Hagit Attiya · Faith Ellen

# Impossibility Results for Distributed Computing

# Impossibility Results For Distributed Computing Hagit Attiya

**Rachid Guerraoui**

**Impossibility Results For Distributed Computing Hagit Attiya:**

Impossibility Results for Distributed Computing Hagit Attiya,Faith Ellen,2014-05-01 To understand the power of distributed systems it is necessary to understand their inherent limitations what problems cannot be solved in particular systems or without sufficient resources such as time or space This book presents key techniques for proving such impossibility results and applies them to a variety of different problems in a variety of different system models Insights gained from these results are highlighted aspects of a problem that make it difficult are isolated features of an architecture that make it inadequate for solving certain problems efficiently are identified and different system models are compared Table of Contents Acknowledgments Introduction Indistinguishability Shifting and Scaling Scenario Arguments Information Theory Arguments Covering Arguments Valency Arguments Combinatorial Arguments Reductions and Simulations Bibliography Authors Biographies **Impossibility Results for Distributed Computing** Hagit Attiya,Faith Ellen,2022-06-01 To understand the power of distributed systems it is necessary to understand their inherent limitations what problems cannot be solved in particular systems or without sufficient resources such as time or space This book presents key techniques for proving such impossibility results and applies them to a variety of different problems in a variety of different system models Insights gained from these results are highlighted aspects of a problem that make it difficult are isolated features of an architecture that make it inadequate for solving certain problems efficiently are identified and different system models are compared **Distributed Computing Pearls** Gadi Taubenfeld,2022-05-31 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 *Distributed Computing* Hagit Attiya,Jennifer Welch,2004-03-25 Comprehensive introduction to the fundamental results in the mathematical foundations of distributed computing Accompanied by supporting material such as lecture notes and solutions for selected exercises Each chapter ends with bibliographical notes and a set of exercises Covers the fundamental models issues and techniques and features some of the more advanced topics **Decentralization** Craig Calcaterra,Wulf Kaal,2021-03-08 Entrepreneurs as well as seasoned business leaders are struggling to innovate and stay ahead of change in the age of decentralization What separates the companies that get disrupted from the ones that thrive when faced with

decentralization What tactics can be deployed to decentralize large monolithic organizations Drawing on their experience as researchers and tech entrepreneurs Professors Calcaterra and Kaal show how to Learn to embrace the change that comes with decentralization Evolve technology communication and culture as the business encounters decentralization Use best practices to maintain profitability in the emerging environments of decentralization across industries Combine responsibility with velocity to leverage the advantages of decentralization for the common good The book examines the core infrastructure elements that are needed before the first genuinely decentralized transaction can happen including a legal environment underwriting a truly decentralized blockchain that can overcome the blockchain trilemma decentralization scaling security and efficient governance of blockchains Decentralization is essential reading for businesses seeking to win in an increasingly decentralized world where adaptation speed is the competitive advantage that matters most **Introduction to Distributed Self-Stabilizing Algorithms** Karine Altisen,Stéphane Devismes,Swan Dubois,Franck Petit,2022-05-31 This book aims at being a comprehensive and pedagogical introduction to the concept of self stabilization introduced by Edsger Wybe Dijkstra in 1973 Self stabilization characterizes the ability of a distributed algorithm to converge within finite time to a configuration from which its behavior is correct i e satisfies a given specification regardless the arbitrary initial configuration of the system This arbitrary initial configuration may be the result of the occurrence of a finite number of transient faults Hence self stabilization is actually considered as a versatile non masking fault tolerance approach since it recovers from the effect of any finite number of such faults in an unified manner Another major interest of such an automatic recovery method comes from the difficulty of resetting malfunctioning devices in a large scale and so geographically spread distributed system the Internet Pair to Pair networks and Delay Tolerant Networks are examples of such distributed systems Furthermore self stabilization is usually recognized as a lightweight property to achieve fault tolerance as compared to other classical fault tolerance approaches Indeed the overhead both in terms of time and space of state of the art self stabilizing algorithms is commonly small This makes self stabilization very attractive for distributed systems equipped of processes with low computational and memory capabilities such as wireless sensor networks After more than 40 years of existence self stabilization is now sufficiently established as an important field of research in theoretical distributed computing to justify its teaching in advanced research oriented graduate courses This book is an initiation course which consists of the formal definition of self stabilization and its related concepts followed by a deep review and study of classical simple algorithms commonly used proof schemes and design patterns as well as premium results issued from the self stabilizing community As often happens in the self stabilizing area in this book we focus on the proof of correctness and the analytical complexity of the studied distributed self stabilizing algorithms Finally we underline that most of the algorithms studied in this book are actually dedicated to the high level atomic state model which is the most commonly used computational model in the self stabilizing area However in the last chapter we present general techniques to achieve self stabilization in the low level

message passing model as well as example algorithms     **Consistent Distributed Storage** Vincent Gramoli,Nicolas Nicolaou,Alexander A. Schwarzmann,2022-05-31 Providing a shared memory abstraction in distributed systems is a powerful tool that can simplify the design and implementation of software systems for networked platforms This enables the system designers to work with abstract readable and writable objects without the need to deal with the complexity and dynamism of the underlying platform The key property of shared memory implementations is the consistency guarantee that it provides under concurrent access to the shared objects The most intuitive memory consistency model is atomicity because of its equivalence with a memory system where accesses occur serially one at a time Emulations of shared atomic memory in distributed systems is an active area of research and development The problem proves to be challenging and especially so in distributed message passing settings with unreliable components as is often the case in networked systems We present several approaches to implementing shared memory services with the help of replication on top of message passing distributed platforms subject to a variety of perturbations in the computing medium     **Decidability of Parameterized Verification** Roderick Bloem,Swen Jacobs,Ayrat Kalimov,Igor Konnov,2022-05-31 While the classic model checking problem is to decide whether a finite system satisfies a specification the goal of parameterized model checking is to decide given finite systems n parameterized by n N whether for all n N the system n satisfies a specification In this book we consider the important case of n being a concurrent system where the number of replicated processes depends on the parameter n but each process is independent of n Examples are cache coherence protocols networks of finite state agents and systems that solve mutual exclusion or scheduling problems Further examples are abstractions of systems where the processes of the original systems actually depend on the parameter The literature in this area has studied a wealth of computational models based on a variety of synchronization and communication primitives including token passing broadcast and guarded transitions Often different terminology is used in the literature and results are based on implicit assumptions In this book we introduce a computational model that unites the central synchronization and communication primitives of many models and unveils hidden assumptions from the literature We survey existing decidability and undecidability results and give a systematic view of the basic problems in this exciting research area     **Network Topology and Fault-Tolerant Consensus** Dimitris Sakavalas,Lewis Tseng,2022-05-31 As the structure of contemporary communication networks grows more complex practical networked distributed systems become prone to component failures Fault tolerant consensus in message passing systems allows participants in the system to agree on a common value despite the malfunction or misbehavior of some components It is a task of fundamental importance for distributed computing due to its numerous applications We summarize studies on the topological conditions that determine the feasibility of consensus mainly focusing on directed networks and the case of restricted topology knowledge at each participant Recently significant efforts have been devoted to fully characterize the underlying communication networks in which variations of fault tolerant consensus can be

achieved Although the deduction of analogous topological conditions for undirected networks of known topology had shortly followed the introduction of the problem their extension to the directed network case has been proven a highly non trivial task Moreover global knowledge restrictions inherent in modern large scale networks require more elaborate arguments concerning the locality of distributed computations In this work we present the techniques and ideas used to resolve these issues Recent studies indicate a number of parameters that affect the topological conditions under which consensus can be achieved namely the fault model the degree of system synchrony synchronous vs asynchronous the type of agreement exact vs approximate the level of topology knowledge and the algorithm class used general vs iterative We outline the feasibility and impossibility results for various combinations of the above parameters extensively illustrating the relation between network topology and consensus     Concurrent Crash-Prone Shared Memory Systems Michel Raynal,2022-03-22 Theory is what remains true when technology is changing So it is important to know and master the basic concepts and the theoretical tools that underlie the design of the systems we are using today and the systems we will use tomorrow This means that given a computing model we need to know what can be done and what cannot be done in that model Considering systems built on top of an asynchronous read write shared memory prone to process crashes this monograph presents and develops the fundamental notions that are universal constructions consensus numbers distributed recursivity power of the BG simulation and what can be done when one has to cope with process anonymity and or memory anonymity Numerous distributed algorithms are presented the aim of which is being to help the reader better understand the power and the subtleties of the notions that are presented In addition the reader can appreciate the simplicity and beauty of some of these algorithms     Distributed Computing and Networking Soma Chaudhuri,Samir R. Das,Himadri S. Paul,Srikanta Tirthapura,2007-03-05 This book constitutes the refereed proceedings of the 8th International Conference on Distributed Computing and Networking ICDCN 2006 held in Guwahati India in December 2006 Coverage in this volume includes ad hoc networks distributed computing and algorithms security grid and P2P computing performance evaluation internetworking protocols and applications optical networks and multimedia sensor networks and wireless networks     Distributed Computing Rachid Guerraoui,2004-10-05 This book constitutes the refereed proceedings of the 18th International Conference on Distributed Computing DISC 2004 held in Amsterdam The Netherlands in October 2004 The 31 revised full papers presented together with an extended abstract of an invited lecture and an eulogy for Peter Ruzicka were carefully reviewed and selected from 142 submissions The entire scope of current issues in distributed computing is addressed ranging from foundational and theoretical topics to algorithms and systems issues to applications in various fields     *Distributed Computing* Marcos K. Aguilera,2012-10-14 This book constitutes the refereed proceedings of the 26th International Symposium on Distributed Computing DISC 2012 held in Salvador Brazil in October 2012 The 27 revised full papers presented together with 24 brief announcements were carefully reviewed and selected from 119 submissions The papers are organized in topical sections on

shared memory mobile agents and overlay networks wireless and multiple access channel networks dynamic networks distributed graph algorithms wireless and loosely connected networks robots and lower bounds and separation

**Principles of Distributed Systems** James H. Anderson,Giuseppe Prencipe,Roger Wattenhofer,2007-01-23 This book constitutes the refereed post proceedings of the 9th International Conference on Principles of Distributed Systems OPODIS 2005 held in Pisa Italy in December 2005 The volume presents 30 revised full papers and abstracts of 2 invited talks The papers are organized in topical sections on nonblocking synchronization fault tolerant broadcast and consensus self stabilizing systems peer to peer systems and collaborative environments sensor networks and mobile computing security and verification real time systems and peer to peer systems      *Distributed Computing* Yoram Moses,2015-10-03 This book constitutes the proceedings of the 29th International Symposium on Distributed Computing DISC 2015 held in Tokyo Japan in October 2015 The 42 full papers presented in this volume were carefully reviewed and selected from 143 submissions The papers feature original contributions to theory design implementation modeling analysis or application of distributed systems and networks A number of 14 two page brief announcements are included in the back matter of the proceedings

*Distributed Algorithms* Jean-Claude Bermond,1989-09-06 This book includes the papers presented at the Third International Workshop on Distributed Algorithms organized at La Colle sur Loup near Nice France September 26 28 1989 which followed the first two successful international workshops in Ottawa 1985 and Amsterdam 1987 This workshop provided a forum for researchers and others interested in distributed algorithms on communication networks graphs and decentralized systems The aim was to present recent research results explore directions for future research and identify common fundamental techniques that serve as building blocks in many distributed algorithms Papers describe original results in all areas of distributed algorithms and their applications including distributed combinatorial algorithms distributed graph algorithms distributed algorithms for control and communication distributed database techniques distributed algorithms for decentralized systems fail safe and fault tolerant distributed algorithms distributed optimization algorithms routing algorithms design of network protocols algorithms for transaction management composition of distributed algorithms and analysis of distributed algorithms      **Proceedings of the ... Annual ACM Symposium on Principles of Distributed Computing** ,2006      **Proceedings of the Eighth Annual ACM Symposium on Principles of Distributed Computing** ,1989      **Proceedings of the ...ACM Symposium on Theory of Computing** ,2007      **Proceedings of the 35th Annual ACM Symposium on the Theory of Computing** ,2003

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