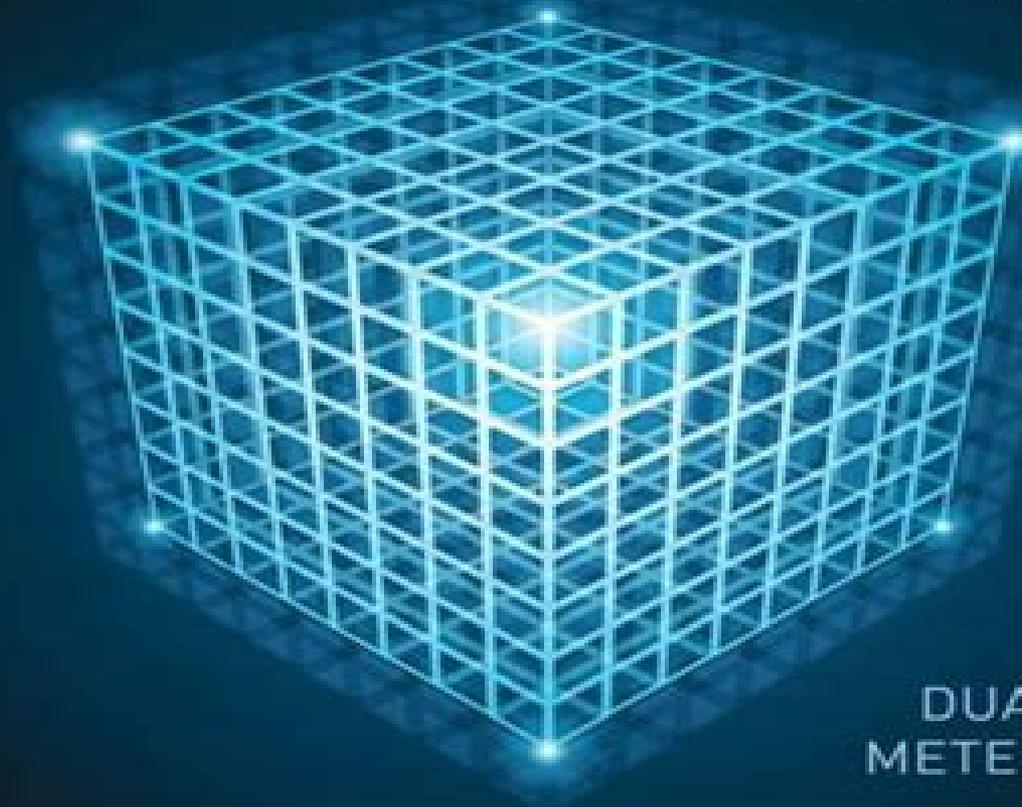




CUDA

FOR ENGINEERS

An Introduction to High-Performance
Parallel Computing



DUANE STORTI
METE YURTOGLU

Cuda For Engineers An Introduction To High Performance Parallel Computing

David B. Kirk, Wen-mei W. Hwu



Cuda For Engineers An Introduction To High Performance Parallel Computing:

Cuda for Engineers Duane Storti, Mete Yurtoglu, 2017-07-05 GPUs can be used for much more than graphics processing As opposed to a CPU which can only run four or five threads at once a GPU is made up of hundreds or even thousands of individual low powered cores allowing it to perform thousands of concurrent operations Because of this GPUs can tackle large complex problems on a much shorter time scale than CPUs Dive into parallel programming on NVIDIA hardware with CUDA by Chris Rose and learn the basics of unlocking your graphics card This updated and expanded second edition of Book provides a user friendly introduction to the subject Taking a clear structural framework it guides the reader through the subject s core elements A flowing writing style combines with the use of illustrations and diagrams throughout the text to ensure the reader understands even the most complex of concepts This succinct and enlightening overview is a required reading for all those interested in the subject We hope you find this book useful in shaping your future career Business

Biologically Inspired Cognitive Architectures 2024 Alexei V. Samsonovich, Tingting Liu, 2024-12-09 This book reports on original approaches intended to support the development of biologically inspired cognitive architectures It bridges together different disciplines including artificial intelligence linguistics neuro and social sciences psychology and philosophy of mind among others The chapters are based on contributions presented at the 2024 Annual International Conference on Brain Inspired Cognitive Architectures for Artificial Intelligence the 15th Annual Meeting of the BICA Society BICA AI 2024 organized in collaboration with the 17th Conference on Artificial General Intelligence AGI 2024 and held on August 13 16 2024 in Seattle WA USA They cover emerging methods theories and ideas towards the realization of general purpose humanlike artificial intelligence or fostering a better understanding of the ways the human mind works All in all this book provides engineers mathematicians psychologists computer scientists and other experts with a timely snapshot of recent research and a source of inspiration for future developments in the broadly intended areas of artificial intelligence and biological inspiration

Networks and Sustainability Andriy Luntovskyy, Mikhailo Klymash, Igor Melnyk, Mykola Beshley, Dietbert Gütter, 2025-09-30 This book explores advanced networking topics building on previous Springer books like Intent based Networking 2022 Emerging Networking in the Digital Transformation Age 2023 and Digital Ecosystems 2024 It merges network technologies with sustainable development energy efficiency AI and smart apps Topics include LLMs ML large scale distributed networks QoS IoT with cloud and fog ecosystems smart grids and robotics It emphasizes the synergy of smart apps AI and computational intelligence The book shows how advanced networks support sustainability energy efficiency and inclusiveness focusing on data science cybersecurity user intentions and cost reduction addressing key aspects like reliability privacy inclusiveness and accessibility Suitable for students professors and lecturers in networking distributed systems cybersecurity data science and AI it also serves as a research base and source of inspiration for professionals seeking new challenges

Developing Linear Algebra Codes on Modern Processors: Emerging Research and

Opportunities Catalán Pallarés, Sandra, Valero-Lara, Pedro, Toledo Díaz, Leonel Antonio, Carratalá Sáez, Rocío, 2022-10-14
Optimized linear algebra LA libraries that are able to exploit the underlying hardware are always of interest in the high performance computing community The implementation of LA software has evolved along with computer architecture while the specification remains unaltered almost from the beginning It is important to differentiate between the specification of LA libraries and their implementation Because LA libraries pursue high performance the implementation for a given architecture needs to be optimized for it specifically However the type of operations included in the libraries the input output parameters and the data types to be handled are common to all of them This is why while the specification remains constant the implementation evolves with the creation of new architectures Developing Linear Algebra Codes on Modern Processors Emerging Research and Opportunities presents the main characteristics of LA libraries showing the differences between the standards for sparse and dense versions It further explores relevant linear algebra problems and shows in a clear and understandable way how to solve them using different computer architectures Covering topics such as programming models batched computing and distributed memory platforms this premier reference source is an excellent resource for programmers computer scientists engineers students and faculty of higher education librarians researchers and academicians

Transactions on Petri Nets and Other Models of Concurrency XIII Maciej Koutny, Lars Michael Kristensen, Wojciech Penczek, 2018-11-20 The 13th volume of ToPNoC contains revised and extended versions of a selection of the best workshop papers presented at the 38th International Conference on Application and Theory of Petri Nets and Concurrency Petri Nets 2017 and the 17th International Conference on Application of Concurrency to System Design ACSD 2017 The 9 papers cover a diverse range of topics including model checking and system verification refinement and synthesis foundational work on specific classes of Petri nets and innovative applications of Petri nets and other models of concurrency Application areas covered in this volume are fault tolerance service composition databases communication protocols business processes and distributed systems Thus this volume gives a good overview of ongoing research on concurrent systems and Petri nets

A Practical Approach to High-Performance Computing Sergei Kurgalin, Sergei Borzunov, 2019-11-10 The book discusses the fundamentals of high performance computing The authors combine visualization comprehensibility and strictness in their material presentation and thus influence the reader towards practical application and learning how to solve real computing problems They address both key approaches to programming modern computing systems multithreading based parallelizing in shared memory systems and applying message passing technologies in distributed systems The book is suitable for undergraduate and graduate students and for researchers and practitioners engaged with high performance computing systems Each chapter begins with a theoretical part where the relevant terminology is introduced along with the basic theoretical results and methods of parallel programming and concludes with a list of test questions and problems of varying difficulty The authors include many solutions and hints and often sample code

Bioinformatics Bertil Schmidt,2010-07-15 New sequencing technologies have broken many experimental barriers to genome scale sequencing leading to the extraction of huge quantities of sequence data This expansion of biological databases established the need for new ways to harness and apply the astounding amount of available genomic information and convert it into substantive biological [Encyclopedia of Bioinformatics and Computational Biology](#) ,2018-08-21 Encyclopedia of Bioinformatics and Computational Biology ABC of Bioinformatics Three Volume Set combines elements of computer science information technology mathematics statistics and biotechnology providing the methodology and in silico solutions to mine biological data and processes The book covers Theory Topics and Applications with a special focus on Integrative omics and Systems Biology The theoretical methodological underpinnings of BCB including phylogeny are covered as are more current areas of focus such as translational bioinformatics cheminformatics and environmental informatics Finally Applications provide guidance for commonly asked questions This major reference work spans basic and cutting edge methodologies authored by leaders in the field providing an invaluable resource for students scientists professionals in research institutes and a broad swath of researchers in biotechnology and the biomedical and pharmaceutical industries Brings together information from computer science information technology mathematics statistics and biotechnology Written and reviewed by leading experts in the field providing a unique and authoritative resource Focuses on the main theoretical and methodological concepts before expanding on specific topics and applications Includes interactive images multimedia tools and crosslinking to further resources and databases

Programming Massively Parallel Processors David B. Kirk,Wen-mei W. Hwu,2010-02-22 Programming Massively Parallel Processors discusses 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 This book describes computational thinking techniques that will enable students to think about problems in ways that are amenable to high performance parallel computing It utilizes CUDA Compute Unified Device Architecture NVIDIA s software development tool created specifically for massively parallel environments Studies learn how to achieve both high performance and high reliability using the CUDA programming model as well as OpenCL This book is recommended for advanced students software engineers programmers and hardware engineers Teaches computational thinking and problem solving techniques that facilitate high performance parallel computing Utilizes CUDA Compute Unified Device Architecture NVIDIA s software development tool created specifically for massively parallel environments Shows you how to achieve both high performance and high reliability using the CUDA programming model as well as OpenCL

CUDA Fortran for Scientists and Engineers Gregory Ruetsch,Massimiliano Fatica,2013-09-11 CUDA Fortran for Scientists and Engineers shows how high performance application developers can leverage the power of GPUs using Fortran the familiar language of scientific computing and supercomputer performance benchmarking The authors presume no prior parallel

computing experience and cover the basics along with best practices for efficient GPU computing using CUDA Fortran To help you add CUDA Fortran to existing Fortran codes the book explains how to understand the target GPU architecture identify computationally intensive parts of the code and modify the code to manage the data and parallelism and optimize performance All of this is done in Fortran without having to rewrite in another language Each concept is illustrated with actual examples so you can immediately evaluate the performance of your code in comparison Leverage the power of GPU computing with PGI s CUDA Fortran compiler Gain insights from members of the CUDA Fortran language development team Includes multi GPU programming in CUDA Fortran covering both peer to peer and message passing interface MPI approaches Includes full source code for all the examples and several case studies Download source code and slides from the book s companion website

CUDA Programming Shane Cook,2012-12-28 If you need to learn CUDA but don t have experience with parallel computing CUDA Programming A Developer s Introduction offers a detailed guide to CUDA with a grounding in parallel fundamentals It starts by introducing CUDA and bringing you up to speed on GPU parallelism and hardware then delving into CUDA installation Chapters on core concepts including threads blocks grids and memory focus on both parallel and CUDA specific issues Later the book demonstrates CUDA in practice for optimizing applications adjusting to new hardware and solving common problems Comprehensive introduction to parallel programming with CUDA for readers new to both Detailed instructions help readers optimize the CUDA software development kit Practical techniques illustrate working with memory threads algorithms resources and more Covers CUDA on multiple hardware platforms Mac Linux and Windows with several NVIDIA chipsets Each chapter includes exercises to test reader knowledge

Professional CUDA C Programming John Cheng,Max Grossman,Ty McKercher,2014-09-08 Break into the powerful world of parallel GPU programming with this down to earth practical guide Designed for professionals across multiple industrial sectors Professional CUDA C Programming presents CUDA a parallel computing platform and programming model designed to ease the development of GPU programming fundamentals in an easy to follow format and teaches readers how to think in parallel and implement parallel algorithms on GPUs Each chapter covers a specific topic and includes workable examples that demonstrate the development process allowing readers to explore both the hard and soft aspects of GPU programming Computing architectures are experiencing a fundamental shift toward scalable parallel computing motivated by application requirements in industry and science This book demonstrates the challenges of efficiently utilizing compute resources at peak performance presents modern techniques for tackling these challenges while increasing accessibility for professionals who are not necessarily parallel programming experts The CUDA programming model and tools empower developers to write high performance applications on a scalable parallel computing platform the GPU However CUDA itself can be difficult to learn without extensive programming experience Recognized CUDA authorities John Cheng Max Grossman and Ty McKercher guide readers through essential GPU programming skills and best practices in Professional CUDA C

Programming including CUDA Programming Model GPU Execution Model GPU Memory model Streams Event and Concurrency Multi GPU Programming CUDA Domain Specific Libraries Profiling and Performance Tuning The book makes complex CUDA concepts easy to understand for anyone with knowledge of basic software development with exercises designed to be both readable and high performance For the professional seeking entrance to parallel computing and the high performance computing community Professional CUDA C Programming is an invaluable resource with the most current information available on the market

Introduction to High Performance Computing for Scientists and Engineers
Georg Hager, 2010-07-02 Written by high performance computing HPC experts Introduction to High Performance Computing for Scientists and Engineers provides a solid introduction to current mainstream computer architecture dominant parallel programming models and useful optimization strategies for scientific HPC From working in a scientific computing center the author

Hands-On GPU Programming with CUDA Jaegeun Han, Bharatkumar Sharma, 2019-09-27 Explore different GPU programming methods using libraries and directives such as OpenACC with extension to languages such as C C and Python Key Features Learn parallel programming principles and practices and performance analysis in GPU computing Get to grips with distributed multi GPU programming and other approaches to GPU programming Understand how GPU acceleration in deep learning models can improve their performance Book Description Compute Unified Device Architecture CUDA is NVIDIA s GPU computing platform and application programming interface It s designed to work with programming languages such as C C and Python With CUDA you can leverage a GPU s parallel computing power for a range of high performance computing applications in the fields of science healthcare and deep learning Learn CUDA Programming will help you learn GPU parallel programming and understand its modern applications In this book you ll discover CUDA programming approaches for modern GPU architectures You ll not only be guided through GPU features tools and APIs you ll also learn how to analyze performance with sample parallel programming algorithms This book will help you optimize the performance of your apps by giving insights into CUDA programming platforms with various libraries compiler directives OpenACC and other languages As you progress you ll learn how additional computing power can be generated using multiple GPUs in a box or in multiple boxes Finally you ll explore how CUDA accelerates deep learning algorithms including convolutional neural networks CNNs and recurrent neural networks RNNs By the end of this CUDA book you ll be equipped with the skills you need to integrate the power of GPU computing in your applications What you will learn Understand general GPU operations and programming patterns in CUDA Uncover the difference between GPU programming and CPU programming Analyze GPU application performance and implement optimization strategies Explore GPU programming profiling and debugging tools Grasp parallel programming algorithms and how to implement them Scale GPU accelerated applications with multi GPU and multi nodes Delve into GPU programming platforms with accelerated libraries Python and OpenACC Gain insights into deep learning accelerators in CNNs and RNNs using GPUs Who this book is for This beginner

level book is for programmers who want to delve into parallel computing become part of the high performance computing community and build modern applications Basic C and C programming experience is assumed For deep learning enthusiasts this book covers Python InterOps DL libraries and practical examples on performance estimation

Hands-On GPU Programming with Python and CUDA Dr. Brian Tuomanen,2018-11-27 Build real world applications with Python 2 7 CUDA 9 and CUDA 10 We suggest the use of Python 2 7 over Python 3 x since Python 2 7 has stable support across all the libraries we use in this book Key FeaturesExpand your background in GPU programming PyCUDA scikit cuda and NsightEffectively use CUDA libraries such as cuBLAS cuFFT and cuSolverApply GPU programming to modern data science applicationsBook Description Hands On GPU Programming with Python and CUDA hits the ground running you ll start by learning how to apply Amdahl s Law use a code profiler to identify bottlenecks in your Python code and set up an appropriate GPU programming environment You ll then see how to query the GPU s features and copy arrays of data to and from the GPU s own memory As you make your way through the book you ll launch code directly onto the GPU and write full blown GPU kernels and device functions in CUDA C You ll get to grips with profiling GPU code effectively and fully test and debug your code using Nsight IDE Next you ll explore some of the more well known NVIDIA libraries such as cuFFT and cuBLAS With a solid background in place you will now apply your new found knowledge to develop your very own GPU based deep neural network from scratch You ll then explore advanced topics such as warp shuffling dynamic parallelism and PTX assembly In the final chapter you ll see some topics and applications related to GPU programming that you may wish to pursue including AI graphics and blockchain By the end of this book you will be able to apply GPU programming to problems related to data science and high performance computing What you will learnLaunch GPU code directly from PythonWrite effective and efficient GPU kernels and device functionsUse libraries such as cuFFT cuBLAS and cuSolverDebug and profile your code with Nsight and Visual ProfilerApply GPU programming to datascience problemsBuild a GPU based deep neuralnetwork from scratchExplore advanced GPU hardware features such as warp shufflingWho this book is for Hands On GPU Programming with Python and CUDA is for developers and data scientists who want to learn the basics of effective GPU programming to improve performance using Python code You should have an understanding of first year college or university level engineering mathematics and physics and have some experience with Python as well as in any C based programming language such as C C Go or Java

Mastering CUDA C++ Programming: From Fundamentals to Advanced GPU Computing Toby Webber,2025-07-31 Unleash the Power of Parallel Processing with CUDA C Mastering CUDA C Programming Dive into the world of GPU programming and accelerate your applications to new heights Are you ready to harness the incredible power of parallel processing Mastering CUDA C Programming is your comprehensive guide to unlocking the full potential of NVIDIA GPUs for general purpose computing Whether you re a curious beginner or a seasoned programmer this book will equip you with the knowledge and skills to write high performance CUDA C applications What is

CUDA Compute Unified Device Architecture is a parallel computing platform and programming model developed by NVIDIA. It allows you to use GPUs for general purpose processing, accelerating applications in fields like artificial intelligence, scientific computing, and high performance data processing.

Why Choose This Book: Crystal Clear Explanations: Complex concepts are broken down into digestible chunks with plenty of examples and analogies to aid understanding. Even if you're new to GPU programming or parallel programming, you'll grasp the fundamentals with ease. Hands On Learning: Solidify your understanding with practical projects that guide you through building real world CUDA applications. You'll find CUDA examples throughout the book illustrating key concepts and techniques.

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Parallel and High Performance Computing Robert Robey, Yuliana Zamora, 2021-08-24. *Parallel and High Performance Computing* offers techniques guaranteed to boost your code's effectiveness. Summary: Complex calculations like training deep learning models or running large scale simulations can take an extremely long time. Efficient parallel programming can save hours or even days of computing time. *Parallel and High Performance Computing* shows you how to deliver faster run times, greater scalability, and increased energy efficiency to your programs by mastering parallel techniques for multicore processor and GPU hardware.

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help you can create software that maximizes both speed and efficiency About the book Parallel and High Performance Computing offers techniques guaranteed to boost your code s effectiveness You ll learn to evaluate hardware architectures and work with industry standard tools such as OpenMP and MPI You ll master the data structures and algorithms best suited for high performance computing and learn techniques that save energy on handheld devices You ll even run a massive tsunami simulation across a bank of GPUs What s inside Planning a new parallel project Understanding differences in CPU and GPU architecture Addressing underperforming kernels and loops Managing applications with batch scheduling About the reader For experienced programmers proficient with a high performance computing language like C C or Fortran About the author Robert Robey works at Los Alamos National Laboratory and has been active in the field of parallel computing for over 30 years Yuliana Zamora is currently a PhD student and Siebel Scholar at the University of Chicago and has lectured on programming modern hardware at numerous national conferences Table of Contents PART 1 INTRODUCTION TO PARALLEL COMPUTING 1 Why parallel computing 2 Planning for parallelization 3 Performance limits and profiling 4 Data design and performance models 5 Parallel algorithms and patterns PART 2 CPU THE PARALLEL WORKHORSE 6 Vectorization FLOPs for free 7 OpenMP that performs 8 MPI The parallel backbone PART 3 GPUS BUILT TO ACCELERATE 9 GPU architectures and concepts 10 GPU programming model 11 Directive based GPU programming 12 GPU languages Getting down to basics 13 GPU profiling and tools PART 4 HIGH PERFORMANCE COMPUTING ECOSYSTEMS 14 Affinity Truce with the kernel 15 Batch schedulers Bringing order to chaos 16 File operations for a parallel world 17 Tools and resources for better code

Introduction to High Performance Computing for Scientists and Engineers Taylor & Francis Group,2019-01-14 Written by high performance computing HPC experts Introduction to High Performance Computing for Scientists and Engineers provides a solid introduction to current mainstream computer architecture dominant parallel programming models and useful optimization strategies for scientific HPC From working in a scientific computing center the authors gained a unique perspective on the requirements and attitudes of users as well as manufacturers of parallel computers The text first introduces the architecture of modern cache based microprocessors and discusses their inherent performance limitations before describing general optimization strategies for serial code on cache based architectures It next covers shared and distributed memory parallel computer architectures and the most relevant network topologies After discussing parallel computing on a theoretical level the authors show how to avoid or ameliorate typical performance problems connected with OpenMP They then present cache coherent non uniform memory access ccNUMA optimization techniques examine distributed memory parallel programming with message passing interface MPI and explain how to write efficient MPI code The final chapter focuses on hybrid programming with MPI and OpenMP Users of high performance computers often have no idea what factors limit time to solution and whether it makes sense to think about optimization at all This book facilitates an intuitive understanding of performance limitations without relying on heavy computer science knowledge It also prepares

readers for studying more advanced literature Read about the authors recent honor Informatics Europe Curriculum Best Practices Award for Parallelism and Concurrency *High Performance Parallel Computing* Satyadhyan Chickerur,2019-03-13 This edited book aims to present the state of the art in research and development of the convergence of high performance computing and parallel programming for various engineering and scientific applications The book has consolidated algorithms techniques and methodologies to bridge the gap between the theoretical foundations of academia and implementation for research which might be used in business and other real time applications in the future The book outlines techniques and tools used for emergent areas and domains which include acceleration of large scale electronic structure simulations with heterogeneous parallel computing characterizing power and energy efficiency of a data centric high performance computing runtime and applications security applications of GPUs parallel implementation of multiprocessors on MPI using FDTD particle based fused rendering design and implementation of particle systems for mesh free methods with high performance and evolving topics on heterogeneous computing In the coming days the need to converge HPC IoT cloud based applications will be felt and this volume tries to bridge that gap **Parallel and High Performance Programming with Python (2nd Edition)** Fabio Nelli ,2026-02-05 Unleash the Full Power of Python to Run Faster Code Scale Smarter and Compute Without Limits Key Features Get a free one month digital subscription to www.avaskillshelf.com Master end to end Python parallelism from multithreading and multiprocessing to distributed computing on GPUs clusters and the cloud Accelerate real world workloads using cutting edge frameworks like Ray Dask PyTorch Spark Modin Joblib and CUDA Deploy high performance pipelines at scale with Kubernetes serverless computing FPGAs and emerging quantum acceleration techniques Book Description Python is the backbone for data science AI and cloud computing and the demand for speed and scalability has never been higher That s why mastering parallel and high performance programming is essential to transform Python into a tool that meets modern performance demands Building on the success of the first edition *Parallel and High Performance Programming with Python 2nd Edition* expands and modernizes the original work adding new frameworks deployment patterns and acceleration techniques for next generation computing You ll begin by mastering the core concepts of parallelism threading and multiprocessing then move into asynchronous programming for responsive and efficient workloads The book guides you through distributed Python across clusters followed by deep dives into GPU acceleration using CUDA and PyTorch You ll explore real world applications in data science and artificial intelligence and learn how to scale pipelines seamlessly with Ray Modin and Spark Advanced chapters introduce Joblib optimization Kubernetes and serverless scaling for cloud native workloads and cutting edge topics such as FPGA acceleration and quantum computing giving you a future ready performance toolkit Packed with hands on examples benchmarks and deployment ready best practices this second edition helps you turn everyday Python into a high performance production grade system What you will learn Design and optimize high performance Python applications using

parallelism concurrency and async patterns Profile diagnose and eliminate CPU I O and memory bottlenecks for real world workloads Accelerate compute intensive tasks using CUDA kernels PyTorch tensors NumPy vectorization and GPU enabled deep learning workflows Build and scale distributed systems seamlessly with Dask Ray Apache Spark and Modin for massive data processing Deploy and orchestrate compute pipelines on Kubernetes AWS Lambda and Azure Functions for cost efficient scalability Integrate advanced acceleration technologies like Joblib FPGA workflows and quantum simulation frameworks to stay ahead of the curve Who is This Book For This book is tailored for data scientists machine learning engineers Python developers and backend programmers who need to boost performance and scalability in their applications It also serves data and cloud engineers DevOps MLOps professionals HPC specialists and distributed systems developers building high throughput pipelines Technical architects research engineers and quantitative analysts will find advanced design patterns to optimize workloads across CPUs GPUs clusters FPGAs and serverless or quantum environments Table of Contents 1 Introduction to Parallel Programming 2 Parallel Programming with Threads 3 Parallel Programming with Processes 4 Asynchronous Programming 5 Distributed Python 6 GPU Programming with Python 7 Parallel Computing Applications 8 Parallel Computing for Data Science 9 Parallel Computing for Artificial Intelligence 10 Future of Parallel Programming 11 Modern Frameworks for Parallelism and Distribution Ray and Modin 12 PySpark 13 Joblib 14 Parallelization on Cloud and Serverless Systems 15 Parallel Programming with FPGAs 16 Introduction to Quantum Computing and Quantum Architectures Index

Adopting the Track of Phrase: An Mental Symphony within **Cuda For Engineers An Introduction To High Performance Parallel Computing**

In a world used by monitors and the ceaseless chatter of immediate communication, the melodic splendor and emotional symphony produced by the prepared word often diminish in to the backdrop, eclipsed by the constant sound and disturbances that permeate our lives. Nevertheless, set within the pages of **Cuda For Engineers An Introduction To High Performance Parallel Computing** a stunning fictional treasure overflowing with organic feelings, lies an immersive symphony waiting to be embraced. Constructed by a masterful musician of language, that interesting masterpiece conducts viewers on a psychological trip, well unraveling the concealed songs and profound affect resonating within each carefully constructed phrase. Within the depths of this touching evaluation, we shall explore the book is central harmonies, analyze their enthralling publishing fashion, and surrender ourselves to the profound resonance that echoes in the depths of readers souls.

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