

Bogdan Alecu

PERSONAL DETAILS

Name: Bogdan Alecu
E-mail: B.Alecu@warwick.ac.uk
Webpage: <https://warwick.ac.uk/fac/sci/math/people/staff/alecu>
Nationality: Romanian
Date of birth: 09/12/1993

EDUCATION

University of Warwick Ph.D. in Mathematics, Advisor: Prof. Vadim Lozin – Thesis: “A parametric approach to hereditary classes”	Coventry 2017–Current
University of Warwick Master of Mathematics with Intercalated Year, 1st class (Hons) – Thesis: “Special values of Rankin-Selberg convolution L -functions” Advisor: Prof. David Loeffler	Coventry 2011–2016
Friedrich-Wilhelms-Universität Bonn Erasmus year	Bonn 2013–2014
Lycée Français Anna de Noailles Baccalauréat S (18.42/20 average, with 20/20 in Mathematics)	Bucharest 2008–2011

PUBLICATIONS AND PREPRINTS

- [1] B. Alecu, A. Atminas, and V. Lozin, “Graph functionality”, *J. Combin. Theory B*, vol. 147, pp. 139–158, 2021.
- [2] B. Alecu, A. Atminas, V. Lozin, and V. Zamaraev, “Graph classes with linear Ramsey numbers”, *Discrete Math.*, vol. 344, no. 4, 2021, Article 112307. 24 pages.
- [3] B. Alecu, V. Lozin, D. de Werra, and V. Zamaraev, “Letter graphs and geometric grid classes of permutations: Characterization and recognition”, *Discrete Appl. Math.*, vol. 283, pp. 482–494, 2020.
- [4] B. Alecu, M. Kanté, and V. Zamaraev, “Between clique-width and linear clique-width of bipartite graphs”, *Discrete Math.*, vol. 343, no. 8, 2020, Article 111926. 14 pages.
- [5] B. Alecu, V. Lozin, and D. de Werra, “The micro-world of cographs”, *Discrete Appl. Math.*, Submitted, Extended abstract available at https://doi.org/10.1007/978-3-030-48966-3_3. 21 pages.
- [6] B. Alecu, V. Lozin, and D. Malyshev, “Critical properties of bipartite permutation graphs”, *European J. Combin.*, Submitted, Preprint available at <https://arxiv.org/abs/2010.14467>. 27 pages.
- [7] B. Alecu, A. Atminas, V. Lozin, and D. Malyshev, “Combinatorics and algorithms for quasi-chain graphs”, 2021, Upcoming preprint.
- [8] B. Alecu, R. Ferguson, M. Kanté, V. Lozin, V. Vatter, and V. Zamaraev, “Letter graphs and geometric grid classes of permutations”, 2021, Upcoming preprint.

SUMMARY OF RESEARCH

The main theme in my research so far has been characterising various properties via minimal classes not satisfying those properties. Indeed, if one looks from far enough away, [4], [5], [6] and to some degree [7] (which deals with $2P_3$ -free bipartite graphs) can all be described as follows: we restrict ourselves to a fixed hereditary class of graphs – our “universe”. We look at the poset of hereditary subclasses of our universe ordered by inclusion, and choose a downwards-closed subset of that poset. This subset is usually specified via a property satisfied by all the classes it contains. Examples of such properties include boundedness of a certain parameter, well-quasi-orderability under induced subgraphs, existence of a universal construction of a certain size, and polynomial-time solvability of a certain problem within the class. We then proceed to characterise those subsets via “minimal obstacles”. Explicitly, under certain circumstances, it is possible to give a list of classes such that a hereditary subclass of our universe belongs to the chosen subset (that is, possesses the relevant property) if and only if it does not contain any of the classes on the list. This can also be seen as a Ramsey-type approach. Indeed, Ramsey’s classical theorem on the ubiquity of homogeneous sets can be stated as follows: within the universe of all graphs, the number of vertices $\nu(G)$ for graphs G within a class \mathcal{X} is bounded if and only if \mathcal{X} does not contain the class \mathcal{K} of all cliques, or the class $\overline{\mathcal{K}}$ of their complements.

There are two notable deviations from this theme. The first concerns [1], where we consider the notion of functional vertices, introduced earlier for enumerative purposes. We then develop it into a full fledged parameter with the potential to give us insight into efficient graph representations of factorial classes. More concretely, functionality is analogous to degeneracy, where instead of just looking for vertices of small degree, we look for those whose adjacency can be determined by looking at few other vertices (such as twin vertices, or vertices whose neighbourhoods have small symmetric difference).

The second deviation concerns [3] and [8]; while technically speaking those papers could fit within the same theme (they are the beginning of an effort to characterise the so-called lettericity via minimal classes where it is unbounded), this direction of research is interesting enough in its own right to deserve a separate mention. Indeed, the study of lettericity exhibits an intriguing connection to the study of geometric griddability, from the world of permutations. A closer look then reveals a structural hierarchy of classes which arises across both graphs and permutations. The hierarchy, which is yet to be completely understood, concerns the ability to partition graphs into a bounded number of homogeneous bags with bipartite chain graphs between them, and increasingly stronger conditions on how those chain graphs connect to each other.

TEACHING

- **Teaching Assistant** at the University of Warwick March 2019 and 2020
Graded student talks for Algorithmic Graph Theory (CS254).
- **Supervisor** at the University of Warwick 2015–2019
Supervisions consist of grading the work of groups of five first or second-year undergraduate students, and meeting with them weekly to give them feedback and discuss the material.
- **Teaching Assistant** at the University of Warwick Autumn 2019
Ran Support Classes for Discrete Mathematics and its Applications 1 (CS136).
- **One-to-one support** at the University of Warwick Autumn 2018
Weekly one-to-one meetings with students in difficulty.
- **Teaching Assistant** at the University of Warwick Autumn 2017
Ran support classes for Graph Theory (MA4J3).

TALKS

- Karlsruhe Institute of Technology Discrete Mathematics Seminar April 2021
“Minimal classes of unbounded lettericity” Online

International Workshop on Combinatorial Algorithms “The micro-world of cographs”	June 2020 Online
Warwick Mathematics Postgraduate Seminar “Geometric griddability of permutation classes”	November 2019 Coventry
British Combinatorial Conference “Graph functionality”	August 2019 Birmingham
45th International Workshop on Graph-Theoretic Concepts in Computer Science “Graph functionality”	June 2019 Vall de Núria

LANGUAGES

- **Romanian:** native
- **English:** fluent
- **French:** fluent
- **German:** advanced
- **Italian:** basic

PROGRAMMING

Basic knowledge in:

- **Java**
- **C**
- **Sage**
- **MAGMA**

SCHOLARSHIPS AND AWARDS

Engineering and Physical Sciences Research Council Doctoral Award Funding to undertake a PhD in Mathematics at the University of Warwick	2017–2021
Undergraduate Research Scholarship Scheme Awarded £1000 for a summer research project with Dr Dmitriy Rumynin	July 2015
Erasmus grant Funding to undertake a year of study abroad	2013–2014

RESEARCH INTERESTS

Most of my interests lie in the area of combinatorics. They include graph theory (structural, algebraic, algorithmic and extremal), permutation patterns, and various enumerative topics. I am also interested in the interplay between combinatorics and other areas of mathematics, notably topology, group theory and number theory.

HOBBIES AND PERSONAL INTERESTS

My hobbies include playing the piano, indoors bouldering (pre-pandemic), as well as playing strategy and social deduction-based games with other people. I also enjoy browsing through textbooks from various areas of mathematics in my free time.