ALBERT GARRETA

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homepage kaggle profile google scholar profile github profile

EDUCATION

Polytechnic University of Catalonia, Barcelona (Spain) 2007 - 2012
Licenciature in Mathematics
Roughly equivalent to what currently is a 4-year college degree and a 1-year master's degree

Stevens Institute of Technology, New Jersey (USA) 2012 - 2016
PhD in Mathematics.
(Excellence in graduate research award)

ACADEMIC APPOINTMENTS

Postdoctoral researcher, *BCAM Basque Center of Applied Mathematics*, Spain. 2021 - today

Postdoctoral researcher, *University of the Basque Country*, Spain. 2016 - 2021

OVERVIEW

I am a mathematician and computer scientist. My career started by doing **academic research on algorithmic problems** in algebra such as solvability of equations in different algebraic structures (rings, monoids, and groups).

In 2018 I became interested and started working on different more applied areas such as **machine learning** (particularly reinforcement learning), and later in **blockchain technology**.

SHORT OVERVIEW OF EXPERIENCE AND SKILLS

Research Extensive experience in academic research on algorithmic algebra. My most important publications are the following:

- *Diophantine problems in solvable groups*, (with Alexei Miasnikov and Denis Ovchinnikov), Bulletin of Mathematical Sciences, v. 10 (1) (2020), pp. 1-21.

  The journal is ranked 17 out of 325 in the category of Mathematics (JCR criterion)

- *Results of the Photometric LSST Astronomical Time-series Classification Challenge (PLAsTiCC)*, (with Renee Hlozek et al.), to appear in *The Astrophysical Journal Supplement*, 2022. (Preprint available upon request)

  This paper describes the solutions of the top 10 teams out of 1094 to the following Kaggle competition: link. My solution was ranked 9th.

  The journal is ranked 7 out of 68 in the category of Astronomy and Astrophysics (JCR criterion).

Machine learning Experience in machine learning, especially in deep and reinforcement learning. My main projects and achievements in this area are:

- *9th out of 1024 place on the Photometric LSST Astronomical Time-series Classification Challenge (PLAsTiCC)*, link. This competition asked its participants to classify the type of stars depending on the patterns their light emits.

- *Extracting interpretable features for bone age estimation.*

  Ongoing project. Estimating the age of bones in a radiograph is relevant for different diagnostics in medicine. Current approches rely either on a lengthy manual process, or on uninterpretable machine learning approaches. This project aims to leverage deep learning techniques in order to extract interpretable features for quickly assessing bone age.

- *Solving word equations using deep Monte Carlo Tree Search.* Ongoing project on solving a certain NP-hard problem by means of deep reinforcement learning. See here

Blockchain technologies

- Good understanding of blockchain technology and the ecosystems built around it.
- Advanced understanding of the cryptographic protocols underlying blockchain technologies.

  I have been teaching cryptography for 2 years as part of the Master's degree *Cryptoeconomy and blockchain technology* at the University of the Basque Country (UPV/EHU).

  I have also supervised two theses on the topics of "Secure Multi Party Computation on the Blockchain", and "Homomorphic Encryption on the Blockchain" (see below).

- Experience developing on EVM-compatible blockchains. See the following (non-competitive) arbitrage bot: link
- Beginner knowledge in developing on some Rust-based blockchains such as Solana.

Coding knowledge

- **Python**: advanced. This includes machine learning frameworks/libraries such as Pytorch, tensorflow, sklearn, etc.
- **Solidity**: intermediate (currently learning).
- **Rust**: basic (currently learning).
- **C++**: basic.
- **Latex**: proficient.

IN-DEPTH CV

Publications

· *Results of the Photometric LSST Astronomical Time-series Classification Challenge (PLAsTiCC)*, (with Renee Hlozek et al.), to appear in The Astrophysical Journal Supplement, 2022. (Preprint available upon request)

· *Simple groups with infinite verbal width and the same positive theory as free groups*, with Montserrat Casals-Ruiz, Ilya Kazachkov, and Javier de la Nuez, 12 pages, to appear in Israel Journal of Mathematics, https://arxiv.org/abs/1911.02117v1.

· *On equations and first-order theory of one-relator monoids*, (with Robert D. Gray), Information & Computation, published online, 2020, 44 pages, doi: https://doi.org/10.1016/j.ic.2021.104745

· *Metabelian groups: full-rank presentations, randomness and Diophantine problems*, (with Leire Legarreta, Alexei Miasnikov, and Denis Ovchinnikov), Journal of group theory, 2020, doi: https://doi.org/10.1515/jgth-2020-0091

· *On the positive theory of groups acting on trees*, (with Montserrat Casals-Ruiz, and Javier de la Nuez), International Mathematic Research Notices (IMRN), Volume 2021, Issue 3, February 2021, Pages 1837–1918, doi:10.1093/imrn/rnaa164.

- *Full rank presentations and nilpotent groups: structure, Diophantine problem, and genericity*, (with Alexei Miasnikov and Denis Ovchinnikov), Journal of Algebra, v. 556 (2020), pp. 1-34
- *Diophantine problems in solvable groups*, (with Alexei Miasnikov and Denis Ovchinnikov), Bulletin of Mathematical Sciences, v. 10 (1) (2020), pp. 1-21
- *Engel elements in some fractal groups*, (with Gustavo Fernández-Alcober and Marialaura Noce), Monatshefte fur Mathematik, (2018), pp. 1-10
- *Random nilpotent groups, polycyclic presentations, and Diophantine problems*, (with Alexei Miasnikov and Denis Ovchinnikov), Groups Complexity Cryptology, v. 9 (2) (2017), pp. 99-115

Preprints and submitted articles

- *A decentralized private data marketplace using blockchain and secure multi-party computation*, with Julen Bernabé and Oscar Lage (preprint available upon request).
- *Solving word equations with Monte Carlo Tree Search and black-box solvers*, link
- *Diophantine problems in rings and algebras: undecidability and reductions to rings of algebraic integers*, with Alexei Miasnikov and Denis Ovchinnikov, https://arxiv.org/abs/1805.02573
- *Group equations with abelian predicates*, with laura Ciobanu, link

Articles in preparation

- *Regressing bone age from radiographs via interpretable features*, with Jordi Fortuny, Oscar Gasulla, Ferran Mazaira, and Miguel Teixidó
- *Studying the Diophantine problem in finitely generated rings via bilinear maps*, with Alexei Miasnikov and Denis Ovchinnikov.
- *Equations in polycyclic groups*, with Alexei Miasnikov and Denis Ovchinnikov.

Machine learning competitions

- Kaggle profile: https://www.kaggle.com/agarreta
- PLAsTiCC Astronomical Classification (Kaggle), Top 1% position (9th out of 1094) 2018
- Abstraction and Reasoning Challenge (Kaggle), Top 8% position (66th out of 914) 2020
- Costa Rican Household Poverty Level Prediction (Kaggle) Top 18% position (106th out of 619) 2018

Theses supervised

- *SMPC BLOCKCHAIN: Creating Private Data Marketplaces* 2021
  Student: Julen Bernabé. Coadvisor: Oscar Lage.
  Thesis for the master's degree *Blockchain technology and cryptoeconomy.* University of the Basque Country (Spain).
  Available here.
- *Blockchain Homomorphic Encryption.* 2021
  Student: Leire Etxebarria. Coadvisor: Oscar Lage.
  Thesis for the master's degree *Blockchain technology and cryptoeconomy.* University of the Basque Country (Spain).
  Available here.

Teaching experience

- *Foundations of Cryptography* and *Modern Cryptography* 2020 - 2022
  Courses for the master's degree *Blockchain technology and cryptoeconomy.* University of the Basque Country (Spain).
- *An introduction to deep learning* 2021
  A 5 hour PhD course taught at the University of the Basque Country (Spain).

· *Information Systems* 2019
An introduction to data science and programming in python). ESADE (Barcelona, Spain).
· *Differential Equations* 2012-2016
Around 500 hours of problem sessions taught during my PhD years at Stevens Institute of Technology (New Jersey, USA). I was rated with scores averaging 3.8 out of 4 in student evaluations.

Invited talks at conferences

· *Geometric and Asymptotic Group Theory with Applications (GAGTA)*, Edinburgh, (UK) 2021
· *Groups and Topological Groups*, Cetara (Italy) 2019
· *Dagstuhl Seminar 'Algorithmic Problems in Group Theory'*, Schloss Dagstuhl (Germany) 2019
· *Congreso Bienal de la Real Sociedad Matemática Española*, Santander (Spain) 2019
· *Fall Meeting of the American Mathematical Society*, Boston (USA) 2018
· *Joint meeting of the Edinburgh Math. Society and Soc. Catalana de Mat.*, Edinburgh (UK) 2017
· *Eleventh Barcelona Weekend in Group Theory*, Universidad Politécnica de Catalunya (Barcelona) 2016
· *Equations and Formal Languages in Algebra*, Les Diablerets (Switzerland) 2016

Contributed talks at conferences

· *Russian Workshop on Complexity and Model Theory*, Moscow (Russia) 2019
· *Advances in Group Theory and Applications*, University of Lecce (Italy) 2017
· *Young Geometric and Asymptotic Group Theory with Applications (yGAGTA)*, (Bilbao) 2017
· *Young Researchers Algebra Conference*, University of Naples "Federico II" (Italy) 2017
· *Fall Meeting of the American Mathematical Society*, Bowdoin College, Maine (USA) 2016
· *Geometric and Asymptotic Group Theory with Applications (GAGTA)*, C. College of NY (USA) 2015

Academic visits

· Oberwolfach Research Institute for Mathematics (Germany) 2021
· Heriot-Watt University (Edinburgh, UK) 2019
· University of East Anglia (Norwich, UK) 2019
· Stevens Institute of Technology (New Jersey) 2019
· Stevens Institute of Technology (New Jersey) 2018
· University of Salerno (Italy) 2017

Organization of conferences and seminars

· 2016 - 2021 — *Bilbao algebra seminar* Coorganizer with Dr. Federico Berlai and Dr. Oihana Garaialde, University of the Basque Country (Bilbao), https://sites.google.com/site/bilbaoalgebraseminar/
· 2020 — *GTA Gran Bilbao 2*, Member of the organizing comittee, University of the Basque Country (Bilbao), https://sites.google.com/view/gta-gran-bilbao-ii/menu
· 2019 — *Young Geometric Group Theory 8 (YGGT8)*, Member of the organizing committee, University of the Basque Country (Bilbao), https://sites.google.com/site/yggt2019bilbao/home
· 2019 — *GTA Gran Bilbao*, Member of the organizing comittee, University of the Basque Country (Bilbao), https://sites.google.com/view/gtagranbilbao
· 2017 — *Geometric and Asymptotic Group Theory with Applications (GAGTA)*, Member of the organizing committee, University of the Basque Country (Bilbao), https://sites.google.com/site/gagta2017/home