

Rachid Guerraoui · Michał Kapałka

# Principles of Transactional Memory

# Principles Of Transactional Memory Michael Kapalka

**Michał Kapalka**



## **Principles Of Transactional Memory Michael Kapalka:**

*Principles of Transactional Memory* Rachid Guerraoui, Michael Kapalka, 2022-06-01 Transactional memory TM is an appealing paradigm for concurrent programming on shared memory architectures With a TM threads of an application communicate and synchronize their actions via in memory transactions Each transaction can perform any number of operations on shared data and then either commit or abort When the transaction commits the effects of all its operations become immediately visible to other transactions when it aborts however those effects are entirely discarded Transactions are atomic programmers get the illusion that every transaction executes all its operations instantaneously at some single and unique point in time Yet a TM runs transactions concurrently to leverage the parallelism offered by modern processors The aim of this book is to provide theoretical foundations for transactional memory This includes defining a model of a TM as well as answering precisely when a TM implementation is correct what kind of properties it can ensure what are the power and limitations of a TM and what inherent trade offs are involved in designing a TM algorithm While the focus of this book is on the fundamental principles its goal is to capture the common intuition behind the semantics of TMs and the properties of existing TM implementations Table of Contents Introduction Shared Memory Systems Transactional Memory A Primer TM Correctness Issues Implementing a TM Further Reading Opacity Proving Opacity An Example Opacity vs Atomicity Further Reading The Liveness of a TM Lock Based TMs Obstruction Free TMs General Liveness of TMs Further Reading Conclusions

**Principles of Transactional Memory** Rachid Guerraoui, Michał Kapalka, 2010 Transactional memory TM is an appealing paradigm for concurrent programming on shared memory architectures With a TM threads of an application communicate and synchronize their actions via in memory transactions Transactions are atomic programmers get the illusion that every transaction executes all its operations instantaneously at some single and unique point in time The aim of this book is to provide theoretical foundations for transactional memory [Principles of Transactional Memory](#) Rachid Guerraoui, Michael Kapalka, 2010-09-24 Transactional memory TM is an appealing paradigm for concurrent programming on shared memory architectures With a TM threads of an application communicate and synchronize their actions via in memory transactions Each transaction can perform any number of operations on shared data and then either commit or abort When the transaction commits the effects of all its operations become immediately visible to other transactions when it aborts however those effects are entirely discarded Transactions are atomic programmers get the illusion that every transaction executes all its operations instantaneously at some single and unique point in time Yet a TM runs transactions concurrently to leverage the parallelism offered by modern processors The aim of this book is to provide theoretical foundations for transactional memory This includes defining a model of a TM as well as answering precisely when a TM implementation is correct what kind of properties it can ensure what are the power and limitations of a TM and what inherent trade offs are involved in designing a TM algorithm While the focus of this book is on the fundamental principles its goal is to capture the

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Reading Opacity Proving Opacity An Example Opacity vs Atomicity Further Reading The Liveness of a TM Lock Based TMs  
Obstruction Free TMs General Liveness of TMs Further Reading Conclusions      **Distributed Computing** Fabian  
Kuhn,2014-09-29 This book constitutes the proceedings of the 28th International Symposium on Distributed Computing DISC  
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coordination and scheduling graph distances and routing radio networks shared memory dynamic and social networks  
relativistic systems transactional memory and concurrent data structures distributed graph algorithms and communication

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Rajsbaum,2014-01-02 This book constitutes the proceedings of the 15th International Conference on Distributed Computing  
and Networking ICDCN 2014 held in Coimbatore India in January 2014 The 32 full papers and 8 short papers presented in  
this volume were carefully reviewed and selected from 110 submissions They are organized in topical sections named mutual  
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distributed networks resource sharing and scheduling cellular and cognitive radio networks and backbone networks

Programming Multicore and Many-core Computing Systems Sabri Pllana,Fatos Xhafa,2017-02-06 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

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Barenboim, Michael Elkin, 2022-06-01 The focus of this monograph is on symmetry breaking problems in the message passing model of distributed computing In this model a communication network is represented by a  $n$  vertex graph  $G(V, E)$  whose vertices host autonomous processors The processors communicate over the edges of  $G$  in discrete rounds The goal is to devise algorithms that use as few rounds as possible A typical symmetry breaking problem is the problem of graph coloring Denote by  $\Delta$  the maximum degree of  $G$  While coloring  $G$  with  $\Delta + 1$  colors is trivial in the centralized setting the problem becomes much more challenging in the distributed one One can also compromise on the number of colors if this allows for more efficient algorithms Other typical symmetry breaking problems are the problems of computing a maximal independent set MIS and a maximal matching MM The study of these problems dates back to the very early days of distributed computing The founding fathers of distributed computing laid firm foundations for the area of distributed symmetry breaking already in the eighties In particular they showed that all these problems can be solved in randomized logarithmic time Also Linial showed that an  $O(\Delta^2)$  coloring can be solved very efficiently deterministically However fundamental questions were left open for decades In particular it is not known if the MIS or the  $\Delta + 1$  coloring can be solved in deterministic polylogarithmic time Moreover until recently it was not known if in deterministic polylogarithmic time one can color a graph with significantly fewer than  $\Delta + 1$  colors Additionally it was open and still open to some extent if one can have sublogarithmic randomized algorithms for the symmetry breaking problems Recently significant progress was achieved in the study of these questions More efficient deterministic and randomized  $\Delta + 1$  coloring algorithms were achieved Deterministic  $O(\Delta^2)$  coloring algorithms with polylogarithmic running time were devised Improved and often sublogarithmic time randomized algorithms were devised Drastically improved lower bounds were given Wide families of graphs in which these problems are solvable much faster than on general graphs were identified The objective of our monograph is to cover most of these developments and as a result to provide a treatise on theoretical foundations of distributed symmetry breaking in the message passing model We hope that our monograph will stimulate further progress in this exciting area     Distributed Computing Yehuda

Afek, 2013-10-04 This book constitutes the proceedings of the 27th International Symposium on Distributed Computing DISC 2013 held in Jerusalem Israel in October 2013 The 27 full papers presented in this volume were carefully reviewed and selected from 142 submissions 16 brief announcements are also included The papers are organized in topical sections named graph distributed algorithms topology leader election and spanning trees software transactional memory shared memory executions shared memory and storage gossip and rumor shared memory tasks and data structures routing radio networks

and the SINR model crypto trust and influence and networking      **Euro-Par 2014: Parallel Processing** Fernando Silva, Inês Dutra, Vitor Santos Costa, 2014-08-11 This book constitutes the refereed proceedings of the 20th International Conference on Parallel and Distributed Computing Euro Par 2014 held in Porto Portugal in August 2014 The 68 revised full papers presented were carefully reviewed and selected from 267 submissions The papers are organized in 15 topical sections support tools environments performance prediction and evaluation scheduling and load balancing high performance architectures and compilers parallel and distributed data management grid cluster and cloud computing green high performance computing distributed systems and algorithms parallel and distributed programming parallel numerical algorithms multicore and manycore programming theory and algorithms for parallel computation high performance networks and communication high performance and scientific applications and GPU and accelerator computing      Parallel Computing Technologies Victor Malyshekin, 2021-09-06 This book constitutes the proceedings of the 16th International Conference on Parallel Computing Technologies PaCT 2021 which was held during September 13 18 2021 The conference was planned to take place in Kaliningrad Russia but changed to an online event due to the COVID 19 pandemic The 24 full and 12 short papers included in this book were carefully reviewed and selected from 62 submissions They were organized in topical sections as follows parallel programming methods and tools applications memory efficient data structures experimental studies job management essential algorithms computing services and cellular automata      *Distributed Computing and Internet Technology* Tomasz Janowski, Hrushikesh Mohanty, 2010-02-08 LNCS 5966      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      **Algorithms and Architectures for Parallel Processing, Part II** Yang Xiang, Alfredo Cuzzocrea, Michael Hobbs, Wanlei Zhou, 2011-10-07 This two volume set LNCS 7016 and LNCS 7017 constitutes the refereed proceedings of the 11th International Conference on Algorithms and Architectures for Parallel Processing ICA3PP 2011 held in Melbourne Australia in October 2011 The second volume includes 37 papers from one symposium and three workshops held together with ICA3PP 2011 main conference These are 16 papers from the 2011 International Symposium on Advances of Distributed Computing and Networking ADCN 2011 10 papers of the 4th IEEE International Workshop on Internet and Distributed Computing Systems IDCs 2011 7 papers belonging to the III International Workshop on Multicore and Multithreaded Architectures and Algorithms M2A2 2011 as well as 4 papers of the 1st IEEE International Workshop on Parallel Architectures for Bioinformatics Systems HardBio 2011      *Programming Languages and Systems* Zhong Shao, 2014-03-21 This book constitutes the proceedings of the 23rd European Symposium on Programming ESOP 2014 which

took place in Grenoble France in April 2014 as part of the European Joint Conferences on Theory and Practice of Software ETAPS 2014 The 27 papers presented in this volume were carefully reviewed and selected from 109 submissions In addition the book contains two invited talks The contributions are organized in topical sections named type systems verified compilation program verification semantics concurrency linear types network and process calculi and program analysis

Proceedings of the ... ACM SIGPLAN Symposium on Principles & Practice of Parallel Programming, 2007 *Theoretical Aspects of Computing - ICTAC 2017* Dang Van Hung, Deepak Kapur, 2017-09-28 This book constitutes the refereed proceedings of the 14th International Colloquium on Theoretical Aspects of Computing ICTAC 2017 held in Hanoi Vietnam in October 2017 The 17 revised full papers presented together with three invited talks were carefully reviewed and selected from 40 submissions The papers are organized in topical sections on logics software components and concurrency automata SMT solvers and algorithms and security **Distributed Computing Pearls** Gadi Taubenfeld, 2018-05-08 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 **Algorithms and Architectures for Parallel Processing** Joanna Kolodziej, Benjamino Di Martino, Domenico Talia, Kaiqi Xiong, 2013-12-09 This two volume set LNCS 8285 and 8286 constitutes the proceedings of the 13th International Conference on Algorithms and Architectures for Parallel Processing ICA3PP 2013 held in Vietri sul Mare Italy in December 2013 The first volume contains 10 distinguished and 31 regular papers selected from 90 submissions and covering topics such as big data multi core programming and software tools distributed scheduling and load balancing high performance scientific computing parallel algorithms parallel architectures scalable and distributed databases dependability in distributed and parallel systems wireless and mobile computing The second volume consists of four sections including 35 papers from one symposium and three workshops held in conjunction with ICA3PP 2013 main conference These are 13 papers from the 2013 International Symposium on Advances of Distributed and Parallel Computing ADPC 2013 5 papers of the International Workshop on Big Data Computing BDC 2013 10 papers of the International Workshop on Trusted Information in Big Data TIBiDa 2013 as well as 7 papers belonging to Workshop on Cloud assisted Smart Cyber Physical Systems C Smart CPS 2013 **Principles of Transactional Memory** Rachid Guerraoui, Michael Kapalka, 2010-04-04 Transactional memory TM is an appealing paradigm

for concurrent programming on shared memory architectures With a TM threads of an application communicate and synchronize their actions via in memory transactions Each transaction can perform any number of operations on shared data and then either commit or abort When the transaction commits the effects of all its operations become immediately visible to other transactions when it aborts however those effects are entirely discarded Transactions are atomic programmers get the illusion that every transaction executes all its operations instantaneously at some single and unique point in time Yet a TM runs transactions concurrently to leverage the parallelism offered by modern processors The aim of this book is to provide theoretical foundations for transactional memory This includes defining a model of a TM as well as answering precisely when a TM implementation is correct what kind of properties it can ensure what are the power and limitations of a TM and what inherent trade offs are involved in designing a TM algorithm While the focus of this book is on the fundamental principles its goal is to capture the common intuition behind the semantics of TMs and the properties of existing TM implementations

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