BARINDER SINGH BANWAIT

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RESEARCH INTERESTS

Computational Number Theory | Arithmetic Geometry | Abelian Varieties | Modular Forms

ACADEMIC APPOINTMENTS

Visiting Scientist
Massachusetts Institute of Technology
Sep 2024 – present — Cambridge, MA, USA

Postdoctoral researcher in Mathematics
Boston University
Sep 2022 – present — Boston, MA, USA
Mentor: Prof. Jennifer Balakrishnan

Postdoctoral researcher in Mathematics
Ruprecht-Karls-Universität Heidelberg
Oct 2021 – Apr 2022 — Heidelberg, Germany
Mentor: Prof. Dr. Gebhard Böckle

Postdoctoral researcher in Mathematics
Harish-Chandra Research Institute
Feb – Sep 2021 — Prayagraj, India

Visiting Scientist
Max-Planck-Institut für Mathematik
Oct 2016 – Nov 2016 — Bonn, Germany
Host: Prof. Alex Bartel

Postdoctoral researcher in Mathematics
Universität Duisburg-Essen
Jan 2015 – Jan 2017 — Essen, Germany
Mentor: Prof. Dr. Ulrich Görtz

Postdoctoral researcher in Mathematics
Institut national de recherche en informatique et en automatique (INRIA)
Jan – Dec 2014 — Bordeaux, France
Mentor: Dr. Andreas Enge

PAPERS AND PREPRINTS

1. **Torsion subgroups of elliptic curves over quadratic fields and a conjecture of Granville**, with M. Derickx. To appear, *Algorithmic Number Theory Symposium*, *arXiv:2401.14514* (2024).
2. **Towards strong uniformity for isogenies of prime degree**, with M. Derickx. Submitted, *arXiv:2302.08350* (2024).
3. **Computing nonsurjective primes associated to Galois representations of genus 2 curves**, with A. Brumer, H. J. Kim, Z. Klagsbrun, J. Mayle, P. Srinivasan and I. Vogt. To appear, *Contemporary Mathematics*, *arXiv:2301.02222* (2023).
4. **Modularity over $\mathbb{C}$ implies modularity over $\mathbb{Q}$**. To appear, *Modularity and the Generalised Fermat Equation*, *arXiv:2212.14412* (2022).

5. **Explicit isogenies of prime degree over number fields**, with M. Derickx. To appear, *Algebra and Number Theory*. *arXiv:2203.06009* (2022).
6. **Cyclic isogenies of elliptic curves over fixed quadratic fields**, with F. Najman and O. Padurariu. *Mathematics of Computation* (2023) (to appear in print).
7. **Explicit isogenies of prime degree over quadratic fields**. *International Mathematics Research Notices*. 2023(14):11829–11876 (2023).
8. **Examples of abelian surfaces failing the local-global principle for isogenies**. *Research in Number Theory*. 7(55) (2021)
9. **Correction: Examples of abelian surfaces failing the local-global principle for isogenies**. *Research in Number Theory*. 8(98) (2022)
10. **Del Pezzo surfaces over finite fields and their Frobenius traces**, with F. Fité and D. Loughran. *Mathematical Proceedings of the Cambridge Philosophical Society*. 167(1) (2019) 35-60.
11. **Tetrahedral Elliptic Curves and the local-global principle for isogenies**, with J. Cremona. *Algebra and Number Theory*. 8:5 (2014) 1201-1229.
12. **On some local to global phenomena for abelian varieties**. PhD Thesis, University of Warwick (2013).

INDUSTRY EXPERIENCE

Quantitative Analyst

Quantile

Sep 2019 – Mar 2020 | London, UK

- Linear, mixed-integer, and multi-objective optimisation for compression of interest-rate derivative portfolios using Gurobi.
- Visualisation of FX trading datasets across several client investment banks.
- Modelling of reset risk and PV01 for swaptions.
- Git code management with Bitbucket.

Research Engineer

CMR Surgical

Jan 2018 – Sep 2019 | Cambridge, UK

- Research and optimisation of robotic control algorithms, including inverse kinematics and mass-spring-damper models.
- Mathematical modelling in Matlab, with Robotics and Control Systems toolboxes.
- Writing production-level, safety-critical embedded C code, compliant with MISRA C and International Standard IEC 62304.
- Time-series telemetry processing in Python, using pandas, numpy, and matplotlib.
- Analysis and visualisation of system log messages with Elasticsearch and kibana.
- Development with Amazon Web Services, including Lambda, S3, and Athena.
- Implementing machine learning algorithms for robot arm condition monitoring, using scikit-learn and Tensorflow.
- Unit and Regression tests in C, C++, and Matlab, including Google Test framework, continuously integrated with TeamCity.
- Agile software development with SVN and Git.

EDUCATION

PhD Mathematics

University of Warwick

Jan 2010 – Sep 2013 | Coventry, UK

Supervisor: Prof. John Cremona

BA and MMath Mathematics

University of Cambridge - Christ's College

Oct 2005 – June 2009 | Cambridge, UK

MMath (*Part III of the Mathematical Tripos*) - Distinction
Part III Essay: Class Field Theory (Cohomological Approach), supervised by Dr. Tim Dokchitser

INVITED TALKS

(recent)

- Arithmetic on Curves, ICERM, Providence RI, Junje 2025
- Algebra Seminar, University of Connecticut, Storrs CT, Nov 2024
- Algorithmic Number Theory Symposium XVI, MIT, Cambridge MA, Jul 2024
- Modular curves and Galois representations, Zagreb, Croatia, Sep 2023
- Rational Points, Schney, Germany, Jul 2023
- MIT Number Theory Seminar, Cambridge MA, Nov 2022
- Boston University Number Theory Seminar, Boston MA, Nov 2022
- Séminaire de Théorie des Nombres, Université de Strasbourg, France, Apr 2022
- Séminaire de Théorie des Nombres, ENS de Lyon, France, Apr 2022
- Séminaire de Théorie des Nombres, Université Blaise-Pascal, Clermont-Ferrand, France, Apr 2022
- Bhaskaracharya Pratishthana, Pune (online), Feb 2022
- Atelier PARI/GP 2022, Besançon, France (online), Jan 2022
- Arithmetic Geometry Seminar, Universität Bayreuth (online), July 2021
- VaNTAGe Seminar (online), June 2021
- Effective Methods in Algebraic Geometry (online conference), June 2021
- Algebra Seminar, Rijksuniversiteit Groningen (online), June 2021
- Mathematics Colloquium, Indian Institute of Technology, Hyderabad (online), June 2021
- University of Washington Number Theory Seminar (online), June 2021
- Séminaire de Théorie Algorithmique des Nombres, Bordeaux (online), May 2021
- Stat-Math Unit, Indian Statistical Institute, Delhi (online), Apr 2021
- Mathematics Colloquium, Indian Institute of Science Education and Research, Mohali (online), Apr 2021
- Joining Seminar, Harish-Chandra Research Institute, Prayagraj (online), Feb 2021
- Zagreb Number Theory Seminar (online), Jan 2021

ACADEMIC MEMBERSHIPS

Member of the *L-functions and Modular Forms Database*. 15 pull requests merged since October 2020 across the codebase, including Classical and Bianchi Modular Forms, Testing utilities, and Dirichlet Characters.

OPEN SOURCE SOFTWARE CONTRIBUTIONS

Absolutely simple endomorphism rings - Sage

2021

- First functionality to check for geometric simplicity of Jacobians of genus 2 curves over $\mathbb{Q}$. Appeared in sage-9.5.

TEACHING EXPERIENCE

Course Lecturer

Computational Number Theory

Oct 2021 - Feb 2022 — Heidelberg, Germany

Masters course covering algorithmic and computational topics in elliptic curves, modular forms, and algebraic number theory.

Vertiefung Zahlentheorie

Apr - July 2016 — Essen, Germany

Representability of primes via quadratic forms - from Fermat, Euler, Gauss, and to Artin Reciprocity. Three hours per week for 15 weeks. Lectures given in German.

Einführung in das Computer-Algebra-Paket *Sage*

Sep 2015 — Essen, Germany

Introductory week-long course on *Sage* aimed at final year undergraduates. Course given in German.

Algebraic Number Theory

July 2009 — Linyi, China

Introductory course at summer school aimed at second year undergraduates.

Seminar Organiser

Prime numbers and Cryptography

Apr 2022 — Heidelberg, Germany

Bachelor's level seminar organised with Sriram Chinthalagiri

Abelian Varieties

Oct 2021 - Feb 2022 — Heidelberg, Germany

Masters level seminar organised with Prof. Böckle.

Algebraic Surfaces

Oct 2015 - Jan 2016 — Essen, Germany

Masters level seminar organised with Prof. Görtz.

Teaching Assistant

Linear Algebra	Apr - July 2015	Vytautas Paškūnas	Universität Duisburg-Essen
Modular Forms	Oct - Dec 2012	Mehmet Haluk Şengün	University of Warwick
Algebraic Number Theory	Jan - Mar 2012	Johan Bosman	University of Warwick
Elliptic Curves	Oct - Dec 2011	Lassina Dembélé	University of Warwick
Algebraic Number Theory	Jan - Mar 2010	William Hart	University of Warwick

Undergraduate Supervisor

Oct 2010 - Apr 2013 — University of Warwick

Holding supervisions of groups of 5 undergraduates.

STEP Mentor

Apr 2007 – 2009 — University of Cambridge

Coaching groups of 10 A-Level students in the STEP mathematics entrance exams to increase diversity and access at Cambridge.

REFEREE DUTIES FOR JOURNALS

Mathematics of Computation | International Journal of Number Theory | Algebra and Number Theory | Research in Number Theory | Acta Arithmetica | International Mathematics Research Notices | Algorithmic Number Theory Symposium

AWARDS

Engineering and Physical Sciences Research Council, UK

Jan 2010

- Full funding for PhD studies.

Institute for Advanced Study, Princeton NJ, USA

Jul 2008

- Full funding to attend Undergraduate Summer School Program of Park City Mathematics Institute on Algebraic Geometry in 2008.

Whelan Prize

Oct 2007

- Awarded by Christ's College, University of Cambridge, for outstanding examination performance (top of college in mathematics).

Nuffield Trust, UK

Jul 2007

- Undergraduate Research Bursary to conduct summer research project.
- Supervisor: Dr. Jon Bevan, University of Surrey, UK.

LANGUAGES

English	●●●●●●	Python	●●●●●○
ਪੰਜਾਬੀ (Punjabi)	●●●●●●	Sage	●●●●○○
Deutsch	●●●●○○	C/C++	●●●●○○
हिंदी (Hindi)	●●●○○○	Magma	●●●●○○
Français	●●●○○○	PARI/GP	●●●○○○