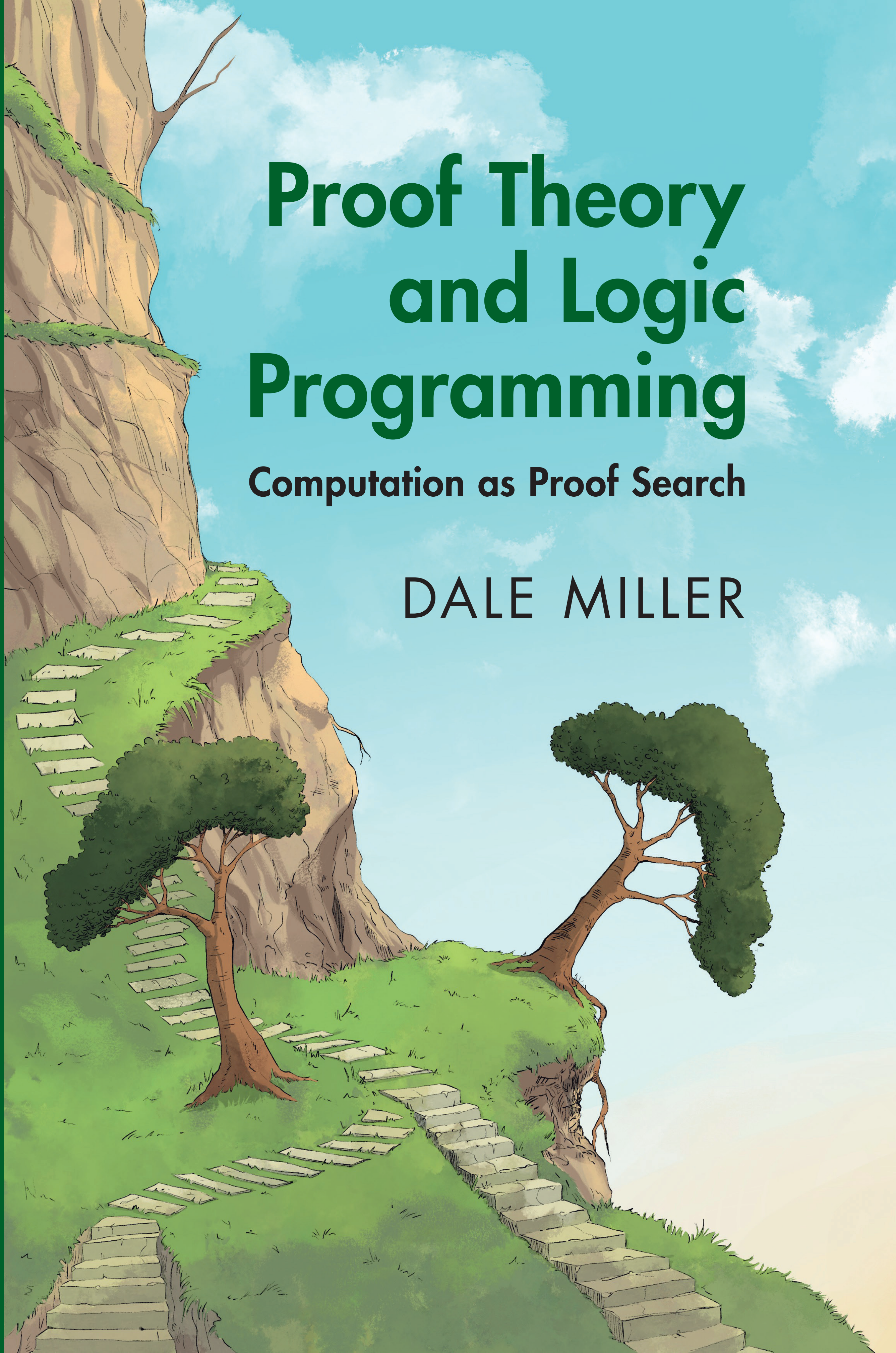
Proof Theory and Logic Programming

Computation as Proof Search

DALE MILLER



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Proof Theory and Logic Programming

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This book develops a modern perspective on logic programming by viewing computation as proof search, whereby program execution is seen as the search for proof. It reveals how programs can be naturally and declaratively expressed as logical formulas and their execution as a systematic search for proofs within classical, intuitionistic, and linear logics. It employs sequent calculus as the essential tool for analyzing the operational reading of logic programs. It introduces and applies advanced techniques such as focused proofs to expose the underlying mechanisms of goal-directed search and backchaining. A key feature is its in-depth coverage of higher-order quantification and its implications for logic programming. Beyond theory, the book explores practical applications, including encoding security protocols, specifying operational semantics, and static analysis of Horn clauses, demonstrating the versatility and power of this proof-theoretic approach.

"An excellent exposition of proof search as a vehicle for realizing computations that, in the process, provides a novel view of structural proof theory through the prism of logic programming. Ideal for a graduate-level course on logic and its role in specification and programming."
Gopalan Nadathur, *University of Minnesota*

"A refreshing look at the role that logic, specifically proof theory, plays in the foundation of computation."
Alwen Tiu, *The Australian National University*

"Miller shows how logic can shape the way we think about computation without losing sight of practical relevance. A great resource for students, researchers, and anyone interested in exploring the theoretical foundations of logic-based programming languages."
Elaine Pimentel, *University College London*

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