

# Understanding Petri Nets



## Modeling Techniques, Analysis Methods, Case Studies

Wolfgang Reisig [Humboldt Universität zu Berlin]

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### Overview

With their intuitive graphical approach and expressive analysis techniques, Petri nets are suitable for a wide range of applications and teaching scenarios, and they have gained wide acceptance as a modeling technique in areas such as software design and control engineering. The core theoretical principles have been studied for many decades and there is now a comprehensive research literature that complements the extensive implementation experience.

In this book the author presents a clear, thorough introduction to the essentials of Petri nets. He explains the core modeling techniques and analysis methods and he illustrates their usefulness with examples and case studies. Part I describes how to use Petri nets for modeling; all concepts are explained with the help of examples, starting with a generic, powerful model which is also intuitive and realistic. Part II covers the essential analysis methods that are specific to Petri nets, introducing techniques used to formulate key properties of system nets and algorithms for proving their validity. Part III presents case studies, each introducing new concepts, properties and analysis techniques required for very different modeling tasks. The author offers different paths among the chapters and sections: the elementary strand for readers who wish to study only elementary nets; the modeling strand for those who wish to study the modeling but not the analysis of systems; and finally the elementary models of the modeling strand for those interested in technically simple, but challenging examples and case studies.

The author achieves an excellent balance between consistency, comprehensibility and correctness in a book of distinctive design. Among its characteristics, formal arguments are reduced to a minimum in the main text with many of the theoretical formalisms moved to an appendix, the explanations are supported throughout with fully integrated graphical illustrations, and each chapter ends with exercises and recommendations for further reading.

The book is suitable for students of computer science and related subjects such as engineering, and for a broad range of researchers and practitioners.

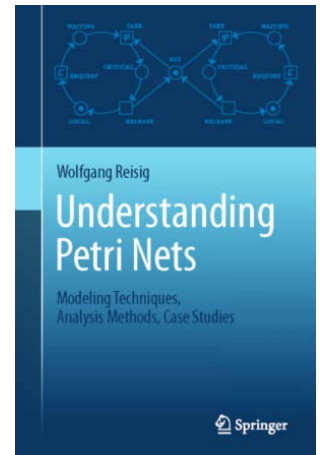
### Comments

"This book chooses the most important, most original, most successful and most basic concepts and presents them comprehensively. ... I wish this book a wide distribution and a long usage."

[Carl Adam Petri, 2010 (German-language edition)]

"This is a wonderful book, on a truly important and central topic, and written by the best person possible. Petri nets constitute one of the very few fundamental formalisms that deal with concurrency, reactivity and communication. They are clean and elegant, useful in practice, and are backed by deep and exciting mathematical underpinnings. The book, which is poised to become the "Bible" of Petri nets, deals with all aspects of the formalism. It is written eloquently, and with great talent and careful planning. It will appeal to computer scientists researching all manners of programming and research on reactive systems, as well as to the software and systems engineers who actually build those systems. Wolfgang Reisig's close relationship with the late Carl Petri himself, and his obvious love of the subject, not to mention the central role he himself plays in Petri net research, emerge impressively from the pages. Inventors of other languages or methods can only hope for someone like him to produce such an excellent account, both broad and deep."

[David Harel, Weizmann Institute of Science]



## Comments (contd.)

"This book, authored by one of the most respected experts in Petri Nets, is one of the most comprehensive treatments of the topic I have seen. This excellent book provides an invaluable guide to all interested in Petri Nets and captures the reader with plenty of examples, different reading paths through the book to follow the topic, as well as its elegant writing style. I highly recommend this book."

[Schahram Dustdar, Vienna University of Technology]

"Half a century ago Carl Adam Petri's thesis appeared, and a new wonderful theory was born: Petri nets. This book digests 50 years of science and engineering, and research and applications of Petri nets; it marks a current high, pedagogically and didactically. The formal theory underlying Petri nets, as presented in this book, is there: firm, elegant and comprehensive — yet is, wisely, put in an appendix. This leaves the author free to present, in carefully thought-out steps, techniques for modeling systems, techniques for analysing such systems and, finally, three impressive, non-trivial case studies. The parts and chapters progress from basic and simple to more complex and comprehensive. They cleverly and beautifully fit into a semester course. Academia must make sure that every computer science and informatics graduate knows about Petri nets, and this is the book to serve that purpose."

[Dines Bjørner, Technical University of Denmark]

"Almost 30 years ago the influential book 'Petri Nets: An Introduction' by Wolfgang Reisig appeared. In his new book 'Understanding Petri Nets' the author again demonstrates his ability to explain essential concepts in a beautiful way. The main theoretical concepts of Petri nets are introduced intuitively and without the usual overhead. The book covers modeling principles, analysis techniques, and case studies. A 'must read' for anyone interested in process modeling and analysis."

[Wil van der Aalst, Eindhoven University of Technology]

"Modelling plays an important role both in the design and in the analysis phase of systems development. Petri Nets are one of the oldest and most successful modelling formalisms thanks to the first-class treatment of key notions such as concurrency, conflict and causality, and to the many effective system analysis tools and techniques. This book is the result of the work of one of the most influential scholars of Petri Nets, and his familiarity with the development of the field in the last 50 years can be recognized in the remarkably clear presentation of the book and in the proposed selection of key notions, fundamental techniques and case studies. The outcome is an excellent textbook that is a fundamental resource for running academic courses and is an essential read for any scientist interested in system modelling."

[Rocco De Nicola, IMT Institute for Advanced Studies, Lucca]

"Graphical notations have an immediate appeal to users. There is, however, the danger that they are a Fata Morgana which lack solid theoretical foundations. Petri Nets, however, achieve usability and comprehensibility and are based on a firm theoretical foundations. Net Theory has already been used in many fields way beyond computer science and this book could greatly enhance the community of scientists and engineers who benefit from Petri Net notation. The clear paths for different readerships and, above all, the numerous practical examples make the book a pedagogic masterpiece."

[Cliff Jones, Newcastle University]

"This is a highly accessible, outstanding guide to modeling and analysis of concurrent systems. The exposition is lucid, with just enough formalism to be precise without overwhelming readers. Substantive examples illustrate the concepts and provide a deeper understanding of concurrency. No doubt this concise and comprehensive work is *the authoritative textbook* to recommend for students and professionals alike."

[Gul Agha, University of Illinois at Urbana-Champaign]

## Comments (contd.)

"This is a very readable textbook in a highly relevant subject area, where readability is combined with precision. The treatment is well-suited for many application areas, and teachers will appreciate the supporting materials."

[Reinhard Wilhelm, Saarland University]

"Petri Nets can not only be seen as a formalism for describing the dynamic aspects of IT-based systems in various application domains but also as an easily understandable, graphical modeling language. This excellent book recognizes both aspects and provides the reader with an insightful overview of the basic concepts followed by a discussion of advanced analysis methods and case studies for successfully applying Petri Nets in research and practice. It is highly recommended for anybody with a serious interest in the formal representation of dynamic systems, and in particular for students in computer science and business informatics as well as other engineering disciplines."

[Dimitris Karagiannis, University of Vienna]

"This is a 'must-have' book. I use it in my lectures introducing modeling as well as in my lectures on advanced business process management. The book is very well written, fun to read, and presents concepts and algorithms that are key to both theoreticians and practitioners."

[Frank Leymann, University of Stuttgart]

"This excellent book gives a crystal-clear treatment of the ins and outs of Petri nets, one of the main modeling formalisms used to study concurrent systems. The author excels in presenting the intricacies of concurrency in an extremely accessible manner. A must-read for those who want to understand Petri nets."

[Joost-Pieter Katoen, RWTH Aachen]

"Distribution and concurrency are today a reality for computer systems, in contrast to the early days of computing. Petri nets were perhaps the first approach to develop a mathematical and a graphical model to capture these important concepts, and were a milestone out of which many of the concepts in the field arose. It is a pleasure to see a book like this, making Petri nets accessible not only for students but also for researchers and practitioners."

[Manfred Broy, Technische Universität München]

"Petri net theory and related applications on almost on every page. This is a fabulous book."

[Holger Hermanns, Saarland University]

"This is an excellent book that should be an obligatory read for students, researchers and professionals who want to learn about Petri nets and also for those who want to consolidate and systematize their knowledge about this very interesting and relevant area. The good selection of modelling techniques and analysis methods and the well-chosen and well-presented examples and case studies make this book attractive for a broad spectrum of readers, ranging from theoreticians to implementers of concurrent systems. I highly recommend this book."

[Grzegorz Rozenberg, Leiden University and University of Colorado, Boulder]

"This book convincingly shows the enormous appeal of Petri nets in modelling and analysing concurrent system, and makes the subject accessible to students, scientists and engineers."

[Rob van Glabbeek, NICTA and University of New South Wales]