Jabari King

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Statement

Undergraduate studying theoretical computer science and mathematics interested in category theory, logic, theory of computation, and foundational correspondences between the three. Out of these interests arisees a second set concerned with artificial general intelligence, artificial life, and self-organizing systems, for which the former three provide language for description and investigation. Currently performing research in applied category theory wherein we seek to develop a framework for knowledge representation in categorical logic.

Education

Massachusetts Institute of Technology Computer Science and Mathematics
G.P.A. 4.6/5.0

(2017 - Present)

First Year Subjects
Multivariable Calculus
Structure and Interpretation of Computer Programs
Computation Structures

Second Year Subjects
Discrete Mathematics
Artificial Intelligence Digital Communication Systems

Research Experience

Undergradute Math Researcher MIT Math Department
Worked under David Spivak to investigate a calculus for Petri nets in free symmetric monoidal categories and a string-diagramatic language for monoidal closed categories.

(Sept - Dec 2018)

Undergradute Math Researcher MIT Math Department
Working under David Spivak to a (graphical) framework for knowledge representation using categorical logic. Specifically working with regular logic, a decidable subset of first-order logic which can be used to structure information as logical formulas. Here we seek formulate features used in knowledge representation (such as fact-checking, confidence levels, and deduction) with category theory.

(Dec 2018 - Present)

Projects

Metacircular Scheme Evaluator Built a metacircular evaluator (an evaluator capable of running its own code) in the Scheme programming language. The evaluator is based on the LISP 1.5 Programming Manual EVAL function. I've added additional capabilities to the evaluator such as continuations and class-based inheritance.

(Jan 2018)

chemlambda-hask Implemented Chemlambda, a novel model of computation based on the lambda calculus, in the Haskell programming language. Chemlambda models programs as molecule-like graphs evaluated by an asynchronous reduction algorithm analogous to local chemical interactions a molecule undergoes in certain environments. I built chemlambda-hask with an emphasis on modularity and research utility.

(May - Dec 2016)

Applicant: Jabari King

Background: In terms of textbooks, I have read and worked through the exercises in “Seven Sketches in Compositionality” to around full coverage, and about half of both Awodey’s “Category Theory” and Mac Lane’s “Categories for the Working Mathematician”. I’ve read the latter texts somewhat nonlinearly, and am currently covering the later chapters of Mac Lane. The more narrow topics that I’ve studied are Petri nets, regular logic (specifically as a language for knowledge representation), and most recently homological algebra. As an undergraduate researcher, I have worked with David Spivak on modeling Petri nets as free symmetric monoidal categories.

PhD: I am currently an undergraduate planning to complete a PhD program in math or theoretical CS following graduation, though I do not know what the topic will be yet. Logic and artificial general intelligence, especially obtaining mathematical formalisms for intelligence, are areas that interest me greatly.

Project Order:

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

Oxford feasibility: Highly confident in my ability to attend.

Statement: I hope that by doing the ACT Adjoint School, I will achieve/gain the following:

1. Progress towards answering questions I have about the usefulness of category theory as a general purpose system modeling language: My current (limited) understanding has led me to find the usefulness/role of applied category theory in the sciences to be present at multiple points in a spectrum of interpretive detail and rigor. On the one end, I’ve seen instances of category theory being used as a source of broad analogies, e.g. maps as endofunctors in the category of the types in a functional program. On the other end of the spectrum there are very direct applications of category theory that use more involved mathematical tooling, e.g. the project that I’m currently working on uses homology groups to describe the behavior of certain Petri nets. That category theory provides frameworks for systems with vastly different mathematical requirements has led me to view applied category theory as a language with a surrounding mathematical “module system” to which people can contribute and import ideas to model their own disciplines. Is this interpretation relevant to the linguist or AI researcher using category theory in their profession? I have several questions about this, centrally: what type of

thing is ACT good at modeling and why? I believe the school will, via interactions with people more knowledgeable on this than I, help me to pursue these curiosities.

2. Practical experience synthesizing research and articulating it clearly: I haven't had much experience with here so far, and I believe these are necessary skills for any researcher. Learning how to articulate research clearly has the nice benefit of increasing one's own ability to absorb new material. Doing this in the presence of researchers -- whose work is predicated on the contribution of ideas -- will certainly make this process more instructive and fun.

Dear ACT committee,

I'm writing to strongly recommend Jabari King for the ACT school.

Jabari is an undergraduate MIT math and computer science student. He's very intelligent, personable, curious, and has a fairly strong background in category theory (e.g. the Seven Sketches book). He's worked with me on an undergraduate research project (an extension of Petri nets to the monoidal closed setting), and always understood the material quickly, asking good questions along the way.

I give him my highest recommendation.

Best,
David Spivak