CALLUM READER

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07913696395

PHD: TO BE COMPLETED APRIL 2022

Investigating Leinster's notion of the magnitude homology of an enriched category.

CATEGORY THEORY EXPERIENCE

The majority of the first semester of my PhD was spent learning abstract category theory necessary to understand the key concepts in my proposed thesis, as well as some applications of categorical concepts in other areas such as homological algebra. Specifically, this involved focus on enriched and monoidal categories. These studies will continue into the current semester alongside involvement in a reading group focused on infinity categories.

ORDER OF PREFERENCE AND ADDITIONAL EXPERIENCE:

The following is a rough order of preference, although I would be more than happy working on any of the projects.

1. David Spivak *Toward a mathematical foundation for autopoiesis.*

2. Tobias Fritz: *Partial evaluations, the bar construction, and second-order stochastic dominance.*
The bar construction plays a pivotal role in the construction of magnitude homology.

3. Pieter Hofstra *Complexity classes, computation, and Turing categories.*
Attended taught module in computation theory that focused on Turing machines, as well as experience with computer programming. There was also some reference to computability in work on set theory and logic.

4. Bartosz Milewski: *Traversal optics and profunctors.*
This relates directly to current work on enriched and monoidal categories which will be continued as part of my PhD between now and the start of the school. I also have some familiarity with Haskell.

5. Mehrnoosh Sadrzadeh: *Formal and experimental methods to reason about dialogue and discourse using categorical models of vector spaces.*
Attended seminars in philosophical foundations of logical languages and problems with translating natural languages to formal languages.

6. Miriam Backens: *Simplifying quantum circuits using the ZX-calculus.*
Some very limited use of string diagrams in understanding monoidal categories.

STATEMENT

Having spent the past semester studying category theory from an abstract perspective, the ACT school would be a great opportunity to use some mathematical rigour and category-theoretic tools to study a topic with a radically different underlying philosophy. Several of the projects appeal for being particularly foundational and some rely on constructions related directly to my thesis, which could provide some exciting context for some relatively abstract ideas.

With PhD work being so independent, I think it would be a lot of fun getting to work collaboratively in a larger team: at this stage, there's not usually much scope for large scale discussions focused on a specific problem, but I find that kind of environment exciting and inspiring. It would be great to have a forum to discuss different areas of mathematics and forge connections and friendships outside of Sheffield. There's always the potential that that might offer some inspiration or collaboration opportunities further down the line.

Regarding career goals, experience of applying my knowledge and working collectively would aid in applications for research positions after completing my doctorate – especially if there was any chance of publication. I'd also be eager for more experience writing and presenting in front of a different audience, especially writing the blog post: having been a follower of the n-category cafe for some time it would be wonderful to be able to finally contribute something.

AVAILABILITY

I can fully commit to coming to Oxford for the school and will definitely be at the preceding conference either way.

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EDUCATION

2018 – 2022   Mathematics PhD   University of Sheffield.
Supervised by Simon Willerton.
On the topic of magnitude homology of enriched categories.

2014 – 2018   Mathematics MSci (1st Class with Honours)   University of Bristol.
Units focused on algebra, logic and set theory.

RESEARCH EXPERIENCE

Large Cardinals   2017–2018   *Philip Welch*

A presentation, literature review and self-study into: different types of large cardinal and their hierarchy; boolean algebras, Scott's theorem and ultraproducts; Cohen's forcing method using boolean algebras and a proof of the independence of the continuum hypothesis; a proof that the inclusion of measurable cardinals in the universe of sets does not resolve the continuum problem, despite Scott's theorem.

Topological Dimension   2017   *Jeremy Rickard*

A lecture given in assessment of an undergraduate algebraic topology course. This covered: inductive dimension, its limitations, and a proof that $\mathbb{R}^m$ is homeomorphic to $\mathbb{R}^m$ if and only if $m = n$; Lebesgue covering dimension, in particular the dimension of the Cantor set; the Sierpinski carpet and the Menger sponge; Hausdorff dimension in relation to the aforementioned fractals and its failing as a topological invariant.

Rubik's Cube   2016–2017   *Francesco Mezzadri*

A three-person group project followed by an independent research project on the first law of cubology: the group theory and combinatorics involved in characterising when an arbitrary arrangement of a Rubik's cube is solvable. After contributing a partial characterisation for a Rubik's-style cube of arbitrary size, the research was continued independently to a complete characterisation.

TUTORING

2019   MAS114: Numbers and Groups   Introductory unit containing the basics of set theory, number theory and group theory.

OTHER EXPERIENCE

LaTeX	Experienced	All above research projects were written in LaTeX as well as most personal notes and several other documents since 2015.
Sage	Competent	Regularly used Sage to check and aid in computations, as well as some experience with larger programs.
Java	Competent	Completed a computer science degree course in Java and used Java to find and check particular move combinations in the Rubik's cube analysis.
Python	Familiar	Aside from its implementation in Sage, I have used Python a number of times to speed up some minor computer tasks.
Haskell	Familiar	Completed a computer science degree course in Haskell in 2014.
C	Familiar	Completed a computer science degree course in C in 2014.

Applied Category Theory <act2019school@gmail.com>

supervisor confirmation for Callum Reader

1 message

Simon Willerton <s.willerton@sheffield.ac.uk>   Wed, Jan 30, 2019 at 10:25 AM
To: act2019school@gmail.com

Hi,

I am Callum Reader's PhD supervisor. I can confirm the research experience he has mentioned in his covering letter.

He started a PhD with me in October, not really having done much with category theory before, but he has already impressed me with his enthusiasm and independence. He has definitely got into enriched category theory. He will be thinking in particular about metric spaces as enriched categories.

I think this school will be a good opportunity for Callum in many ways, for him to be forced to read in detail papers a little away from his area, for him to (virtually) meet and chat with students in similar areas elsewhere, for him to present mathematics to an unfamiliar audience, and also for him to feel part of the ACT community.

You asked for a brief letter, so I hope this suffices; if not, I am happy to elaborate!

Cheers,

Simon.