

# Bishal Deb

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<https://bishaldeb.com>

## Research Interests

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Algebraic, Bijective and Enumerative Combinatorics

**Research keywords:** Bijections, continued fractions, generating functions, lattice paths, permutation statistics, production matrices, Riordan arrays, total positivity, zeroes of polynomials

## Employment and Internships

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- Nov 2023 - Oct 2024* ◇ Postdoctoral researcher at  
Laboratoire de Probabilités, Statistique et Modélisation,  
Sorbonne Université and Université Paris Cité, CNRS,  
Paris, France.  
*Supported by DIMERS project ANR-18-CE40-0033  
funded by Agence Nationale de la Recherche (ANR, France).*
- Feb 2022 - Oct 2022* ◇ Data Engineer at [Realm Inc.](#), Part-time employee.
- May 2018 - Jul 2018* ◇ Product Intern at Adobe Systems, Noida, India.  
Project title: Topological Data Analysis  
Supervisor: K. Balaji
- May 2017 - Jul 2017* ◇ Product Intern at Adobe Systems, Noida.  
Project title: Singular Learning Theory  
Supervisor: K. Balaji

## Education

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- Sep 2019 - Oct 2023* ◇ **PhD. in Mathematics, University College London (UCL), United Kingdom**  
*Funded by Dean's Scholarship and Departmental Teaching Assistantship*  
Dissertation title: Enumerative combinatorics,  
continued fractions and total positivity  
[Proquest link](#)  
Supervisor: Prof. Alan D. Sokal
- Sep 2018 - Aug 2019* ◇ **Master 2 Informatique Fondamentale, Université Paris-Est Marne-la-Vallée (UPEM)\*, France**  
Résultat d'admission (Grade) 16.177/20  
*Funded by LabEx Bezout M2 scholarship (2018-19)*  
Thesis title: Combinatorics of Stammering Tableaux  
Supervisors: Prof. Samuele Giraudo and  
Prof. Matthieu Josuat-Vergès
- Aug 2017 - Jul 2018* ◇ **First year of MSc. in Computer Science, Chennai Mathematical Institute (CMI), India. CGPA 9.43/10**  
*Full scholarship from CMI*
- Aug 2014 - Jul 2017* ◇ **BSc. (Hons) in Mathematics and Computer Science, CMI. CGPA 8.89/10**  
*Funded by INSPIRE SHE Scholarship, Government of India*

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\*now Université Gustave Eiffel

## Publications

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### Journal Publications

- [1] B. Deb, and A. D. Sokal; *Classical continued fractions for some multivariate polynomials generalizing the Genocchi and median Genocchi numbers*; In *Advances in Applied Mathematics*, Volume 161, (October 2024), Article number: 102756. (92 pages). doi: 10.1016/j.aam.2024.102756.  
URL: <https://www.sciencedirect.com/science/article/pii/S0196885824000885>
- [2] B. Deb, and A. D. Sokal; *Continued fractions for cycle-alternating permutations* (48 pages); To appear in *The Ramanujan Journal*.
- [3] B. Deb, and A. D. Sokal; *A remark on continued fractions for permutations and D-permutations with a weight  $-1$  per cycle*; In *Electronic Journal of Combinatorics*, Volume 31, Issue 2 (2024), Article number: P2.14. (34 pages). doi:10.37236/12149  
URL: <https://www.combinatorics.org/ojs/index.php/eljc/article/view/v31i2p14>
- [4] A. Clifton, B. Deb, Y. Huang, S. Spiro, and S. Yoo; *Continuously Increasing Subsequences of Random Multiset Permutations*; In *European Journal of Combinatorics*, Volume 110, 103708 (May 2023). (20 pages). doi:10.1016/j.ejc.2023.103708.  
URL: <https://www.sciencedirect.com/science/article/pii/S0195669823000252>
- [5] B. Deb; *Bijection between Increasing Binary Trees and Rook Placements on Double Staircases*; In *Electronic Journal of Combinatorics*, Volume 30, Issue 1 (2023), Article number: P1.10. (18 pages). doi:10.37236/10926.  
URL: <https://www.combinatorics.org/ojs/index.php/eljc/article/view/v30i1p10>

### Publications in Conference Proceedings

- [6] A. Clifton, B. Deb, Y. Huang, S. Spiro, and S. Yoo; *Continuously Increasing Subsequences of Random Multiset Permutations*; In *Séminaire Lotharingien de Combinatoire 86B* (2022), Proceedings of the 34th International Conference on “Formal Power Series and Algebraic Combinatorics.”  
URL: <https://www.mat.univie.ac.at/slc/wpapers/FPSAC2022/4.html>
- [7] X. Chen, B. Deb, A. Dyachenko, T. Gilmore, and A. D. Sokal; *Coefficientwise total positivity of some matrices defined by linear recurrences*; In *Séminaire Lotharingien de Combinatoire 85B* (2021), Proceedings of the 33rd International Conference on “Formal Power Series and Algebraic Combinatorics.”  
URL: <https://www.mat.univie.ac.at/slc/wpapers/FPSAC2021/30.html>
- [8] B. Deb, A. Sarkar, N. Kumari, A. Rupela, P. Gupta, and Balaji K.; *Multimapper: Data Density Sensitive Topological Visualization*; IEEE International Conference on Data Mining Workshops (ICDMW), 2018. doi:10.1109/ICDMW.2018.00153

### Patents

- [9] A. Rupela, P. Gupta, N. Kumari, B. Deb, Balaji K., and A. Sarkar; *Generating varied-scale topological visualizations of multi-dimensional data*; U.S. Patent 11,100,127, issued August 24, 2021. <https://patents.google.com/patent/US11100127B2/en>

### Unpublished/Work in Progress

- [1] B. Deb, A. Dyachenko, M. Pétréolle, and A. D. Sokal; *Lattice paths and branched continued fractions III. Generalizations of the Laguerre, rook and Lah polynomials*. (86 pages arxiv, 89 pages in revision). arXiv preprint: <https://arxiv.org/abs/2312.11081>;

- [2] B. Deb, and A. D. Sokal; *Coefficientwise Hankel-total positivity of the Schett polynomials*. (12 pages). arXiv preprint: <https://arxiv.org/abs/2311.11747>
- [3] B. Deb; *Continued fractions using a Laguerre digraph interpretation of the Foata-Zeilberger bijection and its variants*. (65 pages arxiv, 85 pages submitted)  
arXiv preprint: <https://arxiv.org/abs/2304.14487>;  
Submitted
- [4] B. Deb; *Chromatic Polynomial and Heaps of Pieces*;  
arXiv preprint: <https://arxiv.org/abs/1902.02240>
- [5] V. Bitonti, B. Deb, and A. D. Sokal; *Thron-type continued fractions for some classes of increasing trees*; In progress.
- [6] B. Deb, and A. Elvey Price; *Not all Diophantine moment sequences are realisable by walks on integer graphs*; In progress.
- [7] B. Deb, and A. D. Sokal; *Higher-order Stirling cycle and subset triangles: Total positivity, continued fractions and real-rootedness*; In progress.
- [8] B. Deb, and A. D. Sokal; *Jacobian elliptic and hyperelliptic functions, Schett polynomials and Schett symmetric functions, and coefficientwise Hankel-total positivity*; In progress.
- [9] X. Chen, B. Deb, A. Dyachenko, T. Gilmore, and A. D. Sokal; *Coefficientwise total positivity of some matrices defined by linear recurrences*; In progress.
- [10] B. Deb, A. Dyachenko, and A. D. Sokal; *Total positivity beyond production matrices: Experiments on the generic Lah polynomials*; In progress.

## Talks and posters

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### Conference Presentations

- *Continued fractions using a Laguerre digraph interpretation of the Foata-Zeilberger bijection*
  - (July 3rd, 2024) at the [30th British Combinatorial Conference](#)
  - (September 5th, 2023) at [International Conference on Enumerative Combinatorics and Applications 2023](#).
  - (July 27th, 2023) [online poster presentation](#) at [AlCoVE: an Algebraic Combinatorics Virtual Expedition 2023](#).
  - (July 6th, 2023) at [Permutation Patterns 2023](#).
- *A remark on continued fractions for permutations and D-permutations with a weight -1 per cycle*, (June 17th, 2024) [online poster presentation](#) at [AlCoVE: an Algebraic Combinatorics Virtual Expedition 2024](#).
- *Laguerre digraphs and continued fractions*, (May 23, 2023) at [Scottish Combinatorics Meeting 2023](#), University of Strathclyde, Glasgow, UK.
- *Continuously Increasing Subsequences of Random Multiset Permutations*, (July 18, 2022) [poster presentation](#) at 34th International Conference on [Formal Power Series & Algebraic Combinatorics](#), Indian Institute of Science, Bangalore, India.

- *Multivariate continued fractions associated to Genocchi and median Genocchi numbers*, (June 9, 2022) at [Heilbronn Meeting on Positivity Problems Associated to Permutation Patterns](#), Lancaster University, UK.
- *Combinatorics of continued fractions in the realm of permutations and Genocchi numbers*, (March 26, 2022) at [Graduate Students Combinatorics Conference 2022](#)
- *Total positivity of the Eulerian triangle: A big generalisation of Brenti's conjecture*,
  - (July 16th, 2021) [British Early Career Mathematicians' Colloquium 2021](#),
  - (June 8th, 2021) at [Young Researchers in Mathematics 2021](#),
  - (April 24th, 2021) at [Graduate Students Combinatorics Conference 2021](#).

## Seminar Presentations

### 2024:

- *Coefficientwise total positivity of Hankel matrices in counting problems*,
  - (August 28th, 2024) at Ahmedabad University.
  - (June 7th, 2024) at Institut de Mathématiques de Jussieu-Paris Rive Gauche, Paris.
- *Coefficientwise Hankel-total positivity of the Laguerre polynomials*,
  - (June 14th, 2024) at Laboratoire de Probabilités, Statistique et Modélisation, Paris, France.
  - (May 28th, 2024) at Laboratoire d'informatique de Paris-Nord, Paris, France.
  - (May 24th, 2024) at University of Tours, Tours, France
- *Continued fractions using a Laguerre digraph interpretation of the Foata–Zeilberger bijection and its variants*
  - (April 16th, 2024) at the Institut Camille Jordan, Lyon, France.
  - (March 26th, 2024) at the Institut de Recherche en Informatique Fondamentale, Paris, France.
- *Coefficientwise Hankel-total positivity of the Schett polynomials*, (February 27th, 2024) at Chennai Mathematical Institute, Chennai, India
- *Accumulation of zeroes for polynomials with combinatorial significance*, (February 23rd, 2024) at [Combinatorics-related Open Problems Seminar \(CROPS\)](#)

### 2023:

- *The “quadratic family” of continued fractions and combinatorial sequences*, (May 11th, 2023), [Topics in Special Function and Number Theory \(SFNT\)](#). (Invited)

### 2022:

- *Combinatorics and total positivity*, (August 23rd, 2022) Chennai Mathematical Institute, Chennai, India. (Invited)
- *Continued fractions and combinatorial sequences: factorials, Genocchi and median Genocchi numbers*, (August 17th, 2022) Institute of Mathematical Sciences, Chennai, India. (Invited)

- *Combinatorics of continued fractions in the realm of permutations and Genocchi numbers*, (April 20, 2022) at [Graduate Online Combinatorics Colloquium](#). (Invited)
- *Combinatorial Hodge Theory*, (March 9, 2022) at UCL-LSE combinatorics reading group.

## 2021:

- *Analysing a strategy for a card guessing game via continuously increasing subsequences in multiset permutations*,
  - (November 18th, 2021) at [Algebra, Representations, Combinatorics and Symmetric functions in India \(ARCSIN\)](#).
  - (November 15th, 2021) at UCL Combinatorics Seminar series.

## 2020:

- *Total Positivity during Distressing Times*, (November 17, 2020) at Postgraduate Student Seminar Series, Department of Mathematics, UCL.
- *Combinatorics of Stammering Tableaux*, (July 31, 2022) at [Online Weekly Research Seminar for Early Career Mathematicians from India](#). (Invited)

## 2019:

- *A Mathematical Pursuit of Happiness*, (September 14, 2019) outreach talk to mathematics undergraduates at Digboi College, Assam, India.
- *Chromatic Polynomials and Heaps of Pieces*, (May 20, 2019) at GT Combinatoire Énumérative et Algébrique, Laboratoire Bordelais de Recherche En Informatique, Université de Bordeaux, France. (Invited)

## 2017:

- *Chromatic Polynomials and Heaps of Pieces*, (March 14, 2017) at Institute of Mathematical Sciences, Chennai.

# Conferences/Workshops Attended

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## In-person

- Formal Power Series and Algebraic Combinatorics 2024, July 2024, Ruhr-Universität Bochum, Bochum, Germany.
- British Combinatorial Conference 2024, July 2024, Queen Mary University of London, London, United Kingdom.
- At the crossroads of physics and mathematics : the joy of integrable combinatorics — A conference in the honor of Philippe Di Francesco's 60th birthday, June 2024, Institut de Physique Théorique, CEA Paris-Saclay, France.
- Journées ALEA 2024, March 2024, Centre International de Rencontres Mathématiques, Luminy, France.
- Workshop on 'Combinatorics, Algorithms, and Geometry', March 2024, Dresden, Germany.
- Workshop on Computer Algebra for Functional Equations in Combinatorics and Physics, December 2023, Institut Henri Poincaré, Paris, France.
- Permutation Patterns 2023, University of Burgundy, Dijon, France.

- Scottish Combinatorics Meeting 2023, University of Strathclyde, Glasgow, UK.
- London Colloquia in Combinatorics 2023, London School of Economics, London, UK.
- Formal Power Series and Algebraic Combinatorics 2022, Indian Institute of Science, Bangalore, India.
- Algorithmic and Enumerative Combinatorics 2022, Technical University of Vienna, Austria.
- Early Career Researchers in Mathematics 2022, UCL, UK.
- Heilbronn Meeting on Positivity Problems Associated to Permutation Patterns, 2022, Lancaster University, UK.
- Göran Gustafsson Symposium 2022, Institut Mittag-Leffler, Sweden.
- Summer School on Geometric and Algebraic Combinatorics, 2019, Sorbonne Université at Jussieu, France.

## Online

2022-23

- International Conference on Enumerative Combinatorics and Applications 2023
- AlCoVE: an Algebraic Combinatorics Virtual Expedition 2023

2021-22

- Graduate Student Combinatorics Conference 2022

2020-21

- Lattice Paths, Combinatorics and Interactions
- Permutation Patterns 2021
- Graduate Student Combinatorics Conference 2021
- Formal Power Series and Algebraic Combinatorics
- AlCoVE: an Algebraic Combinatorics Virtual Expedition
- Young Researchers in Mathematics 2021
- British Early Career Mathematicians Colloquium 2021

2019-20

- Algebraic Combinatorics Online Workshop (ACOW)
- AlCoVE: an Algebraic Combinatorics Virtual Expedition
- Formal Power Series and Algebraic Combinatorics 2020

## Teaching Experience

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- **Modules Tutored at UCL** – Analysis 1 and 2 (MATH0003 and MATH0004), Algebra 1 and 2 (MATH0005 and MATH0006), Further Linear Algebra (MATH0014), Mathematical Methods 3 (MATH0016).
- **Moderating Experience at UCL** – Online problem sessions for MATH0016.
- **Marking experience at UCL** – MATH0005, MATH0016, Combinatorial Optimisation (MATH0028), An Introduction to Mathematica (MATH0032), Computational Methods (MATH0058).



- Developer for UCL's [STACK \(System for Teaching and Assessment using a Computer algebra Kernel\)](#) question bank.
- **Marking experience at CMI** – Topics in Combinatorics (Spring 2018).

## Skills

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- **Programming Languages** - Haskell, Java, Mathematica, Python, Sage, SQL
- **Typesetting Languages** -  $\text{\LaTeX}$
- **Web designing** - *HTML*, *CSS*
- **Languages** : English (Fluent), Bengali (Native tongue), Hindi (Working proficiency), Assamese (Can read and speak), French (Beginners).

## Other Professional Roles and Activities

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- Reviewer for Annals of Combinatorics, Electronic Journal of Combinatorics, Journal of the London Mathematical Society, Formal Power Series and Algebraic Combinatorics 2024.
- Organiser of [ECRM 2022](#), an in-person conference for mathematics PhD students in UK organised by PhD students from Department of Mathematics, UCL.
- Research Student Representative at Department of Mathematics, UCL (September 2020 - May 2022).
- Editor of [Gonit Sora](#), a bilingual web magazine.
- Organised a successful series of webinars (since June 2020) on behalf of Gonit Sora ([Gonit Sora webinar page](#)).
- Volunteered at [London Mathematics Outreach](#).
- Joint Event Co-ordinator of Tessellate 2018, the academic and cultural festival of CMI.
- Organiser of Student Talks at CMI (2017-2018).
- Visharad (Graduate) in Tabla (Indian Percussion Instrument) from Bhatkhande Sangit Vidyapith, Lucknow, India. Senior Diploma in Art & Craft from Society of Art and Craft, West Bengal, India. Vocal music student at [Darbar Academy](#) (2021 - Present).

## Awards, Grants and Honours

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- Runner-up of the British Combinatorial Committee PhD Thesis Prize in Combinatorics. Citation available here: <https://www.britishcombinatorics.org.uk/highlights>.
- Mayer de Rothschild Studentship (2021-2022) at Department of Mathematics, UCL.
- Davenport Prize in Pure Mathematics (2020-2021) for best PhD student in Pure Mathematics for work done in the first year of research at Department of Mathematics, UCL.
- One of seven international students selected for LabEx Bezout M2 scholarship (2018-19).
- Recipient of INSPIRE SHE scholarship for being in the top 1% of Assam State board in class 12 exams.

*Last updated on September 6, 2024.*