

CV for Promotion (Farhad Babaee)

PERSONAL INFORMATION

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Nationality: Iranian -- British

PRESENT APPOINTMENT

Oct 2018-Present Lecturer in Pure Mathematics, University of Bristol, Bristol, UK.

PREVIOUS APPOINTMENTS

Oct 2016 – Oct 2018 Postdoctoral Research Fellow, Université de Fribourg, Fribourg, Switzerland.

Oct 2015 – Oct 2016 Postdoctoral Research Fellow, École Normale Supérieure, Paris, France. Oct 2014– Oct 2015 Postdoc / Research Assistant Professor, Concordia University, Montréal, Canada.

ACADEMIC QUALIFICATIONS

DEGREES

July 2014 Ph.D. in Pure Mathematics, Université de Bordeaux — Università di Padova, France — Italy. Thesis title: Complex Tropical Currents.

2008–2010 M.Sc. in Mathematics, Universiteit Leiden – Università di Padova, Netherlands –

Italy. Thesi titles: Integral Transforms of Constructible Functions

Jan 2007 M.Sc. in Mathematics, Sharif University of Technology, Iran. Thesis title: Global

Dynamics of Certain ODE Models in Population Biology

Oct 2000- Oct 2004 Bachelor of Mathematics, University of Tehran, Iran.

CERTIFICATES & DIPLOMAS

June 2023 CREATE HEA Fellowship

Oct 2021 MIT Schwarzman College of Computing - Data Science and Machine Learning Jan 2017 InnoSuisse (CTI) Entrepreneurship & Start-Up Training (EPFL)

TEACHING AND RELATED ADMINISTRATION

I have had the opportunity to lecture on a range of modules at the University of Bristol, from large first-year Linear Algebra classes with over 400 students to smaller groups in Mathematical Investigations, Tutorial Groups, and Algebraic Geometry. I have served as Unit Director for Linear Algebra on several occasions and have contributed to both the design and delivery of a course in Algebraic Geometry, with a particular focus on Combinatorial Algebraic Geometry.

To support student learning, I have employed a variety of platforms, software tools, and pedagogical approaches. I continually strive to enhance my teaching by actively engaging with student feedback, learning from colleagues, and participating in seminars and talks on education—both within the school and through external initiatives such as online TALMO seminars (http://talmo.uk/).

In addition to my teaching responsibilities, I have provided both pastoral and academic support to Research Fellows, PhD students, and personal tutees during my time at Bristol. I am currently the lead supervisor for a PhD student expected to graduate next year and have supervised several Master's projects. Beyond Pure Mathematics, I have also co-supervised two Data Science Master's projects in collaboration with colleagues from the Department of Engineering Mathematics.

(i) All UG and PGT units that I have contributed to so far (Oct 2018 – April 2025)

Masters' Level Courses

Algebraic Geometry, MATHM0036 (2022 -2025)

- a) Taught a total of 28 (11+6+11) students over three years.
- b) Fourth-year curriculum unit. The audience for this masters' level course included research fellows, PhD students
- c) Designed from scrach, Unit Director, and Lecturer; Exam setter and Marker.
- d) Lectures and problem classes.
- e) Preparation hours: In 2022, around 18 hours per week while writing the lecture notes from

scratch; in 2024 and 2025, around 8 hours per week. Contact hours: 3 hours of lectures per week for lectures and problem classes; 1 or 2 hours of office hours depending on the problem class sessions.

- f) Teaching involved the use of blackboard, slides, printed "gappy notes," pre-recorded videos, and some Zoom sessions in 2022. Organised seminar-style, student-led problem classes; made a popular YouTube video on desingularisation. Utilised "gappy notes" for interactive teaching; created engaging and interactive game quizzes; devised Online Discussion Forums.
- g) Two assessed coursework, presentations during problem classes, and a written final exam. Liaised with both the internal moderator and internal and external examiners to ensure rigorous assessment standards.
- h) The unit sets the foundation for more advanced algebraic geometry as well as research in some areas of combinatorial algebraic geometry. The course presents many ideas from algebra, geometry of manifolds, algebraic topology, and polyhedral combinatorics in a consistent and coherent manner.

2025 Student Survey: 100% of students strongly agreed:

- "The material was explained well by the lecturer(s),"
- "The lecturer(s) made the subject interesting."
- Specific feedback: "The content of this unit is both very interesting and well-presented. The lecturer gives enough information for you to fully understand the content, but leaves enough for there to be satisfying "aha!" Moments."

"I enjoyed having the opportunity to present homework problems in class. I think having to explain myself has helped iron out problems with my understanding." "The lecturer is very friendly and motivated, which inspires me and increases my interest in the topic."

The online video has received very positive comments on YouTube and has been viewed more than 900 times.

Undergraduate

Linear Algebra, MATH10015 (2018 – 2020)

- a) Total of approximately 1600 students taught over four years.
- b) First-year curriculum unit.
- c) Lecturer, Exam setter, and Marker throughout, with additional responsibility as Unit Director in 2020 and 2021.
- d) Lectures and Problem Classes.
- e) 9 hours per week before Covid-19, increasing to up to 24 hours per week when recording and

editing video lectures.

- f) Weekly contact consisted of lectures and problem classes; preparation included the development of new multimedia resources and interactive content. Devised Online Discussion Forums, implemented PollEverywhere for interactive problem classes, and created daily non-assessed quizzes.
- g) Assessed students via a combination of coursework, online quizzes (three assessed), and a final written examination; closely coordinated with approximately 50 tutors (over 4 years) and liaised with both internal and external examiners to ensure rigorous assessment standards.
- h) Demonstrated pedagogical innovation through digital engagement tools, significantly enhancing the student experience with interactive online quizzes after each video lecture. Additionally, produced extracurricular videos highlighting real-life applications of Linear Algebra in Machine Learning, Graph Theory, and Google Search.

Student survey: Students were particularly interested in seeing the real-life applications of linear algebra.

Small Group Teaching

Tutorial Classes on Linear Algebra, Introduction to Pure Mathematics, Analysis

- a) Total of approximately 440 students taught across 34 tutorial classes.
- b) First-year curriculum unit.
- c) Subject tutor for the classes. Role focused on delivering pre-set content rather than developing it.
- d) Tutorial classes.
- e) Preparation usually 2 hours/week for each topic, plus 3-4 hours/week for marking homework for each tutorial class. Contact hours were 1 hour weekly or previously 1 hour biweekly depending on the University's timetabling. Limited contact hours demanded the proposing of very specific and rich questions.
- f) The sessions involved recalling the course materials through examples and were centred on problem-solving discussions, guided student practice, and feedback.
- g) Marked the assessed coursework in Analysis and helped (2024) with the marking of the final Introduction to Pure Mathematics exam.
- h) Students gained a deeper understanding of the material taught by the lecturer and improved their approaches and problem-solving skills for the course.

Mathematical Investigations (MATH10009)

- a) Total of approximately 26 first-year students taught between 2020/2021 and 2022/2023.
- b) First-year curriculum unit.
- c) Lecturing, teaching different topics, project supervision, informal discussion of time management and mathematical attitude, and problem-solving skills.
- d) Some lectures discussing time management; some lab-style hours for teaching LaTeX; project supervision and presentation observation.
- e) Two weekly contact sessions with moderate preparation, including planning group activities and project guidance.
- f) Topics were mostly delivered through discussions with students.
- g) Assessment based on two group project reports and two presentations.
- h) Helped students transition into university-level mathematical thinking and develop communication and collaboration skills.

Note: Following a severe health incident, I stopped teaching the 2020/2021 course after December 2020. However, I continued teaching Linear Algebra.

(ii) Additional major teaching responsibilities

2022—2025 Personal Tutor to 17 Students I have served as a personal tutor for 17 students, supporting them from their first year as they transitioned into university life. This role has involved discussing academic and personal challenges, and where appropriate, signposting students to senior tutors, the Student Wellbeing Service, or Residential Life. I have also offered career advice and referred students to the Careers Service when relevant.

As the Library Representative for the School of Mathematics, I have assisted students in navigating library resources and, when beneficial, directed them to the Study Skills team for additional academic support. I have also written numerous letters of reference for the personal tutees.

Of the 17 students, 12 became my tutees when I began teaching Mathematical Investigations in 2022, and the remaining 5 joined in 2024, when I took on additional responsibilities during a colleague's maternity leave.

(April 2025-) Topics in Geometry and Discrete Mathematics, MATHM0048 (April

- a) Approximately 15-25 students per cohort.
- b) Third- and Fourth-Year unit.
- c) Unit Co-director: Discussing and developing course content, reviewing lecture notes, setting the course pace.
- d) Mentoring HIMR Fellows in their teaching roles; observing teaching sessions, discussing course material, reviewing lecture notes, and exam checking/moderation.
- e) A few meetings to discuss the topics; 15 hours of reading notes and making comments; (expected) 6 hours of exam and mock exam checking.
- f) Discussing various teaching methods with HIMR Fellows.
- g) Two assessed coursework and a final exam.
- h) Enhancing the quality and consistency of course delivery, improving the clarity of lecture notes and teaching methodology, strengthening the mentorship culture among HIMR Fellows, and positively impacting the student experience.

(iii) Innovatory units or teaching methods

The Algebraic Geometry course, with a focus on Combinatorial Algebraic Geometry, aims to offer a modern and accessible introduction to the subject. The lecture notes include illustrations, and some tailored theorems and "recipes" developed specifically for this course. After completing the unit, students are typically well-positioned to begin exploring research articles in areas such as Tropical Geometry or Algebraic Statistics. I used gappy notes, video lectures, video solutions for some exercises, and provided extra notes and videos from world-leading mathematicians for further reading. I made a simple quiz game and the students also reported that they really enjoyed it, and it helped them retain the material better. The quiz/game is accessible on my Webpage: (https://people.maths.bris.ac.uk/~ki18754/index.html)

(iv) Contribution to Life-long Learning and continuing professional development courses

The videos I have made over the years on Linear Algebra and Algebraic Geometry have been used by students in various countries such as UK, Brazil, Russia, Italy and Iran. I plan to create shorter videos (5 to 10 minutes each) on individual topics in Algebraic Geometry and make them available to students to help address common difficulties encountered when studying the fundamentals of the subject.

(v) Collaborative teaching projects with colleagues in other schools or faculties or institutions

I have engaged in outreach activities with Dr. Henna Koivusalo as part of the University of Bristol's widening participation efforts with local schools. The students involved come from Widening Participation backgrounds—typically underrepresented at university due to socio-economic factors or membership in minority groups. These students, currently in Year 10 (ages 14–15), applied to take part in the Maths and Physics Work Experience Week, indicating a high level of motivation and interest in the subjects.

As part of my outreach preparation, I attended training on Active Outreach – Engaging School Students in University of Bristol Outreach and Widening Participation Activities in February 2025. These outreach sessions generally focus on accessible topics linked to the presenter's research area and are designed to be simple, hands-on, and require minimal background knowledge, ensuring inclusivity and engagement.

I co-supervised two Masters' students at the School of Engineering Mathematics with Dr Tobias Kley (University of Göttingen) the following students on the respective projects:

- Sneha Ramesh (COVID-19 Spread: Comparative study of forecasting techniques from Traditional time series models to Machine Learning models)
- Shashwat Upadhyay (Empirical Analysis of Forecasting Techniques for Prices of Tradable Financial Assets)

Both Sneha and Shashwat got emplyed shortly after completing their masters' theses.

(vi) Postgraduate Advising

Research Fellows

I mentored Dr. James Maxwell (HIMR Fellow 2022 to 2024), providing guidance across several areas of his early academic career. This included supporting him with grant writing—offering feedback on proposals and helping him navigate funding opportunities—as well as reviewing and advising on job applications and cover letters. I also assisted him in developing academic collaborations, both within the university and with external researchers. In addition, I supported him in preparing and delivering a course, offering feedback on lecture materials and teaching strategies. In addition, I also provide support to other HIMR through commenting on their proposals and mentoring

their teaching for the Topics in Geometry and Discrete Mathematics.

Postgraduate

1. Daniel Green Tripp, lead supervisor, Started 2022 - Expected 2026.

Daniel has learned a wide range of topics in Combinatorial Algebraic Geometry. He has built a strong network of collaborators and has completed one joint article on Tropical Geometry and Rigidity Theory. We also have a far-reaching project on Matroid Theory. He enjoys teaching tutorial classes and regularly receives positive feedback. He has also received positive reviews at his Annual Progression Meetings.

Co-supervisor, with Song Liu, of Daniel Williams for his mini-project on Geometric Score Matching, during his first year of doctoral training in Compass-CDT.

(Question: Should I include this list here?)

- 3. Peter Bradshaw, second supervisor, graduated 2022
- 4. Alec Chamberlain Cann, second supervisor, graduated 2022
- 5. Ian Gallagher, second supervisor, graduated 2023
- 6. Christopher Jones, second supervisor, graduated 2023
- 7. Alberto Toffano, second supervisor, graduated 2024
- 8. Emilia Alvarez, second supervisor, graduated 2024
- 9. Alex Little, second supervisor, graduated 2024
- 10. Xichen Chao, second supervisor, expected 2025
- 11. Luke Neville, second supervisor, expected 2025
- 12. Jordan Frost, second supervisor, expected 2025
- 13. Marina Anagnostopoulou, second supervisor, expected 2027
- 14. Yakun Wang, second supervisor, expected 2027
- 15. Ryan Lam, second supervisor, expected 2028

Being a second supervisor is primarily a pastoral role. I have organised several gatherings and meetings as the second supervisor, where the PhD students had the opportunity to present their

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research topics in five-minute presentations. The second supervisor setting provides a safe environment for PhD students to raise any issues or miscommunications they may have with their lead supervisor, or to express concerns related to their research or teaching. When appropriate, I pass these concerns on to the Director of Postgraduate Studies or to their lead supervisors.

(vii) Major achievements in teaching administration, explaining the importance and significance

- Designer and Unit Director and Lecturer in Algebraic Geometry
 Significance: This was the first unit in the School in Algebraic Geometry, which is a
 major subject area within pure mathematics, and therefore filled a substantial gap
 in our teaching provision.
- Unit director and Lecturer for Linear Algebra
 Significance: Teaching one of the most fundamental courses to around 1600 students in 4 years.
- Co-director of Topics in Geometry and Discrete Mathematics
 Significance: This is a major mentoring and leadership job to support HIMR fellows for the teaching experience
- Participation in open days in 2019 and 2020
 Significance: Helping the University absorb the best students from high schools
- PhD admission tutor since January 2024
- Significance: Reading hundreds of applications for PhD studies in pure mathematics and helping the colleagues hiring the best PhD candidates to maintain the University's leading research culture

(viii) Any teaching responsibilities which are not typical of your academic pathway

- I am a co-director of the course *Topics in Geometry and Discrete Mathematics* and mentored postdoctoral fellows in course planning and teaching.
- I have organised and led reading seminars on complex analysis, toric geometry, and tropical geometry, fostering collaborative learning and discussion among students and early-career researchers.

 As a postdoctoral fellow in Fribourg, Switzerland in 2016, I volunteered to tutor for Afghan refugees in basic mathematics to help them develop the foundational skills needed for office-based employment.

RESEARCH AND RELATED ADMINISTRATION

https://orcid.org/0000-0002-9440-8829

I am broadly interested in interdisciplinary research, with my primary focus exploring the interface between tropical geometry and the theory of currents in complex analysis and dynamics. Tropical geometry, a piecewise-linear counterpart of algebraic geometry, investigates polyhedral complexes arising from degenerations of algebraic varieties. My introduction of complex tropical currents bridges these fields and, in collaboration with Prof. June Huh (Fields Medal 2022), has led to a counter-example disproving a longstanding conjecture in complex geometry. Further collaboration with Prof. Karim Adiprasito (EMS Prize 2020, New Horizons Prize 2019) extended these results to a broader class of counter-examples.

Seeking deeper connections, I developed a complex dynamical approach to tropicalisation with respect to trivial valuation. In forthcoming work with Prof. Tien Cuong Dinh, we establish analogous theories for non-trivial valuations and apply Dinh—Sibony's superpotential theory within tropical geometry.

I coordinate a research group, initially meeting in person and currently online, with four colleagues from three countries. Our aim is to explore the connections between dynamical tropicalisation and prominent conjectures in algebraic geometry and mirror symmetry in mathematical physics. Recently, we examined the interplay between tropical geometry and rigidity theory, and upcoming research will investigate the relationship between tropical geometry and neural networks.

In terms of professional engagement, I have been an invited speaker at several prestigious conferences and regularly present my work in various seminars. Additionally, I have served as a referee for leading journals and as a reviewer for major grant proposals.

(i) Publications

Academic Journal Papers (Peer-reviewed)

Dynamical tropicalisation, Journal of Geometric Analysis, A Special Edition in Memory of Nessim Sibony. 33, 74 (2023).(38 pages) 100% contribution.

With Karim Adiprasito

Convexity of complements of tropical varieties, and approximations of currents Mathematische Annalen (2019). 373, 237. (15 pages) 50% contribution.

With June Huh

A tropical approach to a generalized Hodge conjecture for positive currents. Duke Mathematical Journal. 166 (2017), 2749–2813. (65 pages) 50% contribution.

(ii) Forthcoming Publications

I'd say arxiv couts as perhaps published, so move to i) perhaps could say "In remain at ____ With Sean Dewar and James Maxwell, Extremal decompositions of tropical varieties and relations with rigidity theory. arXiv:2403.00655. (35 pages.) Contribution 33%.

"Received Positive Reviews, the decision for the revised version should arrive before end of APRIL. I'll move this to Future Plans if we don't hear from the editor by the end of April."

(iii) Research Grants

- 2024: Heilbronn Focused Research Workshop, Awarded £6,500
- 2023: London Mathematical Society, Research in Pairs Grant, Awarded £1,200
- 2021: Heilbronn Focused Research Workshop, Awarded £4,500
- 2019: Heilbronn Focused Research Workshop, Awarded £10,000
- 2015–2016: Postdoctoral Excellence Grant from the Laboratory of Paris Sciences & Lettres. Host University École Normale Supérieure of Paris. France.
- 2011–2014: ALGANT-DOC's grant, full funding for PhD studies in mathematics
- 2008-2010: ALGANT Masters Scholarship, Erasmus Mundus Scholarship of 42,000 EUR

(iv) Indication of External Recognition



- I have been invited to give talks in several both conferences in tropical geometry as well as complex dynamics (around 15 in last 5 years). I have also spoken at European Congress of Mathematics in Berlin in 2016 and Recent Developments in Algebraic Geometry, Arithmetic and Dynamics in National University of Singapore (2023).
- I have given talks at many seminars across the UK and mainland Europe and Asia. I have already received invitations to present my forthcoming work with Prof Dinh internationally (Orsay, Georgia Tech) and the UK (Durham).
- I have been a referee for journals such as Transactions of AMS, Proc. of the London Mathematical Society, Math. Zeitschrift, Commentarii Mathematici Helvetici for both types of articles in tropical geometry and complex dynamics
- I have been the reviewer for research grant proposals by UKRI Future Leaders Fellowships: Round 9, and the Dutch Research Council (NWO).

(v) Future Plans

- Finishing the article with Tien Cuong Dinh. We are hoping that the article will be available on ArXiv on April/May.
- I have been running a Focused Research Group with four other colleagues (all lecturers)
 Dr Enrica Mazzon and Dr Nguyen-Bac Dang (Paris), Dr Roberto Gualdi (Barcelona) and Dr
 Danielle Turchetti (Durham) to expand my results with Dinh to the case of Berkovich spaces.
 I believe this project will have very deep implications in Algebraic Geometry and will have a significant impact.
- During 28 April 02 May, I will have a research visit to Lancaster and together with Dr Sean Dewar (Bristol), Dr Antony Nixon (Lancaster), Dr Ben Smith (Lancaster) we will work on a project that we have defined on interactions of Tropical Geometry and Neural Networks.
- I have discussed with Joseph Najnudel and we are writing an application for Prob_AI
 Discipline Hopping Awards (£50,000 in June) We will explore some applications of
 Algebraic Geometry and Neural Networks. (https://www.probai.ac.uk/funding/).
- Prof Karim Adiprasito plans to visit me during July 21 25 July to work on our projects relating Matroid Theory and Theory of Currents.
- I am preparing a research proposal for the New Investigator Award to apply before the panel meeting in September 2025.

ACADEMIC LEADERSHIP AND CITIZENSHIP

I have developed and maintained a strong international network with researchers in both tropical geometry and complex geometry. Through focused workshops and conferences, I have brought together mathematicians from diverse backgrounds, playing a leading role in supporting early career researchers.

I regularly receive peer-review requests in both tropical geometry and complex dynamics, and I often have opportunities to present and share my research at seminars and conferences. I have also been invited to review two substantial grant proposals from major funding bodies. Within the School, I aim to be collegial and supportive of my colleagues. I consistently strive to meet all my formal responsibilities and contribute to the School's teaching, research, and administrative activities.

(i) Academic leadership in the discipline.

I have organised several Focused Research Groups and gathered international distinguished mathematicians from across the UK and Europe.

I have (co)-organised the following workshops and gatherings:

- May 2023, with James Maxwell, Tropical Days in Bristol (LMS meeting)
- July 2022 Cohomology of toric arrangement complement III, Heilbronn Focused Research Workshop, Bristol
- February 2020 With Alex Fink, Cohomology of toric arrangement complement II, Focused Research Workshop, Queen Mary University of London
- September 2019 with Kevin Grace, Cohomology of toric arrangement complements I, Heilbronn Focused Research Workshop
- I am one of the main organisers of organisers of Tropical Geometry UK Network.
- With other 3 colleagues we are seeking to understand the natural connection between Tropical Geometry and Neural Networks

(i) Academic leadership in the University

• PGR Admissions Tutor (Since January 2024)

As PGR Admissions Tutor for Pure Mathematics, I review around 100 applications each year. This involves assessing academic backgrounds, research statements, and reference letters, as well as coordinating with prospective supervisors to ensure a good match between applicants and research areas. I also contribute to the development and refinement of admissions policies and procedures. Supporting colleagues in selecting the best PhD candidates helps to strengthen and maintain our leading research culture at Bristol.

Mentor for Postdocs

I provide mentorship to postdoctoral researchers within the School, supporting their development in both research and teaching. This includes offering guidance on preparing for lectures, providing feedback on course delivery, and discussing career progression. I also help them navigate administrative processes and integrate into the wider academic community.

Pastoral Mentor for PhD Students

In my role as a pastoral mentor, I support PhD students with academic and personal matters that may affect their studies. This includes regular check-ins, signposting to university support services, and helping them maintain a balanced and productive research experience. I aim to create a safe and open environment where students feel comfortable discussing challenges.

(iii) Professional Activities outside the University

- I have been a referee for journals such as Transactions of AMS, Proc. of the London Mathematical Society, Math. Zeitschrift, Commentarii Mathematici Helvetici for both types of articles in tropical geometry and complex dynamics.
- I have been the reviewer for research grant proposals by UKRI Future Leaders Fellowships: Round 9, and the Dutch Research Council (NWO).
- I have been a Reviewer zbMATH and Mathematical Reviews (MathSciNet)

(vi) Good citizenship

- I am currently the designated Fire Warden for our section of the building. I previously received informal First Aid training and have scheduled formal certification training for May 23rd, 2025.
- In 2023, I collaborated with Dr Sean Dewar and Dr James Maxwell, a HIMR fellow, to write a grant proposal to organise the Focused Research Group on Rigidity Theory and Tropical Geometry.
- In 2025, I assisted Dr Sean Dewar in writing a grant proposal to secure funding for research on Tropical Geometry and Neural Networks.
- During the pandemic, I created instructional videos for my large Linear Algebra class and also made a tutorial video for using Camtasia software.
- For four years as a lecturer, I marked a substantial portion of the Linear Algebra course assessments
- I have frequently contributed to larger marking groups as my own marking load for Algebraic Geometry has been lower.
- I regularly meet marking deadlines, proactively requesting extensions well in advance if necessary, and have assisted in various exam checking processes.
- One month after experiencing a significant health issue in 2021, I received a reduced teaching, however, I committed to preparing myself mentally for teaching Linear Algebra ensure minimal extra load for my colleagues.
- As the library representative for the School of Mathematics, I support colleagues in acquiring printed and online resources and securing journal access.
- I participated in our School's Open Days in both 2019 and 2020.
- I regularly attend school assemblies and also engage with teaching discussions.

FUTURE PLANS

- I am preparing a research proposal for the New Investigator Award to apply before the panel meeting in September 2025.
- Organising another Tropical Geometry conference in Bristol as one of the core organisers of the Tropical Geometry UK network.

- Making short videos on algebraic geometry to promote the subjects within and outside our school.
- Applying, with Dr Joseph Najnudel, to Prob_AI Discipline Hopping Awards (£50,000), https://www.probai.ac.uk/funding/