



Carmen Maria Constantin

Curriculum Vitae

EDUCATION AND RESEARCH EXPERIENCE

DPhil Computer Science

University of Oxford

2010 - 2015

My thesis looked at the various uses of sheaf theoretic methods in the field of Quantum Computation and Quantum Information. The language of sheaf theory provides a robust mathematical setting for describing the fundamental notions of contextuality and non-locality. This setting can be used to distill a hierarchy of three possible strengths of contextuality. We classified certain types of entangled quantum states according to this hierarchy. In particular we showed that most entangled quantum states admit Hardy-type proofs of non-locality without inequalities or probabilities. My thesis included also a reformulation of the concept of entropy using the contextual language of sheaves and topoi. This general reformulation gave a unified treatment of classical Shannon entropy, and its quantum von Neumann counterpart and shed new light on the differences between their respective properties. Supervisors: Prof. Samson Abramsky, Dr. Andreas Döring

MSc Mathematics and Foundations of Computer Science

University of Oxford

2009 - 2010

My dissertation focused on comparing several recent approaches towards a non-commutative generalisation of Gelfand Duality. Graduated with distinction. Supervisor: Dr. Andreas Döring

BSc Pure Mathematics

University of Edinburgh

2005 - 2009

My final year project was on Sheaf Theory, with a focus on sheaf cohomology and its applications. I also undertook a group project on Autonomous Robot Design and two summer research projects in Fractal Geometry and Algebraic Graph Theory. Electives in Informatics. Graduated with first class honours. Ranked 2nd in graduating class.

AWARDS AND PRIZES

Enhanced EPSRC grant

University of Oxford

2010 - 2015

Full graduate scholarship awarded to support my DPhil studies.

EPSRC grant

University of Oxford

2009 - 2010

Full graduate scholarship awarded to support my MSc studies.

Undergraduate Scholarship

University of Edinburgh

2005-2009

Full undergraduate scholarship, awarded annually to two students from Eastern European Countries.

William Manson Bequest in Mathematics

University of Edinburgh

2008

Awarded on the base of academic performance for a summer research project on Fractals.

James Murray Brown Bequest in Mathematics and Statistics

University of Edinburgh

2007

Awarded on the base of academic performance for a summer research project on Graph Index Variation

TEACHING AND OUTREACH EXPERIENCE

Supernumerary Fellow in Mansfield College

2018 - to date

University of Oxford

Responsible for tutoring up to 6 weighted hours a week in Pure Maths and organising the Mathematics teaching across college.

Lecturer for Categories Proofs and Processes

2018

CS Department, University of Oxford

Responsible for delivering lectures and setting the final exam.

Stipendiary Lecturer in University College and Merton College

2018

University of Oxford

Responsible for marking collection papers, organising revision classes and tutorials for the following courses: Introduction to Calculus, Multivariable Calculus, Dynamics, Integral Transforms, Differential Equations I and II, Special Relativity, Constructive Mathematics, Introduction to Manifolds, Geometry and Quantum Theory

Tutor in Oriel College

2017

University of Oxford, Part-time

Responsible for conducting admission interviews as well as teaching 3 Analysis I groups and 3 Metric Spaces and Complex Analysis groups, monitoring student's progress and grading homework sets

Tutor for Categories, Proofs and Processes (Masters Course)

2017, 2012

University of Oxford, Part-time

Responsible for conducting tutorial sessions, monitoring student's progress, grading homework sets and providing sample solutions.

Student Ambassador

2007 - 2009

University of Edinburgh, Volunteer

Organized several presentation sessions about the Mathematics and Computer Science departments at the University of Edinburgh. Presentations focused on entry requirements, funding opportunities and student life at Edinburgh University.

PUBLICATIONS

S. Abramsky, C. M. Constantin, S. Ying, *Hardy is (almost) everywhere: Non-locality without inequalities for almost all entangled multipartite states*, Electronic Proceedings in Theoretical Computer Science, Special Issue of Information and Computation (2015) arXiv:1506.01365

S. Abramsky, C. M. Constantin, *A Classification of Multipartite States by Degree of Non-Locality*, Electronic Proceedings in Theoretical Computer Science, QPL proceedings (2013) arXiv:1412.5213

C. M. Constantin, A. Döring, *Contextual Entropy and Reconstruction of Quantum States* (2012) arXiv:1208.2046

C. M. Constantin, A. Döring, *Reconstructing an Atomic Orthomodular Lattice from the Poset of its Boolean Sublattices*, Houston Journal of Mathematics (2013) arXiv:1306.1950

C. M. Constantin, *Sheaf Theoretic Methods in Quantum Mechanics and Quantum Information Theory*, PhD Thesis, University of Oxford (2015) arXiv:1510.02561

C. M. Constantin, *Quantales and Locales - Comparing Two Notions of Spectra for Non-commutative C^* -Algebras*, MSc Thesis, University of Oxford (2010)

CONFERENCE AND SEMINAR TALKS

Hardy is (almost) everywhere

*Categorical Quantum Mechanics Workshop 2014
Quantum Lunch Seminar, University of Oxford, 2014*

A Classification of Entangled States according to their Degree of Contextuality

*Quantum Lunch Seminar, University of Oxford 2014
Presented by Samson Abramsky at Quantum Physics and Logic, Barcelona 2013*

Reconstructing an Atomic Orthomodular Lattice

Quantum Departmental Workshop, University of Oxford, 2013

A Couple of Reconstruction Results

First Workshop on Quantum Toposophy, Radboud University, Nijmegen 2012

Contextual Entropy and the Reconstruction of Quantum States

*Quantum Physics and Logic, Brussels 2012
Aspects of Mathematical Foundations of Physics Seminar, University of Oxford 2011
Quantum Lunch Seminar, University of Oxford 2010*

Why Symplectic? An Introduction to the Geometry of Classical Mechanics

Reading Course on Geometrical Quantum Mechanics, University of Oxford 2011

The Topos Approach

14th Workshop on Quantum Information Processing, Singapore 2011

Recent Approaches Towards a Non-commutative Gelfand Spectrum

Quantum Lunch Seminar, University of Oxford 2010



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reference for Carmen Constantin Inbox ×**samson.abramsky@cs.ox.ac.uk <samson.abramsky@cs.ox.ac.uk>**

to me

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Carmen is applying to do the project "Partial evaluations, the bar construction, and second-order stochastic domination".

Carmen did her PhD with me, completing in 2015. She has three young children, and has been working her way back to a teaching position in Oxford, and is a regular member of our research group. She also very successfully lectured the term, when I was on sabbatical. She is wonderfully enthusiastic, and a very sharp mathematician. We have a couple of joint contributions. She would find it very beneficial to do this project as a stepping stone to resuming her research career.

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No recent chats

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Dear ACT organisers,

I have completed my PhD in September 2015 at the University of Oxford, under the supervision of Prof. Samson Abramsky and Dr. Andreas Doering. My thesis consisted of four projects, two related to the Topos Approach to Quantum Theories developed by Chris Isham, Andreas Doering and collaborators and two related to the sheaf theoretic approach to contextuality and non-locality initiated by Samson Abramsky and Adam Brandenburger. The topics varied from developing a notion of entropy that would fit within the topos framework to classifying quantum states according to their degree of contextuality and proving constructively that almost all states occupy at least the second level of that hierarchy.

My thesis has enjoyed a very positive reception and in 2017 I returned to Oxford in order to try to rebuild my career after taking a two year break for family related reasons. So far I have focused mostly on teaching - amongst other things I have tutored the two Categories courses offered by the Maths and Computer Science Departments and the Categorical Quantum Mechanics course designed by Jamie Vicary - which offers a comprehensive introduction to symmetric monoidal categories and their graphical calculus. Last term I also had the privilege of lecturing the Categories, Proofs and Processes course, while Prof. Samson Abramsky was on sabbatical.

Since December my teaching load has considerably reduced, as I received a permanent fellowship within Mansfield College as Senior Tutor for Maths.

My next goal is to attend to the research component of my career. The Applied Category Theory School would be an excellent starting point for this. Being able to join a community that shares my broad research interests would be highly beneficial in itself, being able to do this online would be infinitely more practical for me, since I cannot easily arrange a visit to a foreign university for any length of time and I could use the experience gained in this project to develop my own line of research. Needless to say that since I live in Oxford, coming to the summer meeting will not be a problem.

My first preference would be for the Monads project by Tobias Fritz, since on the one hand I have found monads interesting ever since I first lectured on that topic last September and I want to gain more intuition on how they can be used in practice and on the other hand because the bar construction is linked to cohomology computations and there might be links with the cohomology approach to contextuality explored partly by Samson Abramsky, Rui Soares-Barbosa and Shane Mansfield and partly by Giovanni Caru.

A second choice would be the Profunctor Optics Project by Bartosz Milewski, since it would be a good idea for me to learn more about functional programming, since it can be used to study quantum programming semantics. Also because I have read (parts of) the Category Theory for Programmers book written by the project coordinator and I really like the presentation style.

A third choice would be the Autopoiesis project by David Spivak, because it is quite open-ended and leaves a lot of room for creative discussion.

A fourth choice would be the Turing Categories project by Pieter Hofstra, since it would be interesting for me to study the interplay between traced monoidal structure and computation.

I do hope you will accept my application for the ACT summer school, and I am very much looking forward to your reply.

Sincerely yours,
Carmen Constantin