



Quantum Physics and Linguistics: A Compositional, Diagrammatic Discourse

By Chris Heunen, Mehrnoosh Sadrzadeh, Edward Grefenstette

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New scientific paradigms typically consist of an expansion of the conceptual language with which we describe the world. Over the past decade, theoretical physics and quantum information theory have turned to category theory to model and reason about quantum protocols. This new use of categorical and algebraic tools allows a more conceptual and insightful expression of elementary events such as measurements, teleportation and entanglement operations, that were obscured in previous formalisms.

Recent work in natural language semantics has begun to use these categorical methods to relate grammatical analysis and semantic representations in a unified framework for analysing language meaning, and learning meaning from a corpus. A growing body of literature on the use of categorical methods in quantum information theory and computational linguistics shows both the need and opportunity for new research on the relation between these categorical methods and the abstract notion of information flow.

This book supplies an overview of how categorical methods are used to model information flow in both physics and linguistics. It serves as an introduction to this interdisciplinary research, and provides a basis for future research and collaboration between the different communities interested in applying category theoretic methods to their domain's open problems.

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Editorial Review

Review

Category theory is sometimes used for building long and high conceptual bridges. Here it is in action, spanning a string diagram bridge between quantum physics and linguistics. In the middle you may feel dizzy. When you get to the other side, the clouds may obscure where you started from. But the landscape in between is very picturesque and definitely worth the climb. * Dusko Pavlovic, Royal Holloway, University of London * This book will be of interest to people with a background in category theory, whether from a quantum physics background or linguistic background. It may also be useful to researchers who use the approach presented here to apply categorical ideas and compositional reasoning to another field of knowledge, resulting in further links being found between apparently unrelated field. * John Bartlett, Mathematics Today *

About the Author

Dr Heunen is a mathematical physicist with an interest in logic. He obtained his PhD in mathematics and computer science at the University of Nijmegen in 2009. Currently he works as a postdoctoral researcher at the University of Oxford.

Dr Sadrzadeh works on computational logical modelling and reasoning and their applications to natural language syntax and semantics. Her graduate studies in Computer Software Engineering, Logic, and Philosophy, were done in Universities of Sharif (in Iran), Ottawa and Quebec at Montreal (UQAM), and Oxford, where she was an academic visitor for half of the duration of her PhD and then an EPSRC Postdoctoral Fellow and where she is currently working as an EPSRC Career Acceleration Fellow.

Mr Grefenstette is finishing a DPhil in Computer Science on the topic of exploiting category-theoretic methods from quantum information theory to add compositionality to distributional semantic models of natural language. He has a background in Physics (University of Sheffield, UK) and Philosophy (University of St Andrews, UK). He will be continuing his work on compositionality and semantics in Oxford as a postdoc, starting in Autumn 2012.

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