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Eike Best César Fernández C.

Nonsequential Processes

A Petri Net View

With 44 Figures

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TO

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Gudrun und Herbert	Olga y Carlos

WITH LOVE

Preface

The theory of Petri nets is a part of computer science whose importance is increasingly acknowledged. Many papers and anthologies, whose subject matter is net theory and its applications, have appeared to date. There exist at least seven introductory textbooks on the theory.

The present monograph augments this literature by offering a mathematical treatment of one of the central aspects of net theory: the modelling of concurrency by partially ordered sets. Occurrence nets – which are special nets as well as special partial orders – are proposed by net theory for this purpose. We study both the general properties of occurrence nets and their use in describing the concurrent behaviour of systems.

Occurrence nets may be contrasted with a more language-oriented approach to the modelling of concurrency known as arbitrary interleaving. We will discuss some connections between these two approaches. Other approaches based on partially ordered sets – such as the theory of traces, the theory of event structures and the theory of semiwords – are not considered in this book, in spite of the strong links between them and net theory.

The monograph addresses students in theoretical computer science, mathematicians interested in discrete mathematics, researchers in the area of Petri nets and related topics and professionals in the design of concurrent systems interested in theoretical background. The reader is assumed to have an elementary background in set theory and basic mathematics. Previous knowledge in Petri net theory would be advantageous but is not strictly necessary.

The book is divided into four chapters. Chapter 1 gives the introduction. Chapter 2 deals with general partial order theory and finishes with a specialisation of the theory to posets derived from occurrence nets. Chapter 3 introduces a basic class of Petri nets that may model systems and shows how occurrence nets may be used to represent their nonsequential processes. Chapter 4 shows how properties may be translated from a system to its processes and vice versa.

The logical structure of the book is as follows. Chapter 2 describes a variety of properties of partially ordered sets, ones which may be considered as basic for processes (Sections 2.1 and 2.2) and ones which are interesting for other reasons (Sections 2.3, 2.4 and 2.5). Chapter 3 shows how the behaviour of a system can be defined in terms of occurrence nets. In order to understand this definition, Sections 2.1 and 2.2 are prerequisite reading. In Chapter 4,

the properties studied in Sections 2.3, 2.4 and 2.5 are translated into system properties. Hence Sections 2.3, 2.4 and 2.5 (as well as Chapter 3) are required reading in order to understand Chapter 4.

Each chapter is concluded by a number of exercises. Some of them are immediate applications of the concepts defined in the chapter. Some others are extensions of, or recent results in, the theory. The exercises labelled by a star * are harder than the others. An appendix explains the notation used in the book. Another appendix contains a selection of references to the literature and to applications of the theory.

Our appreciation goes to Carl Adam Petri for his willingness to have long discussions about the subject of the book, for his continuous support and, of course, for providing the very subject in the first place. We are indebted to Agathe Merceron and to Raymond Devillers who contributed directly to the material presented in this book. A number of colleagues of our Institute have provided us with comments on all or parts of the manuscript; to all of them we are very grateful. We would also like to thank P.S.Thiagarajan who has given us very useful comments. Our gratitude also goes to two referees who have studied the manuscript carefully and have made valuable suggestions. We are indebted to Elisabeth Münch who has done the drawing of the figures. Last but not least, we thank Grzegorz Rozenberg and Springer-Verlag for making possible the publication of this monograph and for their support.

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