# Amar Hadzihasanovic

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## Employment

**Tallinn University of Technology**, Estonia
Assistant Professor of Quantum Software — 2023 —
Postdoctoral Researcher — 2020 — 2023

**Quantinuum**, United Kingdom
Scientific Advisor (remote, part-time) — 2022 —

**IRIF, Université Paris Cité** and **Inria**, France
FSMP Postdoctoral Research Fellow — 2019 — 2020

**RIMS, Kyoto University**, Japan
JSPS Postdoctoral Research Fellow — 2017 — 2019

## Education

**University of Oxford**, United Kingdom
PhD (DPhil) in Computer Science — 2013 — 2017

**Utrecht University**, The Netherlands
Visiting Student, Mathematical Institute — 2013

**Università di Pavia**, Italy
MSc (Laurea Magistrale) in Mathematics — 2011 — 2013
BSc (Laurea Triennale) in Mathematics — 2008 — 2011

## Publications

### *Preprints*

P2. Combinatorics of Higher-Categorical Diagrams.
Book, single-author. arXiv preprint 2404.07273, 2024.

P1. Diagrammatic Sets and Rewriting in Weak Higher Categories.
Single-author. arXiv preprint 2007.14505, 2020.

### *Peer-reviewed*

12. Obstructions to Compositionality.
With Caterina Puca, Fabrizio Genovese, and Bob Coecke. In *6th International Conference on Applied Category Theory (ACT) 2023*, volume 397 of EPTCS, pages 226—245, 2023.

11. Higher-Dimensional Subdiagram Matching.
With Diana Kessler. In *38th Annual ACM/IEEE Symposium on Logic in Computer Science (LICS) 2023*, pages 1—13, 2023.

10. Data Structures for Topologically Sound Higher-Dimensional Diagram Rewriting.
With Diana Kessler. In *5th International Conference on Applied Category Theory (ACT) 2022*, volume 380 of EPTCS, pages 111—127, 2023.

09. The Smash Product of Monoidal Theories.
Single-author. In *36th Annual ACM/IEEE Symposium on Logic in Computer Science (LICS) 2021*, pages 1—13, 2021.

08. A Combinatorial-Topological Shape Category for Polygraphs.
Single-author. In *Applied Categorical Structures*, volume 28, issue 3, pages 419—476, 2020.

07. Weak Units, Universal Cells, and Coherence via Universality for Bicategories.
Single-author. In *Theory and Applications of Categories*, volume 34, number 29, pages 883—960, 2019.

06. A Diagrammatic Calculus of Fermionic Quantum Circuits.
With Giovanni de Felice and Kang Feng Ng. In *Logical Methods in Computer Science*, volume 15, issue 3, pages 26:1—26:34, 2019.

05. Two Complete Axiomatisations of Pure-State Qubit Quantum Computing.
With Kang Feng Ng and Quanlong Wang. In *33rd Annual ACM/IEEE Symposium on Logic in Computer Science (LICS) 2018*, pages 502—511, ACM, 2018.

04. A Diagrammatic Axiomatisation of Fermionic Quantum Circuits.
With Giovanni de Felice and Kang Feng Ng. In *3rd International Conference on Formal Structures for Computation and Deduction (FSCD) 2018*, volume 108 of LIPIcs, pages 17:1—17:20, 2018.

03. A Topological Perspective on Interacting Algebraic Theories.
Single-author. In *Proceedings 13th International Conference on Quantum Physics and Logic (QPL) 2016*, volume 236 of EPTCS, pages 70—86, 2017.

02. Nonstandard Functional Interpretations and Categorical Models.
With Benno van den Berg. In *Notre Dame Journal of Formal Logic*, volume 58, number 3, pages 343—380, 2017.

01. A Diagrammatic Axiomatisation for Qubit Entanglement.
Single-author. In *30th Annual ACM/IEEE Symposium on Logic in Computer Science (LICS) 2015*, pages 573—584, IEEE, 2015.

*Doctoral thesis*

The Algebra of Entanglement and the Geometry of Composition.
University of Oxford, 2017. Available as arXiv preprint 1709.08086.

## Teaching

**Tallinn University of Technology**, Estonia

Lecturer, *Introduction to Category Theory and Its Applications* 2021
Graduate students of computer science. Four lectures on limits and colimits.

**Kyoto University**, Japan

Lecturer, *Category Theory and Diagrammatic Reasoning* 2019
Advanced undergraduate and graduate students of mathematics and CS.
Lecture notes written and made available on personal website.

**University of Oxford**, United Kingdom

Teaching Assistant, *Automata, Logic and Games* 2017
Teaching Assistant, *Categories, Proofs and Processes* 2015 — 2016
Advanced undergraduate and graduate students of mathematics and CS.

**Università di Pavia**, Italy

Teaching Assistant, *Linear Algebra and Geometry* 2012 — 2013
First-year students of industrial and civil engineering.
Lecturer, *Preliminary Mathematics* 2012
First-year students of mathematics and physics.

## Supervision

Clémence Chanavat. *Combinatorial approaches to directed spaces.* 2023 —
PhD candidate, Tallinn University of Technology.
Co-supervised with Paweł Sobociński.

Diana Kessler. *Diagrammatic models of computation.* 2020 —
PhD candidate, Tallinn University of Technology.
Co-supervised with Paweł Sobociński.

Giovanni de Felice. *Hopf algebras in quantum computation.* 2017
Master's thesis, University of Oxford.
Co-supervised with Bob Coecke.

## Invited talks

*International conferences and workshops*

6 Jul 2023, Geometric and Topological Methods in Computer Science.
8 Jun 2023, François Métayer Days.
2 Jun 2022, Geometric and Topological Methods in Computer Science.
22 Feb 2022, Logic and Higher Structures.
5 Jul 2020, Geometric and Categorical Structures in Computation and Deduction.

*Seminars*

7 Feb 2024, Abstract Homotopy Seminar, MPIM, Bonn, Germany.
30 Nov 2023, Bristol Programming Languages Seminar, Bristol, UK.
17 Nov 2023, (i)Po(m)set Project Online Seminar, online.
20 May 2021, ItaCa Fest, online.
30 Apr 2021, Theoretical Computer Science Seminar, Birmingham, UK.
29 Apr 2021, Algebraic Rewriting Seminar, online.
23 Feb 2021, Higher Homotopical Structures, Barcelona, Catalonia.
11 Jun 2020, TallCat Seminar, Tallinn, Estonia.
21 Feb 2020, OASIS Seminar, Oxford, UK.
31 Oct 2019, RIMS Computer Science Seminar, Kyoto, Japan.
4 Oct 2019, Catégories supérieures, polygraphes et homotopie, Paris, France.
18 Jan 2019, Catégories supérieures, polygraphes et homotopie, Paris, France.
1 Nov 2018, RIMS Computer Science Seminar, Kyoto, Japan.
5 Jul 2018, Catégories supérieures, polygraphes et homotopie, Paris, France.
7 Dec 2017, RIMS Computer Science Seminar, Kyoto, Japan.
14 Jan 2016, Séminaire PPS, Paris, France.
7 Mar 2016, Category Theory Seminar, Bruxelles, Belgium.
28 Aug 2014, Seminario di Logica Permanente, Gargnano, Italy.
11 Sep 2013, Colloquium on Mathematical Logic, Amsterdam, The Netherlands.

## Invited meetings

Dec 2023, *Compositional world-modelling (for safe AI)*, Birmingham, UK.
Nov 2023, *Emergence and non-compositionality*, Wytham Abbey, UK.
Feb 2022, *Logic and higher structures*, CIRM, France.
Jan 2019, *Higher structures*, CIRM, France.
Nov 2018, *Diagrammatic methods for linear and nonlinear systems*, NII Shonan, Japan.
Jan 2018, *Intensional and extensional aspects of computation*, NII Shonan, Japan.
Sep 2017, *Categories for homotopy theory and rewriting*, CIRM, France.

## Funding

*Estonian Research Council* 2022 — 2025
Start-up Grant PSG764 (expected gross € 276,000).

*FSMP – Fondation Sciences Mathématiques de Paris* 2019 — 2020
Postdoctoral Fellowship (net € 30,000).

*JSPS – Japanese Society for the Promotion of Science* 2017 — 2019
Postdoctoral Fellowship for Research in Japan (Standard) (net ¥8,888,000).
KAKENHI Grant-in-Aid (net ¥2,200,000).

*EPSRC – Engineering and Physical Sciences Research Council, Department of Computer Science, and Wolfson College, Oxford* 2013 — 2016

Combined studentship: EPSRC Doctoral Training Partnership, Departmental Studentship for Doctoral Study, and Isaiah Berlin Scholarship.

*IUSS – Istituto Universitario di Studi Superiori and Collegio Ghislieri, Pavia* 2008 — 2013

Studentship and place in highly selective college.

## Awards

*Distinguished presentation.* Applied Category Theory (ACT). 2022

*Data structures for topologically sound higher-dimensional diagram rewriting*, with Diana Kessler.

*Best paper whose author is a student.* Quantum Physics and Logic (QPL). 2015

*A diagrammatic axiomatisation of the GHZ and W quantum states.*

*Premio AILA.* Italian Association of Logic and Applications (AILA). 2014

Best master's thesis in logic defended at an Italian university in 2013.

*Premio Migliore Laureato.* Università di Pavia. 2014

Top-ranked graduate from the Department of Mathematics in 2013.

## Service

Program committee chair for *Symposium on Compositional Structures* (SYCO) 7.

Local organiser of *Symposium on Compositional Structures* (SYCO) 8.

Program committee member for *Mathematical Foundations of Programming Semantics* (MFPS) 2022, *Quantum Physics and Logic* (QPL) 2022, 2023, 2024, *Applied Category Theory* (ACT) 2020, 2023, 2024, *Workshop on String Diagrams in Computation, Logic and Physics* (STRING) 3, and *Symposium on Compositional Structures* (SYCO) 4, 8, 9.

Reviewer for journals: *Journal of Mathematical Physics*, *Mathematical Structures in Computer Science*, *Compositionality*, *Logical Methods in Computer Science.*

Reviewer for conferences with proceedings: *Formal Structures for Computation and Deduction* (FSCD), *Logic in Computer Science* (LICS), *International Colloquium on Automata, Languages, and Programming* (ICALP), *Quantum Physics and Logic* (QPL), *Mathematical Foundations of Programming Semantics* (MFPS), *Mathematical Foundations of Computer Science* (MFCS), *Applied Category Theory* (ACT), *Computer Science Logic* (CSL), *Foundations of Software Science and Computation Structures* (FoSSaCS), *Concurrency Theory* (CONCUR), *Theory of Quantum Computation, Communication and Cryptography* (TQC), *International Conference on Graph Transformation* (ICGT).

## Personal

Italian citizen. One child (Vivian, b. 2019).

## Languages

**Italian** and **Bosnian-Croatian-Serbian** (bilingual native), **English** (near-native), **French** (advanced), **Japanese** (basic). Learning **Estonian**.