Basic Information

Tao Gu

January 2019

Relevant background

I have a Master of Science in Logic from ILLC, University of Amsterdam from 2016 to 2018. During the two years I took most of the courses in the mathematics & logic track, as well as many courses in the computation & logic track. This list includes category theory, coalgebraic modal logic, recursion theory, computational complexity. On average I got GPA 8.3/10. My interest in applied category theory led me to write a master thesis on categorical logic, where we constructed certain categories validating some interesting constructivism mathematics principles, for example the Fan Theorem.

Before that I was a Bachelor of Arts in Philosophy (logic track) in Peking University, Beijing, China, from 2012 to 2016. I also received a Minor in Mathematics there, between 2014 and 2016. During the four years I not only finished all the logic courses available at my home university, but also learned a lot of mathematics courses, including abstract algebra, functional analysis, measure theory, complex analysis. I wrote my bachelor thesis on epistemic logic, and an extension of it (co-authored with Yanjing Wang, Peking University), "'Knowing value' logic as a normal modal logic", was accepted by AiML 2016, a peer-reviewed conference on modal logic.

Since September 2018 I joined Department of Computer Science, University College London as a PhD candidate, supervised by Dr. Fabio Zanasi and co-supervised by Prof. Alexandra Silva. My research project is on compositional approaches to probabilistic computations. Since October 2018, I have been working intensively with Zanasi on a coalgebraic semantics for probabilistic logic programming. We have already worked out the ground case, and are currently looking at the generalisation to the variable case. We aim at submitting this work to CALCO 2019. Alongside that research, Silva, Zanasi and I have recently also started a project on coalgebraic propositional dynamic logic. At this early stage we are looking for a modification of the existing coalgebraic PDL to incorporate probabilistic PDL, one of the most successful generalisations of PDL.

PhD practical information

I started my PhD in September 2018, and am expected to finish in 3.5 years (round mid 2022). My research subject is on compositional approaches to probabilistic computations.

Order of project preference

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

2. *Complexity classes, computation, and Turing categories*, by Pieter Hofstra

Oxford visit

I am totally available for an Oxford visit. I now live in London, which is just 1 hour away from Oxford by train. Also, University College London should be able to cover my travelling and accommodation in Oxford.

Tao Gu

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PERSONAL INFORMATION

Year of Birth: 1994

Nationality: Chinese

Language: Mandarin (native), English (fluent), Dutch (basic)

EDUCATION

Peking University, China — Bachelor of Arts in Philosophy (logic track), 2012-2016

Peking University, China — Minor of Mathematics, 2014-2016

University of Amsterdam, Netherlands — Master of Science in Logic (logic & mathematics track), 2016-2018

University College London — PhD candidate. 2018 - now

AWARDS

2013-2014, Yanking Scholarship, Peking University

2014-2015, Leo Koguan Scholarship, Peking University

2016-2017, Beth Scholarship, University of Amsterdam

2016-2017, Holland Scholarship, Netherlands

2017-2018, Beth Scholarship, University of Amsterdam

PUBLICATIONS

"*'Knowing value' logic as a normal modal logic*", accepted by the peer-reviewed conference *Advances in Modal Logic* (AiML) 2018.

OTHER PROJECTS

"*Review: lambda calculus in modern dress*", Master of Logic research project, supervised by Dr. Benno van den Berg.

"*Majorizability Types, Assemblies, and the Fan Theorem*", Master Thesis, supervised by Dr. Benno van den Berg

COURSES (SELECTED)

Bachelor studies: Abstract Algebra, Real Analysis and Function Analysis, Complex Analysis, Probability Theory and Statistics, Mathematical Logic, Epistemic Logic, various analytic philosophy courses

Master studies: Category Theory, Coalgebraic Modal Logic, Modal Fixed-point Logic, Model Theory, Recursion Theory, Proof Theory, Knowledge Representation, Set Theory

GPA

Bachelor of Arts, Peking University: GPA 3.5/4

Minor of Mathematics, Peking University: GPA 3.3/4

Master of Logic, University of Amsterdam: GPA 8.3/10

TEACHING

Computational Complexity, teaching assistant, University College London, Sep 2018 - Dec 2018

Discrete Mathematics for Computer Science, teaching assistant, University College London, Jan 2019 - now

Dr. Fabio Zanasi
University College London
Department of Computer Science
66-72 Gower Street, London
United Kingdom WC1E 6BT

January 30, 2019

To Whom It May Concern,

with this letter, I give my strongest support to the participation of Tao Gu in the adjoint school of *Applied Category Theory* 2019.

Tao Gu started his PhD at University College London in September 2018, under my supervision. His PhD project is on developing compositional methods for probabilistic systems. He is currently working on a coalgebraic semantics of probabilistic logic programming. At the same time, he just started a parallel project on a categorical account of probabilistic dynamic logic, together with Prof. Alexandra Silva. Tao makes an intense use of category theory in all these projects.

Typically it takes some time for new PhD students to switch from a study-oriented to a research-oriented mindset, but this process was immediate with Tao. I have been impressed with his ability of progressing on the research questions that I gave him— in fact, he already started to formulate his own.

I believe this is also due to Tao's background. He graduated at the Master of Science in Logic at the University of Amsterdam, which is widely recognised as the best logic programme in Europe. This master is unique in preparing students for research and giving them background in subjects that are not covered by more generic master programmes in, say, Mathematics or Computer Science. For instance, Tao arrived at UCL already trained in category theory and mathematical logic (including proof theory, computability theory, model theory, . . .), which I believe put him in best position to profit from the adjoint school. Moreover, as you can see from his CV, he already succeeded in publishing a paper in a peer-reviewed international conference before even starting his PhD, which is yet another demonstration of his attitude towards research.

Tao is still at the very beginning of his PhD. I think this is an ideal time for him to broaden his horizons and explore new topics. In this sense, the school represents a great opportunity for his career. I am very confident UCL will fund his participation, in case other sources of funding are unavailable.

Not only Tao is a very bright student, but he is also well-organised, reliable, resilient and an excellent team worker. I believe these qualities would make Tao a valuable addition to any of the classes of the schools.

Yours Faithfully,

Fabio Zanasi

Statement of Interest

Tao Gu

January 2019

I am very passionate about applied category theory. So when I saw the post on ACT 2019, I knew it was a chance that I couldn't miss. In particular I am very interested in the project *"Toward a mathematical foundation for autopoiesis"*, promoted by David Spivak. On one hand I think this school offers an invaluable opportunity for me to grow as a researcher. On the other hand, I believe I am capable of making good progress for the project.

As a student with background from logic, philosophy and mathematics, I have both comfort with mathematics and critical thinking from various aspects. My interest in category theory and its application prompted me to start a PhD program supervised by Dr. Fabio Zanasi, and co-supervised by Prof. Alexandra Silva, in the department of Computer Science, University College London. In particular, I am working on compositional approaches to probabilistic computation. Since I started my PhD in Octorber 2018, I have been working intensively with Zanasi on a coalgebraic semantics for probabilistic logic programming. We plan to submit the results to CALCO 2019. Alongside that research, Silva, Zanasi and I have also recently started a project on a coalgeabraic generalization of propositional dynamic logic (PDL) which incorporates the probabilistic PDL.

I think the aforementioned project is closely related with my research project. In the *"Graphical regular logic"* paper [2], Fong and Spivak offered a categorical treatment of the syntactical aspect of regular logic, where composition plays a central role in the corresponding regular claculus. In the *"Behavioral mereology"* paper [1], Fong, Myers and Spivak presented a logic describing how constraints on behaviours are passed from one part of the system to another. And such interaction between different parts of the system is eventually captured by a proposition on composition. I am keen on how category theory and string diagrams can be applied in describing system behaviours, especially the role compositionality plays. More importantly, I would like to explore more research topics at an early stage of my PhD, and this school provides such a good opportunity. As a potential future work, I would like to try extending these ideas to probabilistic settings.

I think I am capable of conducting a fruitful research through the project. I have background knowledge in categorical logic, topos theory, string diagram, which are essential for the project. And apart from the aforementioned research projects, I have collaborated with Dr. Yanjing Wang during my undergraduate

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studies on a paper, *"'Knowing value' logic as a normal modal logic"* [3], which was accepted by a peer-reviewed conference AiML (*Advances in Modal Logic*) 2016. With this experience in research I am confident to contribute to the project. What's more, I have a varied background, including philosophy, logic, mathematics, and computer science. So I will bring different perspectives to the project.

Therefore I really hope to attend ACT 2019, and in particular to join the project *"Toward a mathematical foundation for autopoiesis"*. I believe that this project will bring great benefit to my whole research career, and that I can make my own valuable contribution to the research topic.

References

[1] B. Fong, D. J. Myers, and D. I. Spivak. Behavioral mereology. *arXiv preprint arXiv:1811.00420*, 2018.

[2] B. Fong and D. I. Spivak. Graphical regular logic. *arXiv preprint arXiv:1812.05765*, 2018.

[3] T. Gu and Y. Wang. " knowing value" logic as a normal modal logic. *arXiv preprint arXiv:1604.08709*, 2016.