

# ALBERT GARRETA

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## EDUCATION

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<b>Polytechnic University of Catalonia, Barcelona (Spain)</b> “Licenciatura en Matemáticas” (Licenciature in Mathematics) Roughly equivalent to what currently is a 4-year degree and a 1-year master’s degree	2007 - 2012
<b>Stevens Institute of Technology, New Jersey (USA)</b> PhD in Mathematics. (Excellence in graduate research award)	2012 - 2016

## ACADEMIC APPOINTMENTS

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Postdoctoral researcher, <i>BCAM Basque Center of Applied Mathematics</i> , Spain.	2021 - today
Postdoctoral researcher, <i>University of the Basque Country</i> , Spain.	2016 - 2021

## OVERVIEW

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I am a mathematician and computer scientist doing **academic research on algorithmic problems** such as solvability of equations in different algebraic structures (rings, monoids, and groups). Recently I became interested and started working on different more applied areas such as **machine learning** (particularly reinforcement learning) and **blockchain technology**.

## SHORT OVERVIEW OF EXPERIENCE AND SKILLS

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**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).

- *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.

The journal is ranked 61 out of 330 in the category of Mathematics (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 approaches 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.
- Experience developing on EVM-compatible blockchains (this includes Ethereum, Binance Smart Chain, Fantom network, Avalanche network, etc). See the following (non-competitive) arbitrage bot: [link](#)
- Beginner knowledge on developing on the Solana network and other Rust-based blockchains such as Terra-Luna.

## Coding knowledge

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

## IN-DEPTH CV

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### 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 für 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

### 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

### 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.

### 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 committee, 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 committee, 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>