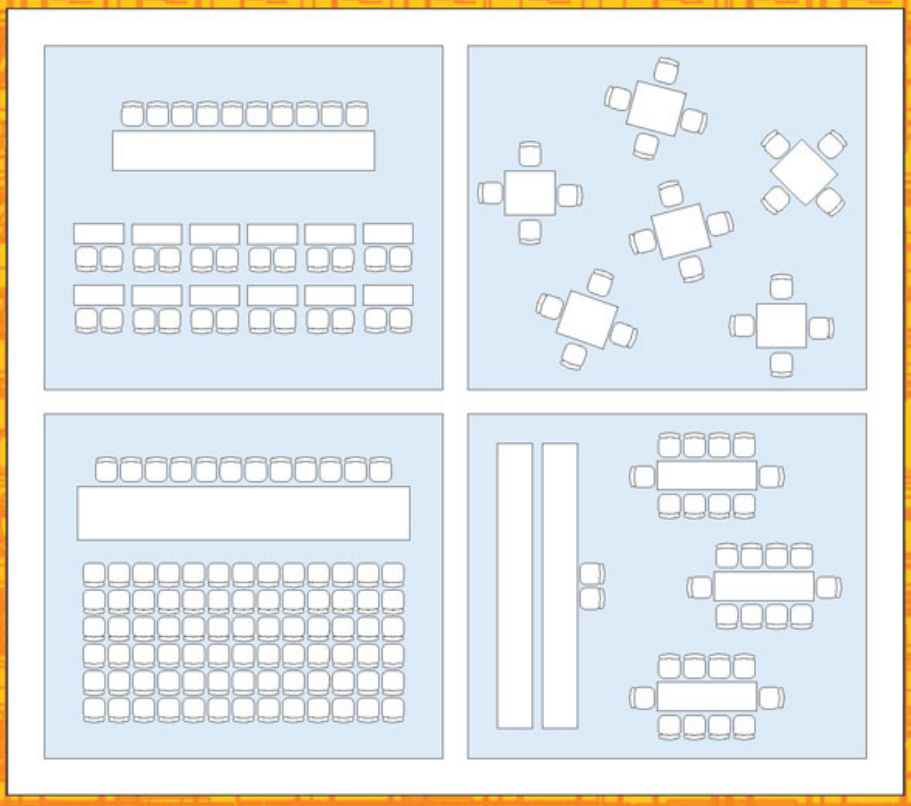
Christophe Bobda

Introduction to Reconfigurable Computing

Architectures, algorithms and applications



Foreword by Reiner Hartenstein

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Architectures, Algorithms, and Applications

by

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Springer

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To Lewin, Jan and Huguette for being so patient

Foreword

"Christophe Bobda's book is an all-embracing introduction to the fundamentals of the entire discipline of Reconfigurable Computing, also seen with the eyes of a software developer and including a taxonomy of application areas.

Reconfigurable Computing is a disruptive innovation currently going to complete the most important breakthrough after introduction of the von Neumann paradigm. On software to FPGA migrations a dazzling array of publications from a wide variety application areas reports speed-up factors between 1 and 4 orders of magnitude and promises to reduce the electricity bill by at least an order of magnitude. Facing the tcyberinfrastructure's growing electricity consumption (predicted to reach 35–50% of the total electricity production by the year 2020 in the USA) also this energy aspect is a strategic issue.

The focal point of worldwide almost 15 million software developers will shift toward new solutions of the productivity problems which stem from programming the coming many-core microprocessors and from educational deficits. Currently Reconfigurable Computing for High Performance computing is even disorienting the supercomputing scene. Their tremulous question is: Do we need to learn hardware design?

In the past, when students asked for a text book, we had to refer to a collection of specialized books and review articles focused on individual topics or special application areas, where Reconfigurable Computing takes only a corner or a chapter, sometimes even treating FPGAs as exotic technology (although in important areas it is mainstream for a decade). The typical style of those books or articles assumes that the reader has a hardware background: a leap too far for the existing software developers community.

The book by Christophe Bobda, however, has also been written for people with a software background, substantially reducing the educational leap bybridging the gap. His book has the potential to become a best-seller and to

stimulate the urgently needed transformation of the software developer population's mindset, by playing a similar role as known from the famous historic Mead-&-Conway textbook for the VLSI design revolution.

Reiner Hartenstein, IEEE fellow,
Professor, TU Kaiserslautern "

Contents

Preface

One indicator of the growing importance of Reconfigurable Computing is the large number of events (conferences, workshops, meetings) organized and devoted to this topic in the last couple of years. Also, the growth observed in the market share of programmable logic devices, particulary the FPGAs, is an indicator of the strong interest in reconfigurable logic.

Following this development, teaching reconfigurable computing, which was initiated in many Universities a couple of years before, has gained more importance. The curricula in reconfigurable computing varies from simple seminars to more heavy syllabus including lectures, exercises and labs.

Many people among whom Reiner Hartenstein have been advocating years ago in favour of a normalized reconfigurable computing syllabus. Aware of the importance of a teaching book in this normalization, during a bi-annual meeting on reconfigurable computing held in Dagstuhl in 2003 [11], Hartenstein coined the importance of a text book in reconfigurable computing and proposed the attendees to write one. He suggested to have several people writing to minimize the work and have the book published as faster as possible. Unfortunately, this initiative was not pursued.

A couple of months after this initiative, in the summer term 2004, I started teaching a course in reconfigurable computing at the university of Erlangen-Nuremberg. With the difficulties of acquiring teaching materials and labs, I started writing a script to ease the learning process of students. The positive feedback gained from the student encouraged me to continue writing. Further repetitions of the course in winter term 2004 and in winter term 2006 were used to improve the course contents. It should be mentioned that in a couple of books [153] [220] [134], reconfigurable computing were published in between. However, none of them were found to cover the complete aspects of reconfigurable computing as I use to teach in my course.

My goal in writing this book was to provide a strong theoretical and practical background, as a contribution for a syllabus in reconfigurable computing.

A short overview on the content of each chapter is provided in Section 6 of Chapter 1.

This book targets graduate students and lecturers in computer engineering, computer science and electrical engineering. Also professional in the afore mentioned field can use the book as well. We supply the book with teaching materials (slides and labs) to ease the course preparation for those willing to introduce a reconfigurable computing curricula. The teaching material as well as the labs can be downloaded from the course Web page at www.bobda.net/rc-book.

Finally, despite all the effort place in the review, we cannot be sure that all the mistakes were filtered out. We will therefore be grateful to receive your comments and feedback on possible errors.

Kaiserslautern, June 2007
Christophe Bobda

About the Author

Dr. Bobda received the Licence degree in mathematics from the University of Yaounde, Cameroon, in 1992, the diploma of computer science and the Ph.D. degree (with honors) in computer science from the University of Paderborn in Germany in 1999 and 2003, respectively. In June 2003, he joined the department of computer science at the University of Erlangen-Nuremberg in Germany as post doc. In October 2005, he moved to the University of Kaiserslautern as Junior Professor, where he leads the working group Self-Organizing Embedded Systems in the department of computer science. His research interests include reconfigurable computing, self-organization in embedded systems, multiprocessor on chip and adaptive image processing.

Dr. Bobda received the Best Dissertation Award 2003 from the University of Paderborn for his work on synthesis of reconfigurable systems using temporal partitioning and temporal placement.

Dr. Bobda is member of The IEEE Computer Society, the ACM and the GI. He has also served in the program committee of several conferences (FPL, FPT, RAW, RSP, ERSA, DRS) and in the DATE executive committee as proceedings chair (2004, 2005, 2006, 2007). He served as reviewer of several journals (*IEEE TC, IEEE TVLSI, Elsevier Journal of Microprocessor and Microsystems, Integration the VLSI Journal*) and conferences (DAC, DATE, FPL, FPT, SBCCI, RAW, RSP, ERSA).

List of Figures