# ACT2019 School Application

Evan Washington

## Category Theory Background

During the summer of 2016, I pursued an independent study of category theory supervised by Hans Halvorson. I read Mac Lane's *Categories for the Working Mathematician* and Awodey's *Category Theory*. In the fall of that year, I designed a reading course in categorical logic under the supervision of Dimitris Tsementzis. We read Makkai and Reyes's *First-Order Categorical Logic*, selections from Mac Lane and Moerdijk's *Sheaves in Geometry and Logic*, the first few chapters of Mac Lane and portions from Part D of Johnstone's *Sketches of an Elephant*. And in Harvey Lederman's graduate seminar on opacity in logic, we considered ways type-theoretical constructions could shed light on the issues surrounding the philosophical phenomenon of opacity.

At Princeton, all juniors and seniors are required to pursue independent work. My junior fall, I gave a more explicit construction of a classifying knot invariant described by Louis Kauffman in *Knot Logic*: an algebra of lambda terms. My junior spring and senior fall were dedicated to proving a result about logical Morita equivalence, a standard of theoretical equivalence proposed by Thomas Barrett and Hans Halvorson. Morita equivalence is a generalization of definitional equivalence. Barrett and Halvorson showed that any two definitionally equivalent theories are intertranslatable (or isomorphic in the category of theories with translations as morphisms). I showed that any two Morita equivalent theories must be *homotopy equivalent*. This gave another sense in which Morita equivalence was a proper generalization of definitional equivalence: it was just the natural notion of equivalence available in the 2-category of theories with translations as 1-morphisms and (following Visser) $t$-maps as 2-morphisms.

I've taken a wide range of courses in mathematics, philosophy, and linguistics (mainly in formal semantics). In addition, this past fall, I helped lead a reading group at Berkeley dedicated to learning to write proofs in Coq.

I am a first-year Ph.D. student in philosophy at UC Berkeley, and I expect to complete my Ph.D. in 2023. I expect my interests will remain in category theory and logic.

I fully expect that I would be able to come to Oxford, if accepted.

# Project Preferences

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

# Evan Washington

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## Education

**University of California, Berkeley**
Ph.D, Philosophy, *2018-Present*

**Princeton University**
A.B., Mathematics *magna cum laude*, *2018*

Thesis: *On the Equivalence of Logical Theories*: I show that Barrett and Halvorson's notion of Morita equivalence corresponds to a natural generalization of a intertranslatability and how it relates to other proposed criteria of theoretical equivalence.

## Papers

- "Morita equivalence is intertranslatability."
- "Tonk made categorical." Draft.
- "Algebras of lambda terms as knot invariants." Draft.

## Fellowships and Awards

- Eugene Cota-Robles Fellowship *Competitive fellowship awarded to "exceptional students who also advance the Regents' goals for diversification of the academy"* (UC Berkeley 2018)
- Mathematics Undergraduate Summer Study Award (Princeton 2016, 2018)

## Experience

- Reader (UC Berkeley, Spring 2019) – Intermediate Logic
- Undergraduate Course Assistant (Princeton University, Spring 2018) – Introductory Logic
- Research Assistant for Hans Halvorson (Princeton 2016-18)

## Coursework

- Categorical Logic, Dimitris Tsementzis (Princeton)
- Philosophical Problems in Logic: Opacity, Harvey Lederman (Princeton)
- The Metaphysical Basis of Logic, Boris Kment (Princeton)

- Social Choice Theory for Philosophers and Logicians, Wes Holliday (Berkeley)
- Advanced Logical Semantics, Amy Rose Deal (Berkeley)
- Metamathematics (Model Theory), Tom Scanlon (Berkeley)
- Metamathematics (Recursion Theory), Antonio Montalbán (Berkeley)
- First-Year Seminar, Shamik Dasgupta & John MacFarlane (Berkeley)
- Descartes, Kristin Primus (Berkeley)
- Philosophical Logic, John MacFarlane (Berkeley)

### Non-Degree Study

- NASSLLI 2018
- Carnegie Mellon Summer School in Logic and Formal Epistemology 2018
- NASSLLI 2016

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**Why the ACT2019 School?**

As an undergraduate at Princeton, I was lucky enough to take a course with Hans Halvorson, whose interests were turning from strictly philosophy of science to more general logic and category theory. From him, and two of his graduate students, Thomas Barrett and Dimitris Tsementzis, I managed to learn quite a lot of category theory, to the point that I was able to pursue independent research during my senior year. I would like to continue developing this strand of my research interests.

I am a philosophy graduate student with a strong mathematical bent. Although I also have the considerable mathematical resources of UC Berkeley, there are relatively few opportunities here to continue pursuing the interest in category theory I developed as an undergraduate. Few faculty or students here are actively interested in doing research in category theory, pure or applied. But in order to become the kind of logician I see myself becoming, research in category theory seems crucial.

I see category theory as a unifying mathematical language, a natural way to see and describe connections between the seemingly disparate. I want to occupy the roles of both philosopher and mathematician, and category theory seems to me the perfect device for straddling the divide between them. Specifically, as a philosopher of mathematics, it would be bizarre to not be in the business of using the best formalism we have for studying mathematics.

In addition, I've recently been developing interests in complexity theory and in linguistics (specifically in formal semantics and formal pragmatics), so two of the research projects are especially exciting to me. I'm so excited by the concept of this school (and have been since I first heard about it from Tai-Danae Bradley's blog and category theory Twitter), and would be grateful for the opportunity to participate in it.