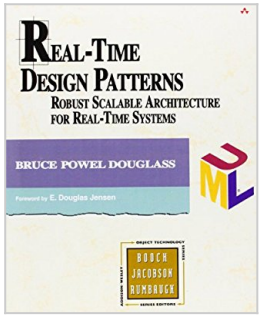

Real-Time Design Patterns: Robust Scalable Architecture for Real-Time Systems

By Bruce Powel Douglass

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Real-time and embedded systems developers face unique challenges. The systems they design must use very limited processor and memory resources optimally to meet mission-critical and high reliability requirements. Developers working on these systems see the same common threads in problems again and again. The very best developers abstract these problems and their solutions into generalized approaches that prove consistently effective: design patterns. In this book, real-time programming guru Bruce Powel Douglass collects the best design patterns from this unique, and rapidly growing, area of programming, and presents them in an instructional format that teaches the reader the "what, when, and how" of leveraging the significant power of these proven design solutions.

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Editorial Review

From the Back Cover

When creating real-time and embedded (RTE) systems, there is no room for error. The nature of the final product demands that systems be powerful, efficient, and highly reliable. The constraints of processor and memory resources add to this challenge. Sophisticated developers rely on design patterns—proven solutions to recurrent design challenges—for building fail-safe RTE systems.

Real-Time Design Patterns is the foremost reference for developers seeking to employ this powerful technique. The text begins with a review of the Unified Modeling Language (UML) notation and semantics then introduces the Rapid Object-Oriented Process for Embedded Systems (ROPES) process and its key technologies. A catalog of design patterns and their applications follows.

Key topics covered in this book include:

RapidRMA™—a tool that integrates with Rhapsody™ to perform schedulability and timeliness analysis of UML models

0201699567B08142002 About the Author
Bruce Powel Douglass is the Chief Evangelist for i-Logix, a leading producer of tools for real-time systems development. He contributed to the original specification of the UML and to the UML 2.0 as one of the co-chairs of the Object Management Group's Real-Time Analysis and Design Working Group. Bruce consults for a number of companies and organizations, including NASA, on building large-scale, real-time, safety-critical systems. He is the author of seven other books, including *Real-Time Design Patterns* (Addison-Wesley, 2003) and *Doing Hard Time* (Addison-Wesley, 1999).

GoalsReal-time and embedded systems (RTE systems) must execute in a much more constrained environment than "traditional" computer systems such as desktop and mainframe computers. RTE systems must be highly efficient, optimally utilizing their limited processor and memory resources, and yet must often outperform systems with significantly more compute power. In addition, many RTE systems have important safety-critical and high-reliability requirements because they are often used in systems such as avionics flight control, nuclear power plant control, life support and medical instrumentation. The creation of RTE systems to meet these functional and quality of service requirements requires highly experienced developers with decades of experience. Yet, over the years, these developers have encountered the same problems over and over--maybe not exactly the same problems but common threads. The very best developers abstract these problems and their solutions into generalized approaches that have proved consistently effective. These generalized approaches are called design patterns. They are often best applied at the level of the system or software architecture--the sum of design decisions that affect the fundamental organization of the system. Real-Time Design Patterns is an attempt to capture in one place a set of architectural design patterns that are useful in the development of RTE systems.AudienceThe book is oriented toward the practicing professional software developer and the computer science major in the junior or senior year. This book could also serve as an undergraduate- or graduate-level text, but the focus is on practical development rather than a theoretical dissertation. The book assumes a reasonable proficiency in at least one programming language and a basic understanding of the fundamental concepts of object

orientation, the Unified Modeling Language (UML), and real-time systems. OrganizationPart I consists of three chapters. Chapter 1 provides a very brief review of the major concepts in the Unified Modeling Language. Chapter 2 introduces the fundamental concepts of architecture as they are defined in the Rapid Object-oriented Process for Embedded Systems (ROPES), including the primary division of architecture into logical (design-time) and physical (run-time) aspects, and the five important architectural views. In the third chapter, the book gets into a discussion of design patterns and their role in defining architecture. Because it is difficult to discuss architecture in a process-free environment, the ROPES process, and the key technologies it tries to optimize, are introduced to provide a background in which design patterns may be effectively discussed. Once process has been introduced, design patterns are next. Their various aspects are explained, and the fundamental organization of design patterns used in this book is provided. The chapter finishes with a discussion of how design patterns can be applied in the development of real systems. Part II contains the architectural design patterns that reify the ways that large-scale system components are organized and structured to optimize some set of general system criteria.The patterns in Part II are organized around the architectural concept they address. Chapter 4 is dedicated to high-level structural patterns--focused around what is called the Subsystem or Component architecture. Because concurrency and resource management is so crucial to real-time and embedded systems, Chapter 5 focuses on the common patterns of concurrency. Memory management is crucial for many systems in this domain, and it is the subject of Chapter 6. We see even more general resource management patterns in Chapter 7. Chapter 8 presents a number of common distribution architecture patterns that define how objects can be distributed across multiple address spaces and computers. Finally, Chapter 9 provides a number of patterns that deal with building safe and reliable architectures. Two appendixes appear at the end of the book. The first is simply a summary of the UML graphical notation, and the second is an index of the patterns by name. The CD-ROM provides a number of interesting and useful tools. It contains a full copy of the Rhapsody UML tool with instructions on how to get a temporary license from I-Logix. Other additional potentially useful tools for developers of real-time systems are also provided. The Papers chapter contains some papers on various topics as well as some useful OMG specifications. More InformationAdditional information on the UML, object-oriented technology, and the development of real-time systems can be found at ilogix. In addition, the current UML, MDA, and CORBA standards can be seen at omg. For more information on using the UML in real-time systems, Real-Time UML, 2nd Edition is also available from Addison-Wesley, as is the more comprehensive Doing Hard Time: Developing Real-Time Systems with UML, Objects, Frameworks and Patterns. Many other well-written and useful books on the UML and software engineering are similarly available. AcknowledgmentsA book like this is always a joint effort, not only of the direct contributors, such as the editorial staff of Addison-Wesley Professional (and I'd especially like to thank my editor, Paul Becker, for the sometimes less-than-gentle pushing to complete the book!) but of many others who in their own way have raised the bar for all of us. The core team members working on the UML--Cris Kobryn, Eran Gery, Jim Rumbaugh, Bran Selic, and many, many others are certainly among those who should be acknowledged in bringing forth a useful standard language for capturing and manipulating models of systems. Also, Erich Gamma, Richard Helm, Ralph Johnson, and John Vlissides deserve recognition for bringing the concept of design patterns into common use with their wonderful book Design Patterns: Elements of Reusable Object-Oriented Software. David Harel (inventor of statecharts, the semantic basis for all behavior in the UML) and Werner Damn continue to make significant contributions to the state of the art, especially with respect to formal verification of systems modeled with the UML. My two boys, Scott and Blake Douglass, continue to delight and amaze me--and keep me humble at the same time--and make all this effort worthwhile.

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Users Review**From reader reviews:**

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