

Preface

*Computer science is no more about computers
than astronomy is about telescopes.*
Edsger Dijkstra

The topic of this book is the following optimisation problem: given a set of discrete variables and a set of functions, each depending on a subset of the variables, minimise the sum of the functions over all variables. This fundamental research problem has been studied within several different contexts of computer science and artificial intelligence under different names: Min-Sum Problems, inference in Markov Random Fields (MRFs) and Conditional Random Fields (CRFs), Gibbs energy minimisation, valued constraint satisfaction problems (VCSPs), and (for two-state variables) pseudo-Boolean optimisation. We present general techniques for analysing the structure of such functions and the computational complexity of the minimisation problem.

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Many results in this book are joint work with Dave Cohen and Pete Jeavons, from whom I have learnt the ropes of academic work. Pete has also served as my mentor and Ph.D. supervisor at Oxford. I am grateful to both for their advice, support, and friendship. Some results from Chap. 2 are joint work with Páidí Creed. Some results described in Chap. 3 are joint work with Bruno Zanuttini. The results described in Chap. 7 were obtained in collaboration with Vladimir Kolmogorov, whom I met at the Tractability Workshop in Microsoft Research Cambridge in 2010, when I was a research intern there. The results presented in Chap. 8 are joint work with Johan Thapper, whom I met at the Algebraic CSP Workshop at the Fields Institute for Research in Mathematical Sciences. The Fields Institute kindly funded my attendance at the workshop. The UK Engineering and Physical Sciences Research Council (EPSRC), the Royal Society (RS), and the French National Research Agency (ANR) financed my trips to the University of Toulouse III. Chapter 9 briefly summarises some of the results that have come out of these very productive research visits to

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