Preface

The impact of mathematics and logic on theoretical computer science has been great from its very birth. It is perhaps less widely known among general mathematicians that mathematics has had a profound impact on computer systems. It has been about 40 years since pioneers like McCarthy, Strachey, Landin, Dijkstra, Scott and deBakker, among others, provided a firm mathematical underpinning to the study of programming languages. It is also about 30 years since Robin Milner, Tony Hoare, Carl Petri and others began looking at concurrent systems from a mathematical point of view.

At this point the theory of concurrency is a very rich subject with annual conferences and journals devoted to research in concurrency theory. The first set of lectures presents a new way of thinking about concurrency; the **coalgebraic** approach. Though it was realized implicitly from the start that coalgebra plays a key role in concurrent systems, it was only made very explicit quite recently in large part because of the work of Prof. Rutten. Roughly speaking, one can say that algebra gives the syntactic structure while a coalgebra describes the behaviour or dynamics of the system. Rutten presents an elegant "calculus of streams" for reasoning coalgebraically and shows some striking formal analogies between calculus as understood in the sense of analysis and the stream calculus.

A relatively young offshoot of concurrency theory is the theory of probabilistic, concurrent systems. The second set of lectures gives an overview of modelling and analysis of such systems. In particular the focus is on **automated tools** for reasoning about the behaviour and correctness of such systems. Prof. Kwiatkowska is one of the pioneers of this area and has been the driving force behind making the transition from theory to practice with a large active group developing implementations of the reasoning tools, carrying out case studies and, of course, enriching the theory further.

Both sets of lectures are suitable for beginning graduate students and even some advanced undergraduates. This helps fill a gap which should make it easier for graduate students to gain entry into these exciting research areas. The notes were reviewed by the editors. We wish to thank the authors for being willing to take time out of their busy research schedules to write these detailed expository notes. We hope that people will enjoy reading them as much as we enjoyed listening to the lectures in Montréal.

The two sets of notes in this volume were based on lectures delivered by Prof. Jan Rutten and Prof. Marta Kwiatkowska at a workshop on "Mathematical Techniques for Analyzing Systems" held from September 30th to October 4th 2002. This workshop was part of the Année Thématique of the Centre de Recherche Mathématiques devoted to theoretical computer science and we are very grateful to the CRM and its director, Jacques Hurtubise, whose generous support made

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Tourneux, André Montpetit, Louise Letendre, Louis Pelletier and Josée Laferriére
who were very helpful in organizing the workshop and producing the book.

The workshop was attended by about 30 participants, including nearly a dozen
students, and included several other individual lectures on the theme of the work-
shop. We would like to thank all the participants for their stimulating comments
and the exciting atmosphere at the workshop.

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