

FOUNDATIONS OF REAL-TIME COMPUTING Scheduling and Resource Management

edited by

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Foundations Of Real Time Computing Scheduling And Resource Management

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Foundations Of Real Time Computing Scheduling And Resource Management:

Foundations of Real-Time Computing: Scheduling and Resource Management André M. van Tilborg, Gary M.

Koob, 2012-12-22 This volume contains a selection of papers that focus on the state of the art in real time scheduling and resource management Preliminary versions of these papers were presented at a workshop on the foundations of real time computing sponsored by the Office of Naval Research in October 1990 in Washington D C A companion volume by the title Foundations of Real Time Computing Formal Specifications and Methods complements this book by addressing many of the most advanced approaches currently being investigated in the arena of formal specification and verification of real time systems Together these two texts provide a comprehensive snapshot of current insights into the process of designing and building real time computing systems on a scientific basis Many of the papers in this book take care to define the notion of real time system precisely because it is often easy to misunderstand what is meant by that term Different communities of researchers variously use the term real time to refer to either very fast computing or immediate on line data acquisition or deadline driven computing This text is concerned with the very difficult problems of scheduling tasks and resource management in computer systems whose performance is inextricably fused with the achievement of deadlines Such systems have been enabled for a rapidly increasing set of diverse end uses by the unremitting advances in computing power per constant dollar cost and per constant unit volume of space End use applications of deadline driven real time computers span a spectrum that includes transportation systems robotics and manufacturing aerospace and defense industrial process control and telecommunications

Foundations of Real-Time Computing: Scheduling and Resource Management André M. van Tilborg, Gary M. Koob, 2012-12-06 This volume contains a selection of papers that focus on the state of the art in real time scheduling and resource management Preliminary versions of these papers were presented at a workshop on the foundations of real time computing sponsored by the Office of Naval Research in October 1990 in Washington D C A companion volume by the title Foundations of Real Time Computing Formal Specifications and Methods complements this book by addressing many of the most advanced approaches currently being investigated in the arena of formal specification and verification of real time systems Together these two texts provide a comprehensive snapshot of current insights into the process of designing and building real time computing systems on a scientific basis Many of the papers in this book take care to define the notion of real time system precisely because it is often easy to misunderstand what is meant by that term Different communities of researchers variously use the term real time to refer to either very fast computing or immediate on line data acquisition or deadline driven computing This text is concerned with the very difficult problems of scheduling tasks and resource management in computer systems whose performance is inextricably fused with the achievement of deadlines Such systems have been enabled for a rapidly increasing set of diverse end uses by the unremitting advances in computing power per constant dollar cost and per constant unit volume of space End use applications of deadline driven real time computers

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Deadline Scheduling for Real-Time Systems John A. Stankovic, Marco Spuri, Krithi Ramamritham, Giorgio C Buttazzo, 2012-12-06 Many real time systems rely on static scheduling algorithms This includes cyclic scheduling rate monotonic scheduling and fixed schedules created by off line scheduling techniques such as dynamic programming heuristic search and simulated annealing However for many real time systems static scheduling algorithms are quite restrictive and inflexible For example highly automated agile manufacturing command control and communications and distributed real time multimedia applications all operate over long lifetimes and in highly non deterministic environments Dynamic real time scheduling algorithms are more appropriate for these systems and are used in such systems Many of these algorithms are based on earliest deadline first EDF policies There exists a wealth of literature on EDF based scheduling with many extensions to deal with sophisticated issues such as precedence constraints resource requirements system overload multi processors and distributed systems *Deadline Scheduling for Real Time Systems EDF and Related Algorithms* aims at collecting a significant body of knowledge on EDF scheduling for real time systems but it does not try to be all inclusive the literature is too extensive The book primarily presents the algorithms and associated analysis but guidelines rules and implementation considerations are also discussed especially for the more complicated situations where mathematical analysis is difficult In general it is very difficult to codify and taxonomize scheduling knowledge because there are many performance metrics task characteristics and system configurations Also adding to the complexity is the fact that a variety of algorithms have been designed for different combinations of these considerations In spite of the recent advances there are still gaps in the solution space and there is a need to integrate the available solutions For example a list of issues to consider includes preemptive versus non preemptive tasks uni processors versus multi processors using EDF at dispatch time versus EDF based planning precedence constraints among tasks resource constraints periodic versus aperiodic versus sporadic tasks scheduling during overload fault tolerance requirements and providing guarantees and levels of guarantees meeting quality of service requirements *Deadline Scheduling for Real Time Systems EDF and Related Algorithms* should be of interest to researchers real time system designers and instructors and students either as a focussed course on deadline based scheduling for real time systems or more likely as part of a more general course on real time computing The book serves as an invaluable reference in this fast moving field

Foundations of Real-Time Computing: Formal Specifications and Methods André M. van Tilborg, Gary M. Koob, 1991 This volume contains a selection of papers that focus on the state of the art in formal specification and verification of real time computing systems Preliminary versions of these papers were presented at a workshop on the foundations of real time computing sponsored by the Office of Naval Research in October 1990 in Washington D C A companion volume by the title *Foundations of Real Time Computing Scheduling and Resource Management* complements this book by addressing many of the recently devised techniques and approaches for scheduling

tasks and managing resources in real time systems Together these two texts provide a comprehensive snapshot of current insights into the process of designing and building real time computing systems on a scientific basis The notion of real time system has alternative interpretations not all of which are intended usages in this collection of papers Different communities of researchers variously use the term real time to refer to either very fast computing or immediate on line data acquisition or deadline driven computing This text is concerned with the formal specification and verification of computer software and systems whose correct performance is dependent on carefully orchestrated interactions with time e g meeting deadlines and synchronizing with clocks Such systems have been enabled for a rapidly increasing set of diverse end uses by the unremitting advances in computing power per constant dollar cost and per constant unit volume of space End use applications of real time computers span a spectrum that includes transportation systems robotics and manufacturing aerospace and defense industrial process control and telecommunications

A Practitioner's Handbook for Real-Time Analysis Mark Klein, Thomas Ralya, Bill Pollak, Ray Obenza, Michael González Harbour, 2012-12-06 A Practitioner's Handbook for Real Time Analysis Guide to Rate Monotonic Analysis for Real Time Systems contains an invaluable collection of quantitative methods that enable real time system developers to understand analyze and predict the timing behavior of many real time systems The methods are practical and theoretically sound and can be used to assess design tradeoffs and to troubleshoot system timing behavior This collection of methods is called rate monotonic analysis RMA The Handbook includes a framework for describing and categorizing the timing aspects of real time systems step by step techniques for performing timing analysis numerous examples of real time situations to which the techniques can be applied and two case studies A Practitioner's Handbook for Real Time Analysis Guide to Rate Monotonic Analysis for Real Time Systems has been created to serve as a definitive source of information and a guide for developers as they analyze and design real time systems using RMA The Handbook is an excellent reference and may be used as the text for advanced courses on the subject

Real Time Computing Alexander D. Stoyenko, 2013-12-14 NATO's Division of Scientific and Environmental Affairs sponsored this Advanced Study Institute because it was felt to be timely to cover this important and challenging subject for the first time in the framework of NATO's ASI programme The significance of real time systems in everyone's life is rapidly growing The vast spectrum of these systems can be characterised by just a few examples of increasing complexity controllers in washing machines air traffic control systems control and safety systems of nuclear power plants and finally future military systems like the Strategic Defense Initiative SDI The importance of such systems for the well being of people requires considerable efforts in research and development of highly reliable real time systems Furthermore the competitiveness and prosperity of entire nations now depend on the early application and efficient utilisation of computer integrated manufacturing systems CIM of which real time systems are an essential and decisive part Owing to its key significance in computerised defence systems real time computing has also a special importance for the Alliance The early research and development activities in this field in the

1960s and 1970s aimed towards improving the then unsatisfactory software situation. Thus the first high level real time languages were defined and developed: RTL 2, Coral 66, Procol LTR and PEARL. In close connection with these language developments and with the utilisation of special purpose process control peripherals the research on real time operating systems advanced considerably.

Hard Real-Time Computing Systems Giorgio C Buttazzo, 2007-08-19 Real time computing plays a crucial role in our society since an increasing number of complex systems rely in part or completely on processor control. Examples of applications that require real time computing include nuclear power plants, railway switching systems, automotive electronics, air traffic control, telecommunications, robotics and military systems. In spite of this large application domain most of the current real time systems are still designed and implemented using low level programming and empirical techniques without the support of a scientific methodology. This approach results in a lack of reliability which in critical applications may cause serious environmental damage or even loss of life. This book is a basic treatise on real time computing with particular emphasis on predictable scheduling algorithms. The main objectives of the book are to introduce the basic concepts of real time computing, illustrate the most significant results in the field and provide the basic methodologies for designing predictable computing systems useful in supporting critical control applications. The book is written for instructional use and is organized to enable readers without a strong knowledge of the subject matter to quickly grasp the material. Technical concepts are clearly defined at the beginning of each chapter and algorithm descriptions are reinforced through concrete examples, illustrations and tables.

Real-Time Database Systems Kam-Yiu Lam, Tei-Wei Kuo, 2006-04-18 In recent years tremendous research has been devoted to the design of database systems for real time applications called real time database systems (RTDBS) where transactions are associated with deadlines on their completion times and some of the data objects in the database are associated with temporal constraints on their validity. Examples of important applications of RTDBS include stock trading systems, navigation systems and computer integrated manufacturing. Different transaction scheduling algorithms and concurrency control protocols have been proposed to satisfy transaction timing data temporal constraints. Other design issues important to the performance of a RTDBS are buffer management, index accesses and I/O scheduling.

Real Time Database Systems Architecture and Techniques summarizes important research results in this area and serves as an excellent reference for practitioners, researchers and educators of real time systems and database systems.

Handbook on Scheduling Jacek Blazewicz, Klaus H. Ecker, Erwin Pesch, Günter Schmidt, Malgorzata Sterna, Jan Weglarz, 2019-04-25 This handbook provides a comprehensive introduction to the theory and applications of scheduling in advanced planning and computer systems. It addresses a broad audience including practitioners and researchers interested in scheduling as well as graduate and advanced undergraduate students in the fields of computer science and computer engineering, operations research, industrial and real time engineering, management science, business administration and information systems and applied mathematics. The book begins by providing an introduction to and basic

concepts from discrete mathematics Single and multiple processor systems are covered with a focus on multiprocessor tasks and hard real time systems Flow shop and open shop scheduling as well as scheduling in job shops are explained in detail Issues like limited processor availability time dependence resource constraints and imprecise computations are dealt with in dedicated chapters Special attention is given to online scheduling constraint programming and disjunctive scheduling The book also features applications and cases involving flexible manufacturing systems computer integrated production scheduling and logistics In particular it presents case studies on optimization procedures for the production of acrylic glass and of helicopter parts in a flexible manufacturing system an efficient decision support system for airport gate scheduling concrete delivery planning and berth and quay crane allocation at seaports Model Checking, second edition Edmund M. Clarke, Jr., Orna Grumberg, Daniel Kroening, Doron Peled, Helmut Veith, 2018-12-04 An expanded and updated edition of a comprehensive presentation of the theory and practice of model checking a technology that automates the analysis of complex systems Model checking is a verification technology that provides an algorithmic means of determining whether an abstract model representing for example a hardware or software design satisfies a formal specification expressed as a temporal logic formula If the specification is not satisfied the method identifies a counterexample execution that shows the source of the problem Today many major hardware and software companies use model checking in practice for verification of VLSI circuits communication protocols software device drivers real time embedded systems and security algorithms This book offers a comprehensive presentation of the theory and practice of model checking covering the foundations of the key algorithms in depth The field of model checking has grown dramatically since the publication of the first edition in 1999 and this second edition reflects the advances in the field Reorganized expanded and updated the new edition retains the focus on the foundations of temporal logic model while offering new chapters that cover topics that did not exist in 1999 propositional satisfiability SAT based model checking counterexample guided abstraction refinement and software model checking The book serves as an introduction to the field suitable for classroom use and as an essential guide for researchers

Applications of Intelligent Control to Engineering Systems Kimon P. Valavanis, 2009-06-11 This book reflects the work of top scientists in the field of intelligent control and its applications prognostics diagnostics condition based maintenance and unmanned systems It includes results and presents how theory is applied to solve real problems **Model Checking** Edmund M. Clarke, Orna Grumberg, Doron Peled, Doron A. Peled, 1999 This presentation of the theory and practice of model checking includes basic as well as state of the art techniques algorithms and tools and can be used as an introduction to the subject or a reference for researchers **Real-Time Systems** Hermann Kopetz, 2006-04-18 7 6 Performance Comparison ET versus TT 164 7 7 The Physical Layer 166 Points to Remember 168 Bibliographic Notes 169 Review Questions and Problems 170 Chapter 8 The Time Triggered Protocols 171 Overview 171 8 1 Introduction to Time Triggered Protocols 172 8 2 Overview of the TTP C Protocol Layers 175 8 3 The Basic CNI 178 Internal Operation of TTP C

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Fault-Tolerant Real-Time Systems Stefan Poledna, 2007-11-23 Real time computer systems are very often subject to dependability requirements because of their application areas Fly by wire airplane control systems control of power plants industrial process control systems and others are required to continue their function despite faults Fault tolerance and real time requirements thus constitute a kind of natural combination in process control applications Systematic fault tolerance is based on redundancy which is used to mask failures of individual components The problem of replica determinism is thereby to ensure that replicated components show consistent behavior in the absence of faults It might seem trivial that given an identical sequence of inputs replicated computer systems will produce consistent outputs Unfortunately this is not the case The problem of replica non determinism and the presentation of its possible solutions is the subject of Fault Tolerant Real Time Systems The Problem of Replica Determinism The field of automotive electronics is an important application area of fault tolerant real time systems Systems like anti lock braking engine control active suspension or vehicle dynamics control have demanding real time and fault tolerance requirements These requirements have to be met even in the presence of very limited resources since cost is extremely important Because of its interesting properties Fault Tolerant Real Time Systems gives an introduction to the application area of automotive electronics The requirements of automotive electronics are a topic of discussion in the remainder of this work and are used as a benchmark to evaluate solutions to the problem of replica determinism

Parallel Algorithm Derivation and Program Transformation Robert Paige, J.H. Reif, Ralph Wachter, 2007-08-28 This book contains selected papers from the ONR Workshop on Parallel Algorithm Design and Program Transformation that took place at New York University Courant Institute from Aug 30 to Sept 1 1991 The aim of the workshop was to bring together computer scientists in transformational programming and parallel algorithm design in order to encourage a sharing of ideas that might benefit both communities It was hoped that exposure to algorithm design methods developed within the algorithm community would stimulate progress in software development for parallel architectures within the transformational community It was also hoped that exposure to

syntax directed methods and pragmatic programming concerns developed within the transformational community would encourage more realistic theoretical models of parallel architectures and more systematic and algebraic approaches to parallel algorithm design within the algorithm community The workshop Organizers were Robert Paige John Reif and Ralph Wachter The workshop was sponsored by the Office of Naval Research under grant number N00014 90 J 1421 There were 44 attendees 28 presentations and 5 system demonstrations All attendees were invited to submit a paper for publication in the book Each submitted paper was refereed by participants from the Workshop The final decision on publication was made by the editors There were several motivations for holding the workshop and for publishing papers contributed by its participants Transformational programming and parallel computation are two emerging fields that may ultimately depend on each other for success The Sixth Annual Workshop on Space Operations Applications and Research (SOAR 1992) ,1993

Multimedia Systems Ralf Steinmetz,Klara Nahrstedt,2013-03-09 Multimedia Systems discusses the basic characteristics of multimedia operating systems networking and communication and multimedia middleware systems The overall goal of the book is to provide a broad understanding of multimedia systems and applications in an integrated manner a multimedia application and its user interface must be developed in an integrated fashion with underlying multimedia middleware operating systems networks security and multimedia devices Fundamental characteristics of multimedia operating and distributed communication systems are presented especially scheduling algorithms and other OS supporting approaches for multimedia applications with soft real time deadlines multimedia file systems and servers with their decision algorithms for data placement scheduling and buffer management multimedia communication transport and streaming protocols services with their error control congestion control and other Quality ofService aware and adaptive algorithms synchronization services with their skew control methods and group communication with their group coordinating algorithms and other distributed services **Real-Time Database and Information Systems: Research Advances** Azer Bestavros,Victor

Fay-Wolfe,2012-12-06 Real time systems are defined as those for which correctness depends not only on the logical properties of the produced results but also on the temporal properties of these results In a database real time means that in addition to typical logical consistency constraints such as a constraint on a data item s value there are constraints on when transactions execute and on the freshness of the data transactions access The challenges and tradeoffs faced by the designers of real time database systems are quite different from those faced by the designers of general purpose database systems To achieve the fundamental requirements of timeliness and predictability not only do conventional methods for scheduling and transaction management have to be redesigned but also new concepts that have not been considered in conventional database systems or in real time systems need to be added Real Time Database and Information Systems Research Advances is devoted to new techniques for scheduling of transactions concurrency management transaction logging database languages and new distributed database architectures Real Time Database and Information Systems

Research Advances is primarily intended for practicing engineers and researchers working in the growing area of real time database and information retrieval systems For practitioners the book will provide a much needed bridge for technology transfer and continued education For researchers the book will provide a comprehensive reference for well established results The book can also be used in a senior or graduate level course on real time systems real time database systems and database systems or closely related courses *Real-Time Database Systems* Azer Bestavros, Kwei-Jay Lin, Sang Hyuk Son, 2012-12-06 Despite the growing interest in Real Time Database Systems there is no single book that acts as a reference to academics professionals and practitioners who wish to understand the issues involved in the design and development of RTDBS Real Time Database Systems Issues and Applications fulfills this need This book presents the spectrum of issues that may arise in various real time database applications the available solutions and technologies that may be used to address these issues and the open problems that need to be tackled in the future With rapid advances in this area several concepts have been proposed without a widely accepted consensus on their definitions and implications To address this need the first chapter is an introduction to the key RTDBS concepts and definitions which is followed by a survey of the state of the art in RTDBS research and practice The remainder of the book consists of four sections models and paradigms applications and benchmarks scheduling and concurrency control and experimental systems The chapters in each section are contributed by experts in the respective areas Real Time Database Systems Issues and Applications is primarily intended for practicing engineers and researchers working in the growing area of real time database systems For practitioners the book will provide a much needed bridge for technology transfer and continued education For researchers this book will provide a comprehensive reference for well established results This book can also be used in a senior or graduate level course on real time systems real time database systems and database systems or closely related courses Database and Expert Systems Applications Vladimir Marik, Jiri Lazansky, 1993-08-25 This volume constitutes the proceedings of the 4th International Conference on Database and Expert Systems Applications DEXA held in Prague Czech Republic in September 1993 Traditionally the objective of the DEXA conferences is to serve as an international forum for the discussion and exchange of research results and practical experience among theoreticians and professionals working in the field of database and artificial intelligence technologies Despite the fact that in the conference title the applications aspect is mentioned explicitly the theoretical and the practical points of view in the field are well balanced in the program of DEXA 93 The growing importance of the conference series is outlined by the remarkably high number of 269 submissions and by the support given by renowned organizations DEXA 93 is held for the first time outside the former GDR in an East European country and is essentially contributing to the advancement of the East West scientific cooperation in the field of database and AI systems This proceedings contains the 78 contributed papers carefully selected by an international program committee with the support of a high number of subreferees The volume is organized in sections on data models distributed databases

advanced database aspects database optimization and performance evaluation spatial and geographic databases expert systems and knowledge engineering legal systems other database and artificial intelligence applications software engineering and hypertext hypermedia and user interfaces

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current region germany england place of origin kreuzburg east prussia members j r r tolkien the tolkien family is an english family of german descent whose best known member is j r r tolkien oxford academic and author of the fantasy books the hobbit the lord of the rings and the silmarillion

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