

Bruno Pasqualotto Cavalar

bruno.cavalar@cs.ox.ac.uk

<http://brunopc.github.io> | [dblp](#) | [Google Scholar](#)

EMPLOYMENT

Research Associate

July 2024 - now

University of Oxford

Department of Computer Science

Host (July 2024 – July 2025): Dr. Ján Pich

Host (August 2025 – now): Prof. Rahul Santhanam

EDUCATION

Ph.D. in Computer Science

2020 - 2024

University of Warwick

Department of Computer Science

Advisor: Igor Carboni Oliveira

Thesis: *Complexity Theory of Classical and Quantum Computational Devices*

M.Sc. in Computer Science

2018 - 2020

University of Sao Paulo

Institute of Mathematics and Statistics (IME-USP)

Advisor: Yoshiharu Kohayakawa

Thesis: *Sunflower theorems in monotone circuit complexity*

B.Sc. in Computer Science (with honours)

2014 - 2017

University of Sao Paulo (IME-USP)

Average: 9.1/10

Ranked 1st among 37 Computer Science students

Advisor: Yoshiharu Kohayakawa

Thesis: *Ramsey-type problems in orientations of graphs*

FUNDING, DISTINCTIONS AND AWARDS

Best Master Thesis Award: Winner of the Latin American Master Thesis Contest (CLTM - XXVII) at the Latin American Computing Conference (CLEI 2021). 2021

Best Master Thesis Award: Winner of the Contest of Theses and Dissertations (CTD - XXXIV) at the Congress of the Brazilian Computer Society (CSBC 2021). 2021

Alejandro López-Ortiz Best Paper Award: For the paper *Monotone Circuit Lower Bounds from Robust Sunflowers* at the LATIN 2020 conference, joint work with Benjamin Rossman and Mrinal Kumar. 2021

Chancellor's International Scholarship: Awarded to the 30 most outstanding international PhD applicants to the University of Warwick. 2020

Computational Complexity and extremal combinatorics September 2018 - August 2020
FAPESP Grant for M.Sc. research

Computational Complexity and extremal combinatorics January 2019 - July 2019
FAPESP Grant for research internship abroad (University of Toronto)

Best student award of IME-USP: Awarded to the best student among all students graduating at IME-USP in a given year, including all majors in Mathematics, Applied Mathematics, Statistics and Computer Science. 2017

Second place, in the admission exam of the University of Sao Paulo for undergraduate studies in Computer Science (over 3,500 applicants). 2014

PUBLICATIONS

10. **Monotone Circuit Complexity of Matching** 2025
 Bruno Cavalar, Mika Göös, Artur Riazanov, Anastasia Sofronova, Dmitry Sokolov
 Preprint
 Available at <https://eccc.weizmann.ac.il/report/2025/102/>
Brief description: Settles the 40-year-old question of determining the monotone complexity of matching. Also separates constant-depth and monotone circuits, solving an open question from the 90s.
9. **A Meta-Complexity Characterisation of Quantum Cryptography** 2024
 Bruno P. Cavalar, Eli Goldin, Matthew Gray, Peter Hall
 Proc. **EUROCRYPT**, 2025
 Available at <https://arxiv.org/abs/2410.04984>
Brief description: Obtains the first complexity-theoretic characterisation of a quantum cryptographic task, pioneering connections between quantum cryptography and Kolmogorov complexity.
8. **Boolean Circuit Complexity and Two-Dimensional Cover Problems** 2024
 Bruno P. Cavalar, Igor C. Oliveira
 ACM Transactions on Computation Theory (ACM **ToCT**) 2025
 Available at <https://dl.acm.org/doi/10.1145/3718746>
Brief description: Reduces the problem of showing circuit lower bounds to a cleaner combinatorial problem, offering a new approach to a problem that has seen very little progress in decades.
7. **On the Computational Hardness of Quantum One-wayness** 2023
 Bruno P. Cavalar, Eli Goldin, Matthew Gray, Peter Hall, Yanyi Liu, Angelos Pelecanos
 Accepted to **Quantum Journal** (To Appear)
 Available at <https://arxiv.org/abs/2312.08363>
Brief description: Shows that complexity-theoretic separations are necessary for quantum one-wayness (an important cryptographic task) to be possible. Also proves that pseudorandom states imply one-way state generators in nearly all parameter regimes.
6. **Constant-Depth Circuits vs. Monotone Circuits** 2023
 Bruno P. Cavalar, Igor Carboni Oliveira
 Proc. 38th Computational Complexity Conference (**CCC**), LIPIcs, Vol. 264, 29:1–29:37
 Available at <https://arxiv.org/abs/2305.06821>
Brief description: Proves the first separation between constant-depth circuit classes and monotone circuits, nearly solving an important open problem of 1990. Shows a dichotomy for the monotone complexity of CSPs, implying limitations for communication complexity methods.
5. **Algorithms and Lower Bounds for Comparator Circuits from Shrinkage** 2022
 Bruno P. Cavalar, Zhenjian Lu
 Proc. 13th Innovations in Theoretical Computer Science Conference (**ITCS**), LIPIcs, Vol. 215, 34:1–34:21
Algorithmica, 85(7):2131–2155, 2023
 Available at <https://arxiv.org/abs/2111.14974>
Brief description: Obtains superlinear average-case lower bounds for the strongest circuit classes ever studied, and derives the first algorithms analysing comparator circuits, such as satisfiability algorithms.
4. **Directed graphs with lower orientation Ramsey thresholds** 2021
 Gabriel Ferreira Barros, Bruno P. Cavalar, Yoshiharu Kohayakawa,

Guilherme Oliveira Mota, Tássio Naia

Extended Abstracts **EuroComb**, Trends in Mathematics, Vol. 14, 799–804

RAIRO-Oper. Res. 58 (2024) 3607–3619

Available at <https://arxiv.org/abs/2211.07033>

Brief description: Constructs graphs for which the probability threshold of their directed Ramsey property is lower than the generic upper bound. Contains part of my undergraduate thesis.

3. **Orientation Ramsey thresholds for cycles and cliques** 2021

Gabriel Ferreira Barros, Bruno P. Cavalar, Yoshiharu Kohayakawa, Tássio Naia

SIAM Journal on Discrete Mathematics (**SIDMA**), 35(4):2844–2857, 2021

Available at <https://arxiv.org/abs/2012.08632>

Brief description: Initiates the problem of determining the threshold function for the directed Ramsey property in random graphs. Determines the corresponding threshold for cycles and cliques.

2. **Monotone circuit lower bounds from robust sunflowers** 2020

Bruno P. Cavalar, Mrinal Kumar, Benjamin Rossman

Proc. 14th Latin American Theoretical Informatics Symposium (**LATIN**),

LNCS Vol. 12118, 311–322

Winner of the *Alejandro López-Ortiz Best Paper Award* at LATIN

Algorithmica, 84(12):3655–3685, 2022

Available at <https://arxiv.org/abs/2012.03883>

Brief description: Obtains the strongest monotone circuit lower bound to-date, improving a 30-year old record, and a tight monotone circuit lower bound for large cliques.

1. **Anti-Ramsey threshold of cycles** 2019

Gabriel Ferreira Barros, Bruno P. Cavalar, Guilherme Oliveira Mota, Olaf Parczyk

Proc. 10th Latin American Algorithms, Graphs and Optimization Symposium (**LAGOS**) 2019,

ENTCS Vol. 346, 89–98

Discrete Applied Mathematics (**DAM**), 323:228–235, 2022

Available at <https://arxiv.org/abs/2006.02079>

Brief description: Settles the problem of determining the threshold function for the anti-Ramsey property of cycles in random graphs, whereas previous works only addressed large cycles.

ACADEMIC VISITS

Charles University July 2025

Host: Michal Koucký

École Polytechnique Fédérale de Lausanne (EPFL) June 2025

Host: Mika Göös

Universitat Politècnica de Catalunya (UPC) May 2025

Host: Tássio Naia

Lund University and University of Copenhagen October 2023

Visiting Graduate Student

Host: Susanna Rezende

École Polytechnique Fédérale de Lausanne (EPFL) May 2023 - June 2023

Visiting Graduate Student

Host: Mika Göös

Simons Institute for the Theory of Computing (UC Berkeley) Jan 2023 - March 2023

Visiting Graduate Student

Program: **Meta-Complexity**

TEACHING ACTIVITIES

University of Warwick

- *Discrete Mathematics and its Applications 1* 2022
Marking and teaching of seminars (~ 10 students).
1st year course for Discrete Mathematics undergraduates.
- *Quantum Computing* 2021, 2022
Marking and teaching of seminars (~ 40 students).
Undergraduate and graduate students of Computer Science.
- *Computational Learning Theory* 2021
Marking and teaching of seminars (~ 20 students).
Undergraduate and graduate students of Computer Science.
- *Algorithms* 2020
Teaching of seminars (~ 40 students).
2nd year course for Computer Science undergraduates.

University of São Paulo

- *Introduction to Graph Theory* 2020
Marking and teaching of seminars (~ 20 students).
Undergraduate/graduate course.
- *Foundations of Data Science* 2019
Marking and teaching of seminars (~ 20 students).
Undergraduate/graduate course.
- *Combinatorial Optimization* 2018
Marking and teaching of seminars (~ 20 students).
Undergraduate course.
- *Languages, Automata and Computability* 2018
Marking and teaching of seminars (~ 80 students).
Graduate course.
- *Introduction to Computer Science* 2015
Marking and teaching of seminars (~ 40 students).
1st year undergraduate course.
- *Mathematical Foundations for Computer Science* 2015
Marking and teaching of seminars (~ 60 students).
1st year undergraduate course.

SELECTED TALKS AND SEMINARS

Boolean Circuit Complexity and Two-Dimensional Cover Problems

- Seminar on Theory of Computing (Seminář z teoretické informatiky), Charles University* 2025
- LIMDA Seminar (Universitat Politècnica de Catalunya, UPC)* 2025

A Meta-Complexity Characterization of Quantum Cryptography

- EPFL Theory Coffee Seminar* 2025

<i>EUROCRYPT (Madrid, Spain)</i>	2025
<i>Quantinuum (London Office)</i>	2025
<i>Complexity Network UK (Imperial College London)</i>	2024

Constant-depth Circuits vs. Monotone Circuits

<i>MIAO Seminar (University of Copenhagen)</i>	2023
<i>EPFL Theory Coffee Seminar (EPFL)</i>	2023
<i>Computational Complexity Conference (CCC)</i>	2023
<i>39th British Colloquium for Theoretical Computer Science (BCTCS)</i>	2023
<i>Simons Institute for the Theory of Computing</i>	2023
<i>Complexity Network UK (Imperial College London)</i>	2022

Algorithms and Lower Bounds for Comparator Circuits from Shrinkage

<i>13th Innovations in Theoretical Computer Science (ITCS)</i>	2022
<i>Complexity Network UK</i>	2022

Monotone circuit lower bounds from robust sunflowers

<i>37th British Colloquium for Theoretical Computer Science (BCTCS)</i>	2021
<i>14th Latin American Theoretical Informatics Symposium (LATIN)</i>	2021

LEADERSHIP AND SCIENTIFIC SERVICE

Organisation of events:

- *Warwick-Imperial-Oxford Complexity Network*
Online and Local Events. Running since December 2021
- Complexity Lunches at Warwick.

Journal reviewing: Journal of Graph Theory, Theory of Computing, Random Structures and Algorithms, ACM Transactions on Computation Theory

Conference reviewing: Computational Complexity Conference (CCC), Innovations in Theoretical Computer Science (ITCS), Symposium on Theory of Computing (STOC), IEEE Symposium on Foundations of Computer Science (FOCS)