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Practical Foundations for Programming Languages

By Professor Robert Harper

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Types are the central organizing principle of the theory of programming languages. In this innovative book, Professor Robert Harper offers a fresh perspective on the fundamentals of these languages through the use of type theory. Whereas most textbooks on the subject emphasize taxonomy, Harper instead emphasizes genetics, examining the building blocks from which all programming languages are constructed. Language features are manifestations of type structure. The syntax of a language is governed by the constructs that define its types, and its semantics is determined by the interactions among those constructs. The soundness of a language design - the absence of ill-defined programs - follows naturally. Professor Harper's presentation is simultaneously rigorous and intuitive, relying on only elementary mathematics. The framework he outlines scales easily to a rich variety of language concepts and is directly applicable to their implementation. The result is a lucid introduction to programming theory that is both accessible and practical.

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Editorial Review

Review

"Harper's book provides a comprehensive treatment of the foundations of computation. He touches on a surprising range of concepts that arise in language design: from simple types to polymorphism to dependent types to modules; from strict to lazy to parallel computation; and from proof techniques for reasoning about extensional behavior to practical, compositional cost models in the presence of garbage collection. More importantly, throughout the book he uses types and the principles of type theory to organize the material and help us discover the orthogonal, composable abstractions that arise naturally not only in the design of programming languages but also in logics and mathematics. This approach helps uncover the fundamental structure lurking inside programming languages of today, and provides a principled approach to the designs for tomorrow."

Greg Morrisett, School of Engineering and Applied Sciences, Harvard University

"Starting with a mathematically simple framework and organizing principles that give type systems a central role, Bob Harper's magnum opus reveals the theory of programming languages as a coherent scientific subject with both breadth and elegance. His enormous experience, pithy views, and great good taste are evident throughout a book that deserves to become a classic."

Andrew Pitts, Computer Laboratory, University of Cambridge

"This book offers an excellent introduction to a wide range of programming language concepts. They are all uniformly and carefully explained, using techniques that are very useful in practice for both analysis and implementation of programming languages. The book is authored by one of the most prominent researchers in type theory for programming languages. The presentation is very effective and based on the author's years of experience teaching the material."

Lars Birkedal, Professor, IT University of Copenhagen

About the Author

Robert Harper has been a member of the faculty of Computer Science at Carnegie Mellon University since 1988. His main research interest is in the application of type theory to the design and implementation of programming languages and to the development of systems for mechanization of mathematics. Professor Harper is a recipient of the Allen Newell Medal for Research Excellence and the Herbert A. Simon Award for Teaching Excellence at Carnegie Mellon and is a Fellow of the Association for Computing Machinery.

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