

Programming Distributed Computing Systems A Foundational Approach

In this book, a programming model is developed that addresses the fundamental issues of 'large-scale programming'. The approach unifies several concepts from database theory, object-oriented programming and designs of reactive systems. The model and the associated theory has been christened "Seuss." The major goal of Seuss is to simplify multiprogramming. To this end, the concern of concurrent implementation is separated from the core program design problem. A program execution is understood as a single thread of control - sequential executions of actions that are chosen according to some scheduling policy. As a consequence, it is possible to reason about the properties of a program from its single execution thread.

In *Distributed Algorithms*, Nancy Lynch provides a blueprint for designing, implementing, and analyzing distributed algorithms. She directs her book at a wide audience, including students, programmers, system designers, and researchers. *Distributed Algorithms* contains the most significant algorithms and impossibility results in the area, all in a simple automata-theoretic setting. The algorithms are proved correct, and their complexity is analyzed according to precisely defined complexity measures. The problems covered include resource allocation, communication, consensus among distributed processes, data consistency, deadlock detection, leader election, global snapshots, and many others. The material is organized according to the system model—first by the timing model and then by the interprocess communication mechanism. The material on system models is isolated in separate chapters for easy reference. The presentation is completely rigorous, yet is intuitive enough for immediate comprehension. This book familiarizes readers with important problems, algorithms, and impossibility results in the area: readers can then recognize the problems when they arise in practice, apply the algorithms to solve them, and use the impossibility results to determine whether problems are unsolvable. The book also provides readers with the basic mathematical tools for designing new algorithms and proving new impossibility results. In addition, it teaches readers how to reason carefully about distributed algorithms—to model them formally, devise precise specifications for their required behavior, prove their correctness, and evaluate their performance with realistic measures.

In modern computing a program is usually distributed among several processes. The fundamental challenge when developing reliable and secure distributed programs is to support the cooperation of processes required to execute a common task, even when some of these processes fail. Failures may range from crashes to adversarial attacks by malicious processes. Cachin, Guerraoui, and Rodrigues present an introductory description of fundamental distributed programming abstractions together with algorithms to implement them in distributed systems, where processes are subject to crashes and malicious

attacks. The authors follow an incremental approach by first introducing basic abstractions in simple distributed environments, before moving to more sophisticated abstractions and more challenging environments. Each core chapter is devoted to one topic, covering reliable broadcast, shared memory, consensus, and extensions of consensus. For every topic, many exercises and their solutions enhance the understanding. This book represents the second edition of "Introduction to Reliable Distributed Programming". Its scope has been extended to include security against malicious actions by non-cooperating processes. This important domain has become widely known under the name "Byzantine fault-tolerance".

Programming multi-core and many-core computing systems Sabri Pllana, Linnaeus University, Sweden Fatos Xhafa, Technical University of Catalonia, Spain Provides state-of-the-art methods for programming multi-core and many-core systems The book comprises a selection of twenty two chapters covering: fundamental techniques and algorithms; programming approaches; methodologies and frameworks; scheduling and management; testing and evaluation methodologies; and case studies for programming multi-core and many-core systems. Program development for multi-core processors, especially for heterogeneous multi-core processors, is significantly more complex than for single-core processors. However, programmers have been traditionally trained for the development of sequential programs, and only a small percentage of them have experience with parallel programming. In the past, only a relatively small group of programmers interested in High Performance Computing (HPC) was concerned with the parallel programming issues, but the situation has changed dramatically with the appearance of multi-core processors on commonly used computing systems. It is expected that with the pervasiveness of multi-core processors, parallel programming will become mainstream. The pervasiveness of multi-core processors affects a large spectrum of systems, from embedded and general-purpose, to high-end computing systems. This book assists programmers in mastering the efficient programming of multi-core systems, which is of paramount importance for the software-intensive industry towards a more effective product-development cycle. Key features: Lessons, challenges, and roadmaps ahead. Contains real world examples and case studies. Helps programmers in mastering the efficient programming of multi-core and many-core systems. The book serves as a reference for a larger audience of practitioners, young researchers and graduate level students. A basic level of programming knowledge is required to use this book.

This book introduces readers to selected issues in distributed systems, and primarily focuses on principles, not on technical details. Though the systems discussed are based on existing (von Neumann) computer architectures, the book also touches on emerging processing paradigms. Uniquely, it approaches system components not only as static constructs, but also "in action," exploring the different states they pass through. The author's teaching experience shows

that newcomers to the field, students and even IT professionals can far more readily grasp the essence of distributed algorithmic structures in action, than on the basis of static descriptions.

This book constitutes the proceedings of the 9th International Conference on Internet and Distributed Computing Systems, IDCS 2016, held in Wuhan, China, in September 2016. The 30 full papers and 18 short papers presented in this volume were carefully reviewed and selected from 78 submissions. They were organized in topical sections named: body sensor networks and wearable devices; cloud computing and networking; distributed computing and big data; distributed scheduling and optimization; internet of things and its application; smart networked transportation and logistics; and big data and social networks. This text is based on a simple and fully reactive computational model that allows for intuitive comprehension and logical designs. The principles and techniques presented can be applied to any distributed computing environment (e.g., distributed systems, communication networks, data networks, grid networks, internet, etc.). The text provides a wealth of unique material for learning how to design algorithms and protocols perform tasks efficiently in a distributed computing environment.

* An invaluable reference for anyone designing new parallel or distributed systems. * Includes detailed case studies of specific systems from Stanford, MIT, and other leading research universities. * The authors emphasize performance, surveying all available techniques.

An introduction to fundamental theories of concurrent computation and associated programming languages for developing distributed and mobile computing systems. Starting from the premise that understanding the foundations of concurrent programming is key to developing distributed computing systems, this book first presents the fundamental theories of concurrent computing and then introduces the programming languages that help develop distributed computing systems at a high level of abstraction. The major theories of concurrent computation—including the π -calculus, the actor model, the join calculus, and mobile ambients—are explained with a focus on how they help design and reason about distributed and mobile computing systems. The book then presents programming languages that follow the theoretical models already described, including Pict, SALSA, and JoCaml. The parallel structure of the chapters in both part one (theory) and part two (practice) enable the reader not only to compare the different theories but also to see clearly how a programming language supports a theoretical model. The book is unique in bridging the gap between the theory and the practice of programming distributed computing systems. It can be used as a textbook for graduate and advanced undergraduate students in computer science or as a reference for researchers in the area of programming technology for distributed computing. By presenting theory first, the book allows readers to focus on the essential components of concurrency, distribution, and mobility without getting bogged down in syntactic details of specific programming languages. Once the theory is understood, the practical part of implementing a system in an actual programming language becomes much easier.

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Future requirements for computing speed, system reliability, and cost-effectiveness entail the development of alternative computers to replace the traditional von Neumann organization. As computing networks come into being, one of the latest dreams is now possible - distributed computing. Distributed computing brings transparent access to as much computer power and data as the user needs for accomplishing any given task - simultaneously achieving high performance and reliability. The subject of distributed computing is diverse, and many researchers are investigating various issues concerning the structure of hardware and the design of distributed software. Distributed System Design defines a distributed system as one that looks to its users like an ordinary system, but runs on a set of autonomous processing elements (PEs) where each PE has a separate physical memory space and the message transmission delay is not negligible. With close cooperation among these PEs, the system supports an arbitrary number of processes and dynamic extensions. Distributed System Design outlines the main motivations for building a distributed system, including: inherently distributed applications performance/cost resource sharing flexibility and extendibility availability and fault tolerance scalability Presenting basic concepts, problems, and possible solutions, this reference serves graduate students in distributed system design as well as computer professionals analyzing and designing distributed/open/parallel systems. Chapters discuss: the scope of distributed computing systems general distributed programming languages and a CSP-like distributed control description language (DCDL) expressing parallelism, interprocess communication and synchronization, and fault-tolerant design two approaches describing a distributed system: the time-space view and the interleaving view mutual exclusion and related issues, including election, bidding, and self-stabilization prevention and detection of deadlock reliability, safety, and security as well as various methods of handling node,

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communication, Byzantine, and software faults efficient interprocessor communication mechanisms as well as these mechanisms without specific constraints, such as adaptiveness, deadlock-freedom, and fault-tolerance virtual channels and virtual networks load distribution problems synchronization of access to shared data while supporting a high degree of concurrency

In modern computing a program is usually distributed among several processes. The fundamental challenge when developing reliable distributed programs is to support the cooperation of processes required to execute a common task, even when some of these processes fail. Guerraoui and Rodrigues present an introductory description of fundamental reliable distributed programming abstractions as well as algorithms to implement these abstractions. The authors follow an incremental approach by first introducing basic abstractions in simple distributed environments, before moving to more sophisticated abstractions and more challenging environments. Each core chapter is devoted to one specific class of abstractions, covering reliable delivery, shared memory, consensus and various forms of agreement. This textbook comes with a companion set of running examples implemented in Java. These can be used by students to get a better understanding of how reliable distributed programming abstractions can be implemented and used in practice. Combined, the chapters deliver a full course on reliable distributed programming. The book can also be used as a complete reference on the basic elements required to build reliable distributed applications.

A lucid and up-to-date introduction to the fundamentals of distributed computing systems As distributed systems become increasingly available, the need for a fundamental discussion of the subject has grown. Designed for first-year graduate students and advanced undergraduates as well as practicing computer engineers seeking a solid grounding in the subject, this well-organized text covers the fundamental concepts in distributed computing systems such as time, state, simultaneity, order, knowledge, failure, and agreement in distributed systems. Departing from the focus on shared memory and synchronous systems commonly taken by other texts, this is the first useful reference based on an asynchronous model of distributed computing, the most widely used in academia and industry. The emphasis of the book is on developing general mechanisms that can be applied to a variety of problems. Its examples-clocks, locks, cameras, sensors, controllers, slicers, and synchronizers-have been carefully chosen so that they are fundamental and yet useful in practical contexts. The text's advantages include: Emphasizes general mechanisms that can be applied to a variety of problems Uses a simple induction-based technique to prove correctness of all algorithms Includes a variety of exercises at the end of each chapter Contains material that has been extensively class tested Gives instructor flexibility in choosing appropriate balance between practice and theory of distributed computing

Harness the power of multiple computers using Python through this fast-paced informative guide About This Book You'll learn to write data processing programs in Python that are highly available, reliable, and fault tolerant Make use of Amazon Web Services along with Python to establish a powerful remote computation system Train Python to handle data-intensive and resource hungry applications Who This Book Is For This book is for Python developers who have developed Python programs for data

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processing and now want to learn how to write fast, efficient programs that perform CPU-intensive data processing tasks. What You Will Learn Get an introduction to parallel and distributed computing See synchronous and asynchronous programming Explore parallelism in Python Distributed application with Celery Python in the Cloud Python on an HPC cluster Test and debug distributed applications In Detail CPU-intensive data processing tasks have become crucial considering the complexity of the various big data applications that are used today. Reducing the CPU utilization per process is very important to improve the overall speed of applications. This book will teach you how to perform parallel execution of computations by distributing them across multiple processors in a single machine, thus improving the overall performance of a big data processing task. We will cover synchronous and asynchronous models, shared memory and file systems, communication between various processes, synchronization, and more. Style and Approach This example based, step-by-step guide will show you how to make the best of your hardware configuration using Python for distributing applications.

Distributed Systems: An Algorithmic Approach, Second Edition provides a balanced and straightforward treatment of the underlying theory and practical applications of distributed computing. As in the previous version, the language is kept as unobscured as possible—clarity is given priority over mathematical formalism. This easily digestible text: Features significant updates that mirror the phenomenal growth of distributed systems Explores new topics related to peer-to-peer and social networks Includes fresh exercises, examples, and case studies Supplying a solid understanding of the key principles of distributed computing and their relationship to real-world applications, Distributed Systems: An Algorithmic Approach, Second Edition makes both an ideal textbook and a handy professional reference.

Explore the power of distributed computing to write concurrent, scalable applications in Java About This Book Make the best of Java 9 features to write succinct code Handle large amounts of data using HPC Make use of AWS and Google App Engine along with Java to establish a powerful remote computation system Who This Book Is For This book is for basic to intermediate level Java developers who is aware of object-oriented programming and Java basic concepts. What You Will Learn Understand the basic concepts of parallel and distributed computing/programming Achieve performance improvement using parallel processing, multithreading, concurrency, memory sharing, and hpc cluster computing Get an in-depth understanding of Enterprise Messaging concepts with Java Messaging Service and Web Services in the context of Enterprise Integration Patterns Work with Distributed Database technologies Understand how to develop and deploy a distributed application on different cloud platforms including Amazon Web Service and Docker CaaS Concepts Explore big data technologies Effectively test and debug distributed systems Gain thorough knowledge of security standards for distributed applications including two-way Secure Socket Layer In Detail Distributed computing is the concept with which a bigger computation process is accomplished by splitting it

into multiple smaller logical activities and performed by diverse systems, resulting in maximized performance in lower infrastructure investment. This book will teach you how to improve the performance of traditional applications through the usage of parallelism and optimized resource utilization in Java 9. After a brief introduction to the fundamentals of distributed and parallel computing, the book moves on to explain different ways of communicating with remote systems/objects in a distributed architecture. You will learn about asynchronous messaging with enterprise integration and related patterns, and how to handle large amount of data using HPC and implement distributed computing for databases. Moving on, it explains how to deploy distributed applications on different cloud platforms and self-contained application development. You will also learn about big data technologies and understand how they contribute to distributed computing. The book concludes with the detailed coverage of testing, debugging, troubleshooting, and security aspects of distributed applications so the programs you build are robust, efficient, and secure. Style and approach This is a step-by-step practical guide with real-world examples.

This timely text/reference describes the development and implementation of large-scale distributed processing systems using open source tools and technologies. Comprehensive in scope, the book presents state-of-the-art material on building high performance distributed computing systems, providing practical guidance and best practices as well as describing theoretical software frameworks.

Features: describes the fundamentals of building scalable software systems for large-scale data processing in the new paradigm of high performance distributed computing; presents an overview of the Hadoop ecosystem, followed by step-by-step instruction on its installation, programming and execution; Reviews the basics of Spark, including resilient distributed datasets, and examines Hadoop streaming and working with Scalding; Provides detailed case studies on approaches to clustering, data classification and regression analysis; Explains the process of creating a working recommender system using Scalding and Spark.

Topics in Parallel and Distributed Computing provides resources and guidance for those learning PDC as well as those teaching students new to the discipline. The pervasiveness of computing devices containing multicore CPUs and GPUs, including home and office PCs, laptops, and mobile devices, is making even common users dependent on parallel processing. Certainly, it is no longer sufficient for even basic programmers to acquire only the traditional sequential programming skills. The preceding trends point to the need for imparting a broad-based skill set in PDC technology. However, the rapid changes in computing hardware platforms and devices, languages, supporting programming environments, and research advances, poses a challenge both for newcomers and seasoned computer scientists. This edited collection has been developed over the past several years in conjunction with the IEEE technical committee on parallel processing (TCPP), which held several workshops and discussions on

learning parallel computing and integrating parallel concepts into courses throughout computer science curricula. Contributed and developed by the leading minds in parallel computing research and instruction Provides resources and guidance for those learning PDC as well as those teaching students new to the discipline Succinctly addresses a range of parallel and distributed computing topics Pedagogically designed to ensure understanding by experienced engineers and newcomers Developed over the past several years in conjunction with the IEEE technical committee on parallel processing (TCPP), which held several workshops and discussions on learning parallel computing and integrating parallel concepts

This book, presented in three volumes, examines environmental disciplines in relation to major players in contemporary science: Big Data, artificial intelligence and cloud computing. Today, there is a real sense of urgency regarding the evolution of computer technology, the ever-increasing volume of data, threats to our climate and the sustainable development of our planet. As such, we need to reduce technology just as much as we need to bridge the global socio-economic gap between the North and South; between universal free access to data (open data) and free software (open source). In this book, we pay particular attention to certain environmental subjects, in order to enrich our understanding of cloud computing. These subjects are: erosion; urban air pollution and atmospheric pollution in Southeast Asia; melting permafrost (causing the accelerated release of soil organic carbon in the atmosphere); alert systems of environmental hazards (such as forest fires, prospective modeling of socio-spatial practices and land use); and web fountains of geographical data. Finally, this book asks the question: in order to find a pattern in the data, how do we move from a traditional computing model-based world to pure mathematical research? After thorough examination of this topic, we conclude that this goal is both transdisciplinary and achievable.

Distributed computing and Java go together naturally. As the first language designed from the bottom up with networking in mind, Java makes it very easy for computers to cooperate. Even the simplest applet running in a browser is a distributed application, if you think about it. The client running the browser downloads and executes code that is delivered by some other system. But even this simple applet wouldn't be possible without Java's guarantees of portability and security: the applet can run on any platform, and can't sabotage its host. Of course, when we think of distributed computing, we usually think of applications more complex than a client and server communicating with the same protocol. We usually think in terms of programs that make remote procedure calls, access remote databases, and collaborate with others to produce a single result. Java Distributed Computing discusses how to design and write such applications. It covers Java's RMI (Remote Method Invocation) facility and CORBA, but it doesn't stop there; it tells you how to design your own protocols to build message passing systems and discusses how to use Java's security facilities, how to write

multithreaded servers, and more. It pays special attention to distributed data systems, collaboration, and applications that have high bandwidth requirements. In the future, distributed computing can only become more important. Java Distributed Computing provides a broad introduction to the problems you'll face and the solutions you'll find as you write distributed computing applications. Topics covered in Java Distributed Computing: Introduction to Distributed Computing Networking Basics Distributed Objects (Overview of CORBA and RMI) Threads Security Message Passing Systems Distributed Data Systems (Databases) Bandwidth Limited Applications Collaborative Systems

Distributed Computer Systems: Theory and Practice is a collection of papers dealing with the design and implementation of operating systems, including distributed systems, such as the amoeba system, argus, Andrew, and grapevine. One paper discusses the concepts and notations for concurrent programming, particularly language notation used in computer programming, synchronization methods, and also compares three classes of languages. Another paper explains load balancing or load redistribution to improve system performance, namely, static balancing and adaptive load balancing. For program efficiency, the user can choose from various debugging approaches to locate or fix errors without significantly disturbing the program behavior. Examples of debuggers pertain to the ada language and the occam programming language. Another paper describes the architecture of a real-time distributed database system used for computer network management, monitoring integration, as well as administration and control of both local area or wide area communications networks. The book can prove helpful to programmers, computer engineers, computer technicians, and computer instructors dealing with many aspects of computers, such as programming, hardware interface, networking, engineering or design.

In the race to compete in today's fast-moving markets, large enterprises are busy adopting new technologies for creating new products, processes, and business models. But one obstacle on the road to digital transformation is placing too much emphasis on technology, and not enough on the types of processes technology enables. What if different lines of business could build their own services and applications—and decision-making was distributed rather than centralized? This report explores the concept of a digital business platform as a way of empowering individual business sectors to act on data in real time. Much innovation in a digital enterprise will increasingly happen at the edge, whether it involves business users (from marketers to data scientists) or IoT devices. To facilitate the process, your core IT team can provide these sectors with the digital tools they need to innovate quickly. This report explores: Key cultural and organizational changes for developing business capabilities through cross-functional product teams A platform for integrating applications, data sources, business partners, clients, mobile apps, social networks, and IoT devices Creating internal API programs for building innovative edge services in low-code

or no-code environments Tools including Integration Platform as a Service, Application Platform as a Service, and Integration Software as a Service The challenge of integrating microservices and serverless architectures Event-driven architectures for processing and reacting to events in real time You'll also learn about a complete pervasive integration solution as a core component of a digital business platform to serve every audience in your organization.

The communications-served data-processing system. Today's teleprocessing systems. System trends. Evolution of configuration and function distribution. Improving line utilization. System objectives summary. The architectural layers. Basic concepts of systems network architecture. Higher-level services of sna network. Data flow control. Transmission control. Path control. Data link control. Overview of operations. Putting it together. Finite state architecture. Reliability and security control. Advanced functions. Multidomain networks. Routing techniques. Interfacing to new data networks.

Distributed Computer Control Systems: Proceedings of the IFAC Workshop, Tampa, Florida, U.S.A., 2-4 October 1979 focuses on the design, processes, methodologies, and applications of distributed computing systems. The selection first discusses the use of distributed control systems for facility energy management, including space conditioning control, plant design, central plant control, and system design. The book then takes a look at programming distributed computer systems with higher level languages. Topics include design of an application programming language for distributed computing systems; realization of a suitable programming language for distributed computing systems; and optimal structure and capabilities of an automatic control system. The text focuses on the similarities and differences of distributed computer control systems; transaction processing as an efficient conceptual framework for comparing and understanding distributed systems; and multi-processor approach for the automation of quality control in an overall production control system. The selection also deals with transaction processing in distributed control systems; parallel processing for distributed computer control systems; and design and development of distributed control systems. The book is a vital source of data for readers interested in distributed computing.

Systems Programming: Designing and Developing Distributed Applications explains how the development of distributed applications depends on a foundational understanding of the relationship among operating systems, networking, distributed systems, and programming. Uniquely organized around four viewpoints (process, communication, resource, and architecture), the fundamental and essential characteristics of distributed systems are explored in ways which cut across the various traditional subject area boundaries. The structures, configurations and behaviours of distributed systems are all examined, allowing readers to explore concepts from different perspectives, and to understand systems in depth, both from the component level and holistically. Explains key ideas from the ground up, in a self-contained style, with material

carefully sequenced to make it easy to absorb and follow. Features a detailed case study that is designed to serve as a common point of reference and to provide continuity across the different technical chapters. Includes a 'putting it all together' chapter that looks at interesting distributed systems applications across their entire life-cycle from requirements analysis and design specifications to fully working applications with full source code. Ancillary materials include problems and solutions, programming exercises, simulation experiments, and a wide range of fully working sample applications with complete source code developed in C++, C# and Java. Special editions of the author's established 'workbenches' teaching and learning tools suite are included. These tools have been specifically designed to facilitate practical experimentation and simulation of complex and dynamic aspects of systems.

This is the book for Gophers who want to learn how to build distributed systems. You know the basics of Go and are eager to put your knowledge to work. Build distributed services that are highly available, resilient, and scalable. This book is just what you need to apply Go to real-world situations. Level up your engineering skills today. Take your Go skills to the next level by learning how to design, develop, and deploy a distributed service. Start from the bare essentials of storage handling, then work your way through networking a client and server, and finally to distributing server instances, deployment, and testing. All this will make coding in your day job or side projects easier, faster, and more fun. Create your own distributed services and contribute to open source projects. Build networked, secure clients and servers with gRPC. Gain insights into your systems and debug issues with observable services instrumented with metrics, logs, and traces. Operate your own Certificate Authority to authenticate internal web services with TLS. Automatically handle when nodes are added or removed to your cluster with service discovery. Coordinate distributed systems with replicated state machines powered by the Raft consensus algorithm. Lay out your applications and libraries to be modular and easy to maintain. Write CLIs to configure and run your applications. Run your distributed system locally and deploy to the cloud with Kubernetes. Test and benchmark your applications to ensure they're correct and fast. Dive into writing Go and join the hundreds of thousands who are using it to build software for the real world. What You Need: Go 1.13+ and Kubernetes 1.16+

Both authors have taught the course of "Distributed Systems" for many years in the respective schools. During the teaching, we feel strongly that "Distributed systems" have evolved from traditional "LAN" based distributed systems towards "Internet based" systems. Although there exist many excellent textbooks on this topic, because of the fast development of distributed systems and network programming/protocols, we have difficulty in finding an appropriate textbook for the course of "distributed systems" with orientation to the requirement of the undergraduate level study for today's distributed technology. Specifically, from - to-date concepts, algorithms, and models to implementations

for both distributed system designs and application programming. Thus the philosophy behind this book is to integrate the concepts, algorithm designs and implementations of distributed systems based on network programming. After using several materials of other textbooks and research books, we found that many texts treat the distributed systems with separation of concepts, algorithm design and network programming and it is very difficult for students to map the concepts of distributed systems to the algorithm design, prototyping and implementations. This book intends to enable readers, especially postgraduates and senior undergraduate level, to study up-to-date concepts, algorithms and network programming skills for building modern distributed systems. It enables students not only to master the concepts of distributed network system but also to readily use the material introduced into implementation practices.

Designing distributed computing systems is a complex process requiring a solid understanding of the design problems and the theoretical and practical aspects of their solutions. This comprehensive textbook covers the fundamental principles and models underlying the theory, algorithms and systems aspects of distributed computing. Broad and detailed coverage of the theory is balanced with practical systems-related issues such as mutual exclusion, deadlock detection, authentication, and failure recovery. Algorithms are carefully selected, lucidly presented, and described without complex proofs. Simple explanations and illustrations are used to elucidate the algorithms. Important emerging topics such as peer-to-peer networks and network security are also considered. With vital algorithms, numerous illustrations, examples and homework problems, this textbook is suitable for advanced undergraduate and graduate students of electrical and computer engineering and computer science. Practitioners in data networking and sensor networks will also find this a valuable resource. Additional resources are available online at www.cambridge.org/9780521876346.

Concurrent and Distributed Computing in Java addresses fundamental concepts in concurrent computing with Java examples. The book consists of two parts. The first part deals with techniques for programming in shared-memory based systems. The book covers concepts in Java such as threads, synchronized methods, waits, and notify to expose students to basic concepts for multi-threaded programming. It also includes algorithms for mutual exclusion, consensus, atomic objects, and wait-free data structures. The second part of the book deals with programming in a message-passing system. This part covers resource allocation problems, logical clocks, global property detection, leader election, message ordering, agreement algorithms, checkpointing, and message logging. Primarily a textbook for upper-level undergraduates and graduate students, this thorough treatment will also be of interest to professional programmers.

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Computers and computer networks are one of the most incredible inventions of the 20th century, having an ever-expanding role in our daily lives by enabling complex human activities in areas such as entertainment, education, and commerce. One of the most challenging problems in computer science for the 21st century is to improve the design of distributed systems where computing devices have to work together as a team to achieve common goals. In this book, I have tried to gently introduce the general reader to some of the most fundamental issues and classical results of computer science underlying the design of algorithms for distributed systems, so that the reader can get a feel of the nature of this exciting and fascinating field called distributed computing. The book will appeal to the educated layperson and requires no computer-related background. I strongly suspect that also most computer knowledgeable readers will be able to learn something new.

A tutorial leading the aspiring Go developer to full mastery of Golang's distributed features. Key Features This book provides enough concurrency theory to give you a contextual understanding of Go concurrency It gives weight to synchronous and asynchronous data streams in Golang web applications It makes Goroutines and Channels completely familiar and natural to Go developers Book Description Distributed Computing with Go gives developers with a good idea how basic Go development works the tools to fulfill the true potential of Golang development in a world of concurrent web and cloud applications. Nikhil starts out by setting up a professional Go development environment. Then you'll learn the basic concepts and practices of Golang concurrent and parallel development. You'll find out in the new few chapters how to balance resources and data with REST and standard web approaches while keeping concurrency in mind. Most Go applications these days will run in a data center or on the cloud, which is a condition upon which the next chapter depends. There, you'll expand your skills considerably by writing a distributed document indexing system during the next two chapters. This system has to balance a large corpus of documents with considerable analytical demands. Another use case is the way in which a web application written in Go can be consciously redesigned to take distributed features into account. The chapter is rather interesting for Go developers who have to migrate existing Go applications to computationally and memory-intensive environments. The final chapter relates to the rather onerous task of testing parallel and distributed applications, something that is not usually taught in standard computer science curricula. What you will learn Gain proficiency with concurrency and parallelism in Go Learn how to test your application using Go's standard library Learn industry best practices with technologies such as REST, OpenAPI, Docker, and so on Design and build a distributed search engine Learn strategies on how to design a system for web scale Who this book is for This book is for developers who are familiar with the Golang syntax and have a good idea of how basic Go development works. It would be advantageous if you have been through a web application product cycle, although it's not necessary.

Java's rich, comprehensive networking interfaces make it an ideal platform for building today's networked, Internet-centered applications, components, and Web services. Now, two Java networking experts demystify Java's complex networking API, giving developers practical insight into the key techniques of network development, and providing extensive code examples that show exactly how it's done. David and Michael Reilly begin by reviewing fundamental Internet architecture and TCP/IP protocol concepts all network programmers need to understand, as well as general Java features and techniques that are especially important in network programming, such as exception handling and input/output. Using practical examples, they show how to write clients and servers using UDP and TCP; how to build multithreaded network applications; and how to utilize HTTP and access the Web using Java. The book includes detailed coverage of server-side application development; distributed computing development with RMI and CORBA; and email-enabling applications with the powerful JavaMail API. For all beginning to intermediate Java programmers, network programmers who

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need to learn to work with Java.

This title gives students an integrated and rigorous picture of applied computer science, as it comes to play in the construction of a simple yet powerful computer system.

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