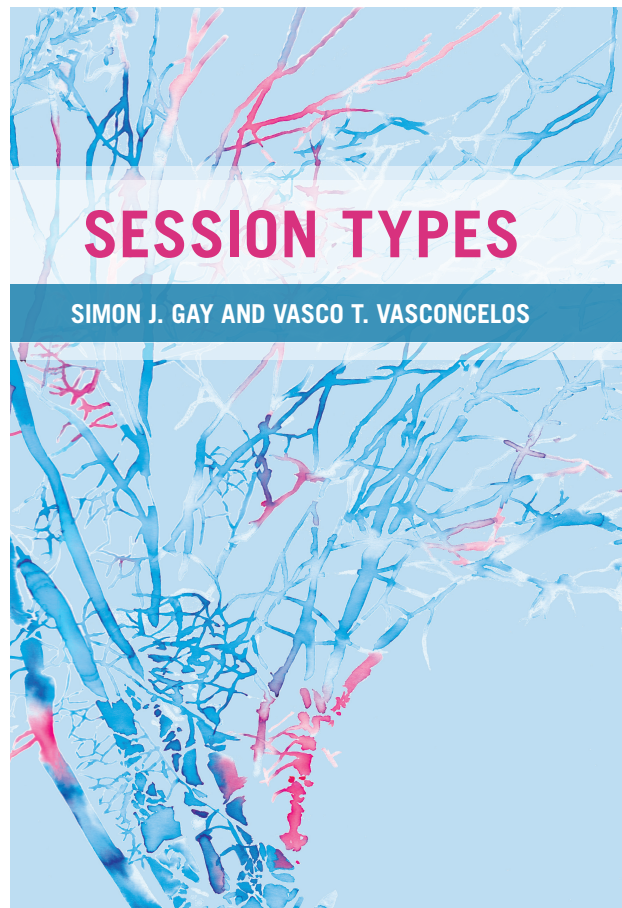


BOOK ANNOUNCEMENT: SESSION TYPES

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Summary

Session types are type-theoretic specifications of communication protocols in concurrent or distributed systems. By codifying the structure of communication, they make software more reliable and easier to construct. Over recent decades, the topic has become a large and active research area within the field of programming language theory and implementation.

Written by leading researchers in the field, this is the first text to provide a comprehensive introduction to the key concepts of session types. The thorough theoretical treatment is complemented by examples and exercises, suitable for use in a lecture course or for self-study. It serves as an entry point to the topic for graduate students and researchers.

Contents

1. Introduction
2. Basic Concepts
3. Infinite Behaviour
4. Sharing
5. Subtyping
6. Algorithmic Typing
7. Functional Programming
8. Linear Pi Calculus with Values
9. Propositions as Sessions

Preface

The topic of *session types* concerns the use of programming language type systems to specify and verify the communication behaviour of programs. Just as data types describe the structure of data and constrain the operations that can be performed on it, session types describe the structure of communication and constrain

the communication operations that can be performed. A session type is a formal description of a communication protocol, made accessible to programming language tools such as typecheckers, compilers, IDEs and runtime monitors.

The theory of session types was developed by Kohei Honda and his collaborators at Keio University during the 1990s. Honda's paper *Types for Dyadic Interaction* contains the key ideas, but is not always cited as the original paper. It was followed by *An Interaction-Based Language and Its Typing System*, co-authored with Kaku Takeuchi and Makoto Kubo, and *Language Primitives and Type Discipline for Structured Communication-Based Programming*, co-authored with Vasco Vasconcelos and Makoto Kubo. The latter paper included a range of examples showing that the type system could describe interesting protocols such as FTP. It was published at the ESOP conference, and is noteworthy for being 17 pages long at a time when ESOP papers were restricted to 15 pages. Kohei persuaded the programme committee chair that the paper was important enough to justify extra space.

None of the original papers used the phrase “session types”, although they referred to both sessions and (of course) types. The phrase “session types” first appeared in the paper *Types and Subtypes for Client-Server Interactions* by Simon Gay and Malcolm Hole. Subsequently it became established as the name of the research topic, and at the time of writing, Google Scholar lists more than 500 papers with “session types” in the title. Most conferences on programming languages now include papers on session types every year, often with a whole session devoted to them.

The purpose of this book is to give a clear presentation of the core theory of session types. More precisely, we cover *binary* session types, which deal with interaction between pairs of agents. There is a large literature on *multiparty session types*, introduced by Kohei Honda, Nobuko Yoshida and Marco Carbone in the paper *Asynchronous Multiparty Session Types*, which extends the theory to collective protocols among multiple agents. In order to keep the book to a reasonable size with a clear focus, we have not included multiparty session types. They deserve a book of their own.

After an introductory overview in Chapter 1, Chapter 2 covers the basic theory of binary session types in pi calculus. In this chapter, all behaviour is finite and there is no sharing of channels.

Chapter 3 introduces infinite behaviour in both types and processes, detailing a coinductive foundation for a convenient finite syntax. Chapter 4 adds the possibility of shared channels. At this point we reach a language with similar expressiveness to the one presented in Vasco Vasconcelos' paper *Fundamentals of Session Types*, although the presentation is a little different.

Chapter 5 extends the theory to include subtyping, to support a more flexible approach to judging when two components can communicate safely. Chapter 6

adapts the declarative type system of Chapter 5 into an algorithmic system suitable for implementation as a type checker.

In Chapter 7 we present the ideas from our own paper *Linear Type Theory for Asynchronous Session Types*, integrating session types into a multithreaded functional programming language.

Chapter 8 presents work by Ornela Dardha, Elena Giachino and Davide Sangiorgi, showing how session types can be encoded in more primitive type-theoretic constructs. The encoding was originally published in *Session Types Revisited*.

Chapter 9 covers a Curry-Howard correspondence between session types and linear logic. This important direction in the field was opened up by Luís Caires and Frank Pfenning in the paper *Session Types as Intuitionistic Linear Propositions* and is still being explored. Our presentation follows Philip Wadler’s reformulation of the correspondence in the paper *Propositions as Sessions*.

Endorsements

“... a comprehensive account of the basic theory and [...] possible applications, beautifully leavened with insightful examples and exercises. It will become—and well deserves to become—the definitive reference textbook on session types.” *Davide Sangiorgi, University of Bologna*

“How should we structure distributed computation? One of the most promising approaches is session types. Here we have a superb introduction by two founders of the field. Gay and Vasconcelos provide a readable yet thorough introduction. It has long been needed and will help the field flourish.” *Philip Wadler, University of Edinburgh*

“This book offers a deep view on the core theory of binary session types. The reader is captivated by the appropriate and clarifying examples and stimulated by the challenging exercises. The authors are outstanding researchers as witnessed by the simplicity and rigour of their writing.” *Mariangiola Dezani-Ciancaglini, University of Turin*