Leo Lobski — ACT 2019 School Application

Background in category theory and applications During my undergraduate studies, I took two category theory courses; the first one, *Categories and Quantum Informatics* (taught by Chris Heunen, spring 2017) introduced monoidal categories and the graphical language for quantum computation, while the second one (taught by Tom Leinster, spring 2018) covered the book *Basic category theory*, thus introducing category theory in its own right.

Having a strong interest in mathematical physics, I did a research project in categorical quantum logic and set theory (supervised by Chris Heunen) during the summer of 2017, for which I had to learn a little about Boolean-valued models of set theory, subobject classifiers as well as hidden variable models for quantum mechanics. During the same summer, I was also participating in a reading group on topological quantum field theories. I proceeded to do my BSc project on sheaf theory (supervised by Tom Leinster); the main resources I studied were *Sheaves in Geometry and Logic* (Mac Lane and Moerdijk) and *Topoi, The Categorial Analysis of Logic* (Goldblatt).

After starting my master's degree, I have continued to pursue my interests in both pure and applied category theory. Namely, I took a course on topos theory (taught by Jaap van Oosten), which covered elementary toposes, geometric morphisms, topos logic and classifying toposes. In addition to that, I have been organizing a weekly 'Logic and Physics' reading group; we have been reading and working through *Picturing Quantum Processes* (Coecke and Kissinger).

Apart from pure mathematics, I have taken quite a few courses in mathematical physics, especially in quantum theory, which makes me especially interested in the project offered by Miriam Backens.

Order of project preference Backens > Spivak > Hofstra > Fritz > Sadrzadeh > Milewski

Practical matters I started my master's degree in autumn 2018 at the Institute of Logic, Language and Computation (University of Amsterdam). Afterwards, I am planning to do a PhD in a field related to category theory, either pure or applied. My current interests range from categorical quantum mechanics to categorical logic.

I can commit to coming to Oxford in July.

Statement of interest I have been convinced in the power of category theory to express both existing and new scientific ideas ever since I was first introduced to it. This conviction has become stronger and stronger as I have continued to familiarize myself with various facets of the subject. Category theory not only has an immense clarifying and organizing effect on whatever field it is being applied to, but it also manages to highlight the essential features of the field; an example of this is given by the observation that a disconnected string diagram captures the absence of an information flow, thus making this informal notion precise.

Solving the increasingly complex global problems will require truly interdisciplinary work and research. This, in turn, requires theoretical clarity so as to make learning of a new field as effective as possible, as well as a means of translating ideas and concepts from one field to another. Applications of category theory will hopefully fill both of these roles. Facilitating the learning process is also crucial in making highly technical

fields more accessible to a larger number of people, a task I find particularly important; category-theoretic thinking can thus serve as a convenient tool in education and communication.

No matter what kind of research I will end up doing, I am sure it will involve category theory in one form or another. The ACT School will thus provide me with a perspective when choosing both a topic for my MSc thesis and an area for a PhD. I also hope to deepen my understanding of interconnections between fields as diverse as the project topics. The school will also be an excellent chance to see how category theory is applied outside of my immediate interests, for instance to such fields as complexity and distributional semantics.

Leo Lobski — Curriculum Vitae

Carolina MacGillavrylaan 2702
1098 XK Amsterdam
Netherlands

leo.lobski@student.uva.nl
Phone: +358 40963 2557
Date of birth: 11.3.1995

Education

University of Amsterdam
MSc Logic, 2020 (Expected).

University of Edinburgh
BSc Mathematics, 2018 (First class honours).
BSc Project: Sheaves on Topological Spaces and their Logic.
Supervisor: Tom Leinster.

Jyväskylän Normaalikoulu (Finland)
Ylioppilastutkinto (High school matriculation examination), 2014.
Mathematics, Physics, Chemistry, Finnish, Russian, English, French.

Projects and Traineeships

Tartu Observatory
Development of Satellite Attitude Determination Software.
Summer 2018.

London Mathematical Society Undergraduate Research Bursary
Project title: Quantum Logic and Set Theory.
Report title: The Category of Hilbert Spaces as an Orthogonal Category.
Project blog: andinparticularexists.wordpress.com
Supervisor: Chris Heunen.
Summer 2017.

Tartu Observatory
Erasmus+ traineeship.
Traineeship title: Development of Satellite Attitude Determination Software.
Summer 2016.

Department of Physics, University of Jyväskylä
Summer trainee, 2013.

Extracurricular positions

The University of Edinburgh SocieTea
Committee position, Publicity, 2017-18.
Committee position, President, 2016-17.

The University of Edinburgh Philosophy Society
Committee position, Ordinary member, 2015-16.

Other experience

Logic and Physics reading group
Organizer, 2018-present.

Amsterdam Fringe Festival
Volunteer, September 2018.

Hidden Door Festival
Volunteer, May-June 2018.

Art-Master Theatre
Website translator, occasionally between 2013 and 2015.

Publications

Statistical Hypothesis Testing in the Context of Hume's Critique of Induction
University of Edinburgh Philosophy Society Journal, Issue 2: 2017-18.

Languages

Finnish (native), Russian (native), English (fluent),
French (DELF B2), Swedish (basics), German (basics).

Prizes and Scholarships

Amsterdam Science Talent Scholarship, 2018-19.

William & Isabella Dick Prize awarded for distinguished performance in Pre-Honours Year 2 examinations, 2015-16.

Institute and Faculty of Actuaries Prize for the highest aggregate mark across Pre-Honours Year 2 Probability and Statistics courses, 2015-16.

Simon Gray Prize awarded for best performances by Pre-Honours students in Logic 1, 2014-15.

Technology Industries of Finland Centennial Foundation Prize awarded for a high mark in high school matriculation exam in advanced level mathematics, 2014.

26 January 2019

SCHOOL *of* MATHEMATICS

The University of Edinburgh
James Clerk Maxwell Building
The King's Buildings
Peter Guthrie Tait Road
Edinburgh EH9 3FD

Telephone +44 (0)131 650 5060
Email Tom.Leinster@ed.ac.uk
https://www.maths.ed.ac.uk/∼tl

Dear ACT Committee

Leo Lobski

I am writing in strong support of Leo Lobski's application for a place on the Applied Category Theory school.

Leo is now taking the prestigious Master in Logic at the University of Amsterdam. Previously he was an undergraduate at the University of Edinburgh. I have known him since March 2017, when he approached me asking if I could supervise him for a fourth-year project on sheaf theory. This in itself was unusual in a couple of ways. First, students usually choose their projects from a fixed list rather than coming up with a proposal themselves. So, this demonstrated a high degree of enthusiasm and engagement. Second, it was clear that Leo would be starting from an unusually advanced position: he was shortly to begin a summer project on quantum set theory and logic with Chris Heunen, and had already taken the course 'Categories and Quantum Informatics' (intended for fourth- or fifth-year students, but which he took during his third year). Thus, his project with me was significantly more advanced than a typical fourth-year project.

Last academic year, I met Leo every week to discuss his project with him. He also took the introductory category theory course that I taught (which was rather easy for him, having already taken the more advanced course just mentioned). In principle, much of my course was actually a prerequisite for his sheaf theory project, so it is fortunate that he had already learned most of the material.

In the project, Leo worked through some of the earlier parts of Mac Lane and Moerdijk's book *Sheaves in Geometry and Logic: A First Introduction to Topos Theory*. He is a careful worker, always wanting to understand the best perspective on each concept and result, and challenging himself by filling in details that the authors have left to the reader. But the attention to detail is not excessive: when I suggested to him that it was time to stop looking at the details of one thing and move on to another thing, he was responsive to that advice. Generally, he is very pleasant and polite, highly engaged, and easy to supervise.

The project included some standard material on sheaves, various examples that he worked out himself, an introduction to elementary toposes, a short chapter on logic in toposes, and an appendix on category theory. This was *well* beyond the level of sophistication that we

The University of Edinburgh is a charitable body, registered in Scotland, with registration number SC005336.

would usually expect from a fourth-year project. I know that he wanted to go further in exploring the connections between topos theory and logic than our time constraints allowed.

If you have seen Leo's transcript, you will know that he did extremely well in his exams, with many course grades in the 95–100% range. Along with the courses he took credit, he took at least five for pleasure only, including four in physics.

Leo is an exceptionally strong student, certainly the strongest in that Edinburgh year group (of about 100) that I encountered, and among the top five or ten that I have known in fifteen years as a lecturer. He is surely an excellent fit for the Applied Category Theory school, and I recommend him to you in the strongest terms.

Yours sincerely

Dr Tom Leinster
Reader in Mathematics
University of Edinburgh

Leo Lobski — ACT 2019 School Application

Background in category theory and applications During my undergraduate studies, I took two category theory courses; the first one, *Categories and Quantum Informatics* (taught by Chris Heunen, spring 2017) introduced monoidal categories and the graphical language for quantum computation, while the second one (taught by Tom Leinster, spring 2018) covered the book *Basic category theory*, thus introducing category theory in its own right.

Having a strong interest in mathematical physics, I did a research project in categorical quantum logic and set theory (supervised by Chris Heunen) during the summer of 2017, for which I had to learn a little about Boolean-valued models of set theory, subobject classifiers as well as hidden variable models for quantum mechanics. During the same summer, I was also participating in a reading group on topological quantum field theories. I proceeded to do my BSc project on sheaf theory (supervised by Tom Leinster); the main resources I studied were *Sheaves in Geometry and Logic* (Mac Lane and Moerdijk) and *Topoi, The Categorial Analysis of Logic* (Goldblatt).

After starting my master's degree, I have continued to pursue my interests in both pure and applied category theory. Namely, I took a course on topos theory (taught by Jaap van Oosten), which covered elementary toposes, geometric morphisms, topos logic and classifying toposes. In addition to that, I have been organizing a weekly 'Logic and Physics' reading group; we have been reading and working through *Picturing Quantum Processes* (Coecke and Kissinger).

Apart from pure mathematics, I have taken quite a few courses in mathematical physics, especially in quantum theory, which makes me especially interested in the project offered by Miriam Backens.

Order of project preference Backens > Spivak > Hofstra > Fritz > Sadrzadeh > Milewski

Practical matters I started my master's degree in autumn 2018 at the Institute of Logic, Language and Computation (University of Amsterdam). Afterwards, I am planning to do a PhD in a field related to category theory, either pure or applied. My current interests range from categorical quantum mechanics to categorical logic.

I can commit to coming to Oxford in July.

Statement of interest I have been convinced in the power of category theory to express both existing and new scientific ideas ever since I was first introduced to it. This conviction has become stronger and stronger as I have continued to familiarize myself with various facets of the subject. Category theory not only has an immense clarifying and organizing effect on whatever field it is being applied to, but it also manages to highlight the essential features of the field; an example of this is given by the observation that a disconnected string diagram captures the absence of an information flow, thus making this informal notion precise.

Solving the increasingly complex global problems will require truly interdisciplinary work and research. This, in turn, requires theoretical clarity so as to make learning of a new field as effective as possible, as well as a means of translating ideas and concepts from one field to another. Applications of category theory will hopefully fill both of these roles. Facilitating the learning process is also crucial in making highly technical

fields more accessible to a larger number of people, a task I find particularly important; category-theoretic thinking can thus serve as a convenient tool in education and communication.

No matter what kind of research I will end up doing, I am sure it will involve category theory in one form or another. The ACT School will thus provide me with a perspective when choosing both a topic for my MSc thesis and an area for a PhD. I also hope to deepen my understanding of interconnections between fields as diverse as the project topics. The school will also be an excellent chance to see how category theory is applied outside of my immediate interests, for instance to such fields as complexity and distributional semantics.