Categorical and other background knowledge related to the school

Category Theory

In Algebraic Topology I&II as well as the "Seminar on 2D - TQFTs" I learned categorical concepts such as:

- Categories, Functors, Natural Transformations
- (Symmetric) Monoidal Categories and Functors
- Universal Objects
- (Filtered) (Co-)limits
- The Acyclic Models Theorem
- Adjoint Functors and Adjoint Functor Theorem

Computability and Complexity Theory

In the course "Algorithms and Complexity" an my time as a competitive programmer I learned about the following:

- Basic complexity classes such as P, NP, EXP.
- NP-completeness
- The halting problem
- Graph and dynamic programming algorithms and their performance
- Data structures and their perfomance

Physics

In the course "Physics III" an introduction to quantum mechanics was given, including Schrödingers equation, basic potentials, the harmonic oscillator and the hydrogen atom.

Concerning PhD and thesis

I'm not currently doing a PhD as I'm doing my Master's at ETH Zürich at the moment. My tentative Master's thesis "Floer Homology as a Topological Quantum Field Theory" would discuss how Floer Homology (the homology of a chain complex generated by closed trajectories of a Hamiltonian system) can be made into a 2D TQFT and in which ways that additional structure can be used to gain knowledge about the underlying dynamical system and the symplectic manifold it's defined on.

Order of project preference

1. Miriam Backens - Simplifying quantum circuits using the ZX-calculus
2. Pieter Hofstra - Complexity classes, computation, and Turing categories
3. Mehrnoosh Sadrzadeh - Formal and experimental methods to reason about dialogue and discourse using categorical models of vector spaces
4. Tobias Fritz - Partial evaluations, the bar construction, and second-order stochastic dominance
5. David Spivak - Toward a mathematical foundation for autopoiesis
6. Bartosz Milewski - Traversal optics and profunctors

To what extent can I commit to come to Oxford?

I fully commit to coming to Oxford.

Dear Madam/Sir,

The school on ACT 2019 aligns well with four of my core motivations. I would therefore like to attend it in order to explore applied category theory as a possible career path.

First, interdisciplinarity. Since high school I had an interest in the natural sciences, however at no point I managed to commit to one specific area. I participated with success both at International Olympiads in Mathematics and Informatics and later added the European Union Scientific Olympiad (a multidisciplinary Olympiad), where my team got 10^{th} place out of 42. Still today, my course schedule is varied, ranging from set theory over algebra to topology and geometry, with a touch of physics and informatics sprinkled in between.

Second, abstraction. The reason I went into mathematics as opposed to other sciences is that it focuses on the essential parts and the underlying structure. The apex of this mentality is in my opinion category theory, providing a framework to talk about mathematical theories and the relations between them in the most general possible way. I think a remarkable instance of this is the equivalence of Frobenius algebras (an algebraic object) and two-dimensional topological quantum field theories (a topological object), which can be understood best via monoidal natural transformations.

Third, practical usefulness. I appreciate mathematics for its own sake, however I also believe that the most interesting pieces of mathematics are those which are in touch with reality. Just knowing that homology is in principle a way to distinguish topological spaces is pleasant, but using it to determine if a swarm of sensors covers an area (such as in Ghrist's book "Elementary applied topology") is fascinating.

Fourth, cooperation and communication. Having participated in three student seminars and having been teaching assistant for two courses because of these interests, I would love to experience the cooperative and communicative environment provided by your school.

As I believe I would be a meaningful addition to the school on applied category theory 2019 because of my interests and competencies, I am kindly asking you to consider my application.

Sincerely,

Gilles Englebert

Universität Zürich[UZH]

January 9, 2019

Institut für Mathematik
Universität Zürich
Winterthurerstrasse 190
Campus Irchel, Office Y27J32
8057 Zürich, Switzerland
http://www.dtubbenhauer.com/
Phone: +41 (0) 44 635 58 44
Email: daniel.tubbenhauer@math.uzh.ch

Adjoint School, ACT 2019
Oxford, UK, 2019 July 22–26

Dear colleague,

I am writing this letter to **strongly support** the application of Gilles `Englebert` for the *Adjoint School for Applied Category Theory 2019* (*ACT2019*).

Gilles is a Ph.D. student in Zürich and I first met him in a seminar which I organized in Zurich in the Fall Semester 2018. I would like to stress that Gilles was one of the most active participants of the seminar; he made a lasting impression on me – for example, due to his broad knowledge of various fields of research – and undoubtedly on the other students as well.

The seminar was about categorical representation theory, a modern field in the intersection of algebra and category theory, which, in my opinion, clearly confirm that he has the appropriate background for the conference which you are organizing.

I can also testify from our meetings that Gilles' works hard, comes up with nice, new ideas and uses his background from other areas to tackle the problems at hand. Because of this I think he will, on the one hand, be able to quickly catch-up new mathematics in the inspiring environment of the *ACT2019* and, on the other hand, contribute to the school with his knowledge and curiousness.

Altogether, Gilles `Englebert` has my **strongest possible recommendation** for the participation in your school he is applying for.

(Please do not hesitate to contact me if you have further questions, or I can be of any help with respect to Gilles' application.)

Sincerely yours,

Daniel Tubbenhauer

Dear Madam/Sir,

The school on ACT 2019 aligns well with four of my core motivations. I would therefore like to attend it in order to explore applied category theory as a possible career path.

First, interdisciplinarity. Since high school I had an interest in the natural sciences, however at no point I managed to commit to one specific area. I participated with success both at International Olympiads in Mathematics and Informatics and later added the European Union Scientific Olympiad (a multidisciplinary Olympiad), where my team got 10^{th} place out of 42. Still today, my course schedule is varied, ranging from set theory over algebra to topology and geometry, with a touch of physics and informatics sprinkled in between.

Second, abstraction. The reason I went into mathematics as opposed to other sciences is that it focuses on the essential parts and the underlying structure. The apex of this mentality is in my opinion category theory, providing a framework to talk about mathematical theories and the relations between them in the most general possible way. I think a remarkable instance of this is the equivalence of Frobenius algebras (an algebraic object) and two-dimensional topological quantum field theories (a topological object), which can be understood best via monoidal natural transformations.

Third, practical usefulness. I appreciate mathematics for its own sake, however I also believe that the most interesting pieces of mathematics are those which are in touch with reality. Just knowing that homology is in principle a way to distinguish topological spaces is pleasant, but using it to determine if a swarm of sensors covers an area (such as in Ghrist's book "Elementary applied topology") is fascinating.

Fourth, cooperation and communication. Having participated in three student seminars and having been teaching assistant for two courses because of these interests, I would love to experience the cooperative and communicative environment provided by your school.

As I believe I would be a meaningful addition to the school on applied category theory 2019 because of my interests and competencies, I am kindly asking you to consider my application.

Sincerely,

Gilles Englebert