

# Paolo Perrone

*Mathematician & math teacher*

University of Oxford  
Dept. of Computer Science  
Wolfson Building, Parks Road  
Oxford, OX1 3QD, U.K.  
✉ [paolo.perrone@cs.ox.ac.uk](mailto:paolo.perrone@cs.ox.ac.uk)  
🌐 [www.paoloperrone.org](http://www.paoloperrone.org)

## *Curriculum Vitae*

### Personal data

Name Paolo Perrone  
Date of birth 10th November 1989  
Place of birth Bergamo (Italy)  
Nationality Italian  
Marital status single

### Current position

#### Research:

Institution University of Oxford, England (U.K.)  
Department Computer Science  
Position Research associate  
Group leader Sam Staton

#### Teaching (college):

Institution University of Oxford, England (U.K.)  
College Mansfield College (Oxford)  
Courses Probability I, Probability II, Integration, Integral Transforms

### Past positions

- 2020 **Postdoctoral associate, Mathematics, Massachusetts Institute of Technology (MIT), Cambridge, MA (U.S.A.).**  
Group leader: David Spivak.
- 2019 **Postdoctoral visitor, Mathematics, York University, Toronto, ON (Canada).**  
Group leader: Walter Tholen.

2019 **Postdoctoral researcher, Mathematics, Max Planck Institute for Mathematics in the Sciences, Leipzig (Germany).**

Group leader: Jürgen Jost. Official German name: Wissenschaftlicher Mitarbeiter im Fachbereich Mathematik.

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## Education

2018 **PhD in Mathematics, Max Planck Institute for Mathematics in the Sciences and University of Leipzig, Leipzig (Germany), Magna cum laude.**

Supervisor: Jürgen Jost. Official German name: Doktor der Naturwissenschaften (Dr. Rer. Nat.) im Fachbereich Mathematik.

2013 **Master of Science in Physics, Università degli Studi di Milano, Milan (Italy), 110/110 cum laude.**

Supervisor: Guido Parravicini. Official Italian name: Laurea Magistrale in Fisica.

2012–2013 **Exchange year, Physics, KU Leuven, Leuven (Belgium).**

2011 **Bachelor of Science in Physics, Università degli Studi di Milano-Bicocca, Milan (Italy), 110/110 cum laude.**

Supervisor: Diego Noja. Official Italian name: Laurea Triennale in Fisica.

2008 **Scientific High School Diploma, Liceo Scientifico Mascheroni, Bergamo (Italy), 100/100.**

Official Italian name: Diploma di Liceo Scientifico.

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## Articles

### Published:

2023 **C. Constantin, T. Fritz, P. Perrone and B. Shapiro, Partial evaluations and the compositional structure of the bar construction, Theory and Application of Categories, vol. 39, n. 11, pages 322–364.**

2023 **S. Moss und P. Perrone, A category-theoretic proof of the ergodic decomposition theorem, Ergodic Theory and Dynamical Systems.**

2022 **S. Moss and P. Perrone, Probability monads with submonads of deterministic states, Proceedings of LICS.**

2022 **P. Perrone and W. Tholen, Kan extensions are partial colimits, Applied Categorical Structures.**

2021 **T. Fritz, P. Perrone and S. Rezagholi, Probability, valuations, hyperspace: Three monads on Top and the support as a morphism, Mathematical Structures in Computer Science, vol. 31, n. 8, pp. 850-897.**

- 2021 **T. Fritz, T. Gonda and P. Perrone**, *De Finetti's Theorem in Categorical Probability*, *Journal of Stochastic Analysis*, vol. 2, n. 4, art. 6.
- 2020 **T. Fritz and P. Perrone**, *Stochastic order on metric spaces and the ordered Kantorovich monad*, *Advances in Mathematics*, vol. 366.
- 2020 **T. Fritz and P. Perrone**, *Monads, partial evaluations, and rewriting*, *Proceedings of MFPS 36, ENTCS*.
- 2019 **T. Fritz and P. Perrone**, *A Probability Monad as the Colimit of Spaces of Finite Samples*, *Theory and Application of Categories*, vol. 34, n. 7, pages 170–220.
- 2018 **T. Fritz and P. Perrone**, *Bimonoidal Structure of Probability Monads*, *Proceedings of MFPS 34, ENTCS*.
- 2016 **P. Perrone and N. Ay**, *Hierarchical Quantification of Synergy in Channels*, *Frontiers in Robotics and AI*.

#### Submitted:

- 2023 **T. Fritz, F. Gadducci, P. Perrone and D. Trotta**, *Weakly affine monads*, preprint at arXiv:2303.14049.
- 2022 **P. Perrone**, *Markov Categories and Entropy*, preprint at arXiv:2212.11719.
- 2022 **T. Fritz, T. Gonda, N. Gauguin Houghton-Larsen, P. Perrone and D. Stein**, *Dilations and information flow axioms in categorical probability*, preprint at arXiv:2211.02507.
- 2021 **P. Perrone**, *Lifting couplings in Wasserstein spaces*, preprint at arXiv:2110.06591.
- 2021 **C. Constantin, T. Fritz, P. Perrone and B. Shapiro**, *Weak cartesian properties of simplicial sets*, preprint at arXiv:2105.04775.
- 2020 **T. Fritz, T. Gonda, P. Perrone and E. F. Rischel**, *Representable Markov Categories and Comparison of Statistical Experiments in Categorical Probability*, preprint at arXiv:2010.07416.

#### PhD Thesis:

- 2018 **P. Perrone**, *Categorical Probability and Stochastic Dominance in Metric Spaces*, University of Leipzig, Germany, Available online at [www.paoloperrone.org/phdthesis.pdf](http://www.paoloperrone.org/phdthesis.pdf).

#### Lecture notes, conference papers and other material:

- 2019 **P. Perrone**, *Notes on Category Theory with examples from basic mathematics*, lecture notes, arXiv:1912.10642.

- 2018 **T. Fritz and P. Perrone**, *A Criterion for Kan Extensions of Lax Monoidal Functors*.
- 2016 **P. Perrone and N. Ay**, *Iterative Scaling Algorithm for Channels*.
- 2016 **P. Perrone and N. Ay**, *Decomposition of Markov Kernels*, Proceedings of WUPES 10.
- 2015 **P. Perrone**, *Dual Connections and Holonomy*.

## Teaching and community work

### Courses:

- 2022 **Tutor**, *Quantum Computing and Modelling: an Applied Category Theory Perspective*, undergraduate course, Cambridge Center for International Research (U.K.).
- 2022 **College Tutor**, *Integral Transforms*, undergraduate course, Mansfield College, University of Oxford (U.K.).
- 2022 **College Tutor**, *Integration*, undergraduate course, Mansfield College, University of Oxford (U.K.).
- 2022 **College Tutor**, *Groups and Group Actions*, undergraduate course, Mansfield College, University of Oxford (U.K.).
- 2022 **College Tutor**, *Linear Algebra II*, undergraduate course, Mansfield College, University of Oxford (U.K.).
- 2022 **Lecturer**, *Teoria delle categorie*, online, in Italian. Collaboration with the ItaCa Project.
- 2021 **Lecturer**, *Bayesian Statistical Probabilistic Programming*, graduate course, University of Oxford (U.K.). Together with Hugo Paquet and Sam Staton.
- 2021 **College Tutor**, *Linear Algebra I*, undergraduate course, Mansfield College, University of Oxford (U.K.).
- 2021 **Lecturer**, *Applied Category Theory*, graduate course, University of Oxford (U.K.).
- 2021 **College Tutor**, *Groups and Group Actions*, undergraduate course, Mansfield College, University of Oxford (U.K.).
- 2020 **Teacher**, *Categories and gauge theory*, reading seminar, Massachusetts Institute of Technology, Cambridge, MA (U.S.A.).
- 2019 **Lecturer**, *Applied Linear Algebra*, undergraduate course, University of York, Toronto, ON (Canada).

2019 **Teaching assistant**, *Applied Category Theory*, summer school and online seminars, University of Oxford (U.K.).

2019 **Lecturer**, *Category theory and applications*, graduate course, Max Planck Institute, Leipzig (Germany).

### Organizing and supporting events:

2023 **Organizer**, *Oxford Advanced Seminar on Informatic Structures (OASIS)*, research seminar, University of Oxford (U.K.).

2022 **Co-organizer**, *Compositional Robotics: Mathematics and Tools*, ICRA 2022 Workshop, Philadelphia, PA (U.S.A.).  
(co-organized by Andrea Censi, Gioele Zardini et al.)

2021 **Co-organizer**, *Compositional Robotics: Mathematics and Tools*, ICRA 2021 Workshop, ETH Zürich (Switzerland) – Moved online due to CoViD-19 outbreak.  
(co-organized by Andrea Censi, Gioele Zardini et al.)

2020 **Co-organizer and technical support**, *MIT Categories Seminar*, research and graduate seminar, Massachusetts Institute of Technology, Cambridge, MA (U.S.A.) – Moved online due to CoViD-19 outbreak.  
(co-organized by Brendan Fong and David Spivak)

2020 **Local organizer and technical support**, *Applied Category Theory (ACT)*, conference, Massachusetts Institute of Technology, Cambridge, MA (U.S.A.) – Moved online due to CoViD-19 outbreak.  
(other local organizers: Brendan Fong, David Myers and David Spivak)

2020 **Organizer**, *Applied Category Theory*, summer school and online seminars, Massachusetts Institute of Technology, Cambridge, MA (U.S.A.) – Moved online due to CoViD-19 outbreak.  
(together with Carmen Constantin and Eliana Lorch)

2020 **Technical support**, *Categorical Probability and Statistics*, conference, University of Ottawa, ON (Canada) – Moved online due to CoViD-19 outbreak.  
(organized by Tobias Fritz and Rory Lucyshyn-Wright)

2015-2018 **Co-organizer**, *LikBez seminar, Mathematics*, reading seminar, Max Planck Institute, Leipzig (Germany).  
(together with Rostislav Matveev and Sharwin Rezagholi)

### Reviews:

- 2022 Journal of the London Mathematical Society
- 2022 Applied Category Theory (ACT), conference and proceedings
- 2022 Theory and Applications of Categories (TAC), journal
- 2022 Master Thesis review for Macquarie University, Sydney (Australia)
- 2021 Compositionality, journal
- 2020 Logic In Computer Science (LICS), conference and proceedings
- 2020 Applied Category Theory (ACT), conference and proceedings
- 2020 Compositionality, journal
- 2019 Applied Category Theory (ACT), conference and proceedings

### Other activities:

- 2020 Obtained Kaufman Teaching Certificate Program at MIT
- Current Scientific committee of ItaCa, association of Italian category theorists
- Current ItaCa online course, in Italian, on category theory
- Current Applied Category Theory Ethics and Values committee
- Current (Co-)author of nLab, category theory wiki
- Current (Co-)moderator of Zulip Category Theory Community Server, collaboration, learning, and discussion forum

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### Industry collaboration

- 2022 **Consulting**, Cavenwell AI, Ottawa (Canada).

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### Conference and invited talks

#### 2023:

- Jan. 2023 **Invited event**, *Research week on Markov categories*, Universität Innsbruck (Austria).

#### 2022:

- Dec. 2022 **SYCO 10**, *Dilations and information flow axioms in categorical probability*, University of Edinburgh (Scotland).  
Speaker: Tomáš Gonda (joint work).
- Dec. 2022 **Invited talk**, *GS-monoidal structures and thunkability in Kleisli categories*, Università di Pisa (Italy).

- Nov. 2022 **Invited talk**, *Introduction to Markov categories*, Sheaf Talk Seminar, University of Oxford (United Kingdom).
- Nov. 2022 **Invited talk**, *When measurable spaces don't have enough points*, Theoretical Computer Science Seminar, University of Birmingham (United Kingdom).
- Sept. 2022 **SYCO 9**, *Lifting weights: enriched lenses between transport plans*, Università dell'Insubria, Como (Italy).
- Aug. 2022 **Logic in Computer Science (LICS)**, *Probability monads with submonads of deterministic states*, Technion, Haifa (Israel).  
Speaker: Sean Moss (joint work).
- July 2022 **Invited talk**, *When measurable spaces don't have enough points*, Seminário de Teoria das Categorias, Universidade de Coimbra (Portugal).  
(Held online.)
- July 2022 **Applied Category Theory 2022**, *A category-theoretic proof of the ergodic decomposition theorem*, University of Strathclyde (Scotland).
- June 2022 **Guest lecture**, *Introduction to categorical probability*, Applied Category Theory course, University of Oxford (United Kingdom).  
(Held online.)
- 2021 (most events held online):**
- July 2022 **Applied Category Theory 2022**, *A category-theoretic proof of the ergodic decomposition theorem*, University of Strathclyde (Scotland).
- June 2022 **Guest lecture**, *Introduction to categorical probability*, Applied Category Theory course, University of Oxford (United Kingdom).  
(Held online.)
- Nov. 2021 **Invited talk**, *The rise of quantitative category theory*, Topos Colloquium, Topos Institute, Berkeley (U.S.A.).
- Aug. 2021 **Category Theory 2021**, *Kan extensions are partial colimits*, Università di Genova (Italy).  
(Held in person.)
- July 2021 **Applied Category Theory 2021**, *De Finetti's theorem in categorical probability*, University of Cambridge (U.K.).  
Speaker: Tobias Fritz (joint work).
- June 2021 **Keynote talk, Categories and Companions 2021**, *An invitation to categorical probability and statistics with Markov categories*, Macquarie University, Sydney (Australia).  
Speaker: Tobias Fritz (joint work).

- June 2021 **Categories and Companions 2021**, *Compositional structure of partial evaluations*, Macquarie University, Sydney (Australia).  
Speaker: Brandon Shapiro (joint work).
- May 2021 **Seminar talk**, *Weighted limits in metric geometry*, Metric Geometry seminar, Max Planck Institute for Mathematics in the Sciences, Leipzig (Germany).
- May 2021 **Seminar talk**, *Markov categories: towards a syntax for probability*, Logic and Semantics for Dummies, University of Cambridge (U.K.).
- May 2021 **Invited talk**, *The law of large numbers in categorical probability*, Topos Colloquium, Topos Institute, Berkeley (U.S.A.).  
Speaker: Tobias Fritz (joint work).
- Apr. 2021 **Invited talk**, *The de Finetti theorem in categorical probability*, Cohomology in algebra, geometry, physics and statistics, Institute of Mathematics, Czech Academy of Sciences (Czech Republic).  
Speaker: Tobias Fritz (joint work).
- Mar. 2021 **Invited talk**, *Categorical probability, Markov categories and the de Finetti theorem*, New York City Category Theory Seminar, CUNY, New York (U.S.A.).  
Speaker: Tobias Fritz (joint work).
- Mar. 2021 **Impromptu seminar talk**, *Categorical probability, Markov categories and the de Finetti theorem*, New York City Category Theory Seminar, CUNY, New York (U.S.A.).
- Feb. 2021 **Invited talk**, *Partial evaluations: the results so far*, Seminario de categorías UNAM, Mexico City (Mexico).
- Feb. 2021 **Invited talk**, *Partial evaluations for monads and 2-monads*, Seminário de Teoria das Categorias, Universidade de Coimbra (Portugal).
- Feb. 2021 **Invited talk**, *Kan extensions are partial colimits*, Masaryk University Algebra Seminar, Brno (Czech Republic).
- Jan. 2021 **Invited lecture**, *An introduction to monads*, Applied Compositional Thinking for Engineers, ETH, Zürich (Switzerland).
- Jan. 2021 **Oxford Quantum Group Workshop**, *Markov categories: randomness and information flow*, University of Oxford (United Kingdom).

**2020 (all events held online):**

- Sept. 2020 **Invited talk**, *Colimits as algebraic operations*, ItaCa Fest III, ItaCa (Italy).
- Sept. 2020 **Invited talk**, *Compositional structure of partial evaluations*, Massachusetts Institute of Technology (MIT), Cambridge, MA (U.S.A.).  
Speaker: Brandon Shapiro (joint work).



- July 2020 **Applied Category Theory 2020**, *Distribution functors, second-order stochastic dominance and the Blackwell–Sherman–Stein Theorem in Categorical Probability*, Massachusetts Institute of Technology (MIT), Cambridge, MA (U.S.A.).  
Speaker: Tomáš Gonda (joint work).
- July 2020 **Tutorial talk for ACT 2020**, *Monads and Comonads*, Massachusetts Institute of Technology (MIT), Cambridge, MA (U.S.A.).
- June 2020 **Invited talk**, *Monads, Partial Evaluations, and Rewriting*, POPV Seminar, University of Boston, Boston, MA (U.S.A.).
- June 2020 **Invited talk**, *Kan extensions are partial colimits*, Massachusetts Institute of Technology (MIT), Cambridge, MA (U.S.A.).
- June 2020 **Categorical Probability and Statistics workshop**, *Probability monads and stochastic dominance*, University of Ottawa, ON (Canada).
- June 2020 **Tutorial talk for the CPS workshop**, *What is a probability monad?*, University of Ottawa, ON (Canada).
- June 2020 **MFPS 36**, *Monads, Partial Evaluations, and Rewriting*, Université Paris VII, Paris (France).
- May 2020 **Seminar talk**, *The support as a morphism from probability to possibility*, Tallinn Institute of Technology (TalTech), Tallinn (Estonia).  
Speaker: Sharwin Rezagholi (joint work).
- April 2020 **Seminar talk**, *Stochastic orders and Kantorovich duality*, Metric Geometry seminar, Max Planck Institute for Mathematics in the Sciences, Leipzig (Germany).
- March 2020 **Seminar talk**, *Composing partial evaluations*, Massachusetts Institute of Technology (MIT), Cambridge, MA (U.S.A.).
- 2019:**
- Nov. 2019 **Invited talk**, *The compositional structure of partial evaluations*, University of Ottawa, ON (Canada).
- July 2019 **Applied Category Theory 2019**, *The support is a morphism of monads*, University of Oxford (United Kingdom).
- May 2019 **SYCO 4**, *Categorical Probability: Results and Challenges*, Chapman University, CA (U.S.A.).  
Speaker: Tobias Fritz (joint work).
- March 2019 **SYCO 3**, *The support is a morphism of monads*, University of Oxford (United Kingdom).  
Speaker: Sharwin Rezagholi (joint work).

Feb. 2019 **Invited talk**, *Towards probability theory without measure theory*, Massachusetts Institute of Technology (MIT), Cambridge, MA (U.S.A.).  
Speaker: Tobias Fritz (joint work).

2018:

Oct. 2018 **Invited talk**, *Monads, Partial Evaluations, and Martingales*, Massachusetts Institute of Technology (MIT), Cambridge, MA (U.S.A.).

Sept. 2018 **SYCO 1**, *Monads, Partial Evaluations, and Rewriting*, University of Birmingham (United Kingdom).

July 2018 **Category Theory 2018**, *On the Operational Meaning of the Bar Construction*, Universidade dos Açores, Ponta Delgada, Azores (Portugal).

June 2018 **MFPS 34**, *Bimonoidal Structure of Probability Monads*, Dalhousie University, Halifax, NS (Canada).

May-June 2018 **FMCS 26**, *A Kantorovich Monad for Ordered Spaces*, Mount Allison University, Sackville, NB (Canada).

Earlier:

July 2017 **Category Theory 2017**, *The Wasserstein Monad in Categorical Probability*, University of British Columbia, Vancouver, BC (Canada).

Nov. 2016 **Invited talk**, *A Conceptual Viewpoint on Information Decomposition*, Perimeter Institute for Theoretical Physics, Waterloo, ON (Canada).

Sept. 2015 **WUPES 10**, *Decomposition of Markov Kernels*, Moníec (Czech Republic).

Dec. 2014 **GSO 2014**, *Synergy as a Linear Operator*, Albert-Ludwig-Universität, Freiburg (Germany).

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For further information or material about any of the above, please contact me directly.

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