yet. David Kirk and Wen-mei Hwu are the pioneers in this increasingly important field, and their insights are invaluable and fascinating. This book will be the standard reference for years to come." **--Hanspeter Pfister, Harvard University**

"This is a vital and much-needed text. GPU programming is growing by leaps and bounds. This new book will be very welcomed and highly useful across inter-disciplinary fields." **--Shannon Steinfadt, Kent State University**

"GPUs have hundreds of cores capable of delivering transformative performance increases across a wide range of computational challenges. The rise of these multi-core architectures has raised the need to teach advanced programmers a new and essential skill: how to program massively parallel processors." **--CNNMoney.com**

From the Back Cover

Programming Massively Parallel Processors: A Hands-on Approach shows both student and professional alike the basic concepts of parallel programming and GPU architecture. Various techniques for constructing

parallel programs are explored in detail. Case studies demonstrate the development process, which begins with computational thinking and ends with effective and efficient parallel programs.

About the Author
David B. Kirk is well recognized for his contributions to graphics hardware and algorithm research. By the time he began his studies at Caltech, he had already earned B.S. and M.S. degrees in mechanical engineering from MIT and worked as an engineer for Raster Technologies and Hewlett-Packard's Apollo Systems Division, and after receiving his doctorate, he joined Crystal Dynamics, a video-game manufacturing company, as chief scientist and head of technology. In 1997, he took the position of Chief Scientist at NVIDIA, a leader in visual computing technologies, and he is currently an NVIDIA Fellow.

At NVIDIA, Kirk led graphics-technology development for some of today's most popular consumer-entertainment platforms, playing a key role in providing mass-market graphics capabilities previously available only on workstations costing hundreds of thousands of dollars. For his role in bringing high-performance graphics to personal computers, Kirk received the 2002 Computer Graphics Achievement Award from the Association for Computing Machinery and the Special Interest Group on Graphics and Interactive Technology (ACM SIGGRAPH) and, in 2006, was elected to the National Academy of Engineering, one of the highest professional distinctions for engineers.

Kirk holds 50 patents and patent applications relating to graphics design and has published more than 50 articles on graphics technology, won several best-paper awards, and edited the book Graphics Gems III. A technological "evangelist" who cares deeply about education, he has supported new curriculum initiatives at Caltech and has been a frequent university lecturer and conference keynote speaker worldwide.

Wen-mei W. Hwu is a Professor and holds the Sanders-AMD Endowed Chair in the Department of Electrical and Computer Engineering, University of Illinois at Urbana-Champaign. His research interests are in the area of architecture, implementation, compilation, and algorithms for parallel computing. He is the chief scientist of Parallel Computing Institute and director of the IMPACT research group (www.impact.crhc.illinois.edu). He is a co-founder and CTO of MulticoreWare. For his contributions in research and teaching, he received the ACM SigArch Maurice Wilkes Award, the ACM Grace Murray Hopper Award, the Tau Beta Pi Daniel C. Drucker Eminent Faculty Award, the ISCA Influential Paper Award, the IEEE Computer Society B. R. Rau Award and the Distinguished Alumni Award in Computer Science of the University of California, Berkeley. He is a fellow of IEEE and ACM. He directs the UIUC CUDA Center of Excellence and serves as one of the principal investigators of the NSF Blue Waters Petascale computer project. Dr. Hwu received his Ph.D. degree in Computer Science from the University of California, Berkeley.

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