José Abel Castellanos Joo

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Research Interests

Formal Methods

Verification

Archimedean Quadratic Modules

Gröebner basis methods

Quantifier-free interpolation algorithms for decidable logics

Non-classical logics

Education

University of New Mexico — Albuquerque, New Mexico
Ph.D. in Computer Science, Advisor: Prof. Deepak Kapur — 2020–2026

- Thesis: Computing Certificates of Members in Archimedean Quadratic Modules in $\mathbb{A}[X]$ and Certifying the Emptiness in Inconsistent Monogenic Archimedean Quadratic Modules in $\mathbb{A}[\overline{X}]$

University of New Mexico — Albuquerque, New Mexico
M.S. in Computer Science, Advisor: Prof. Deepak Kapur — 2016–2020

- Thesis: Implementation of Uniform Interpolation Algorithms

Universidad de las Americas Puebla — Cholula, Puebla
B.S. in Electronics Engineering, Advisor: Prof Maurio Javier Osorio Galindo — 2010–2015

- Thesis: Revisiting C_1

Research Experience

University of New Mexico — Albuquerque, New Mexico
Research Assistant; Advisor: Prof. Deepak Kapur — Fall 2020 - Spring 2026

- Research on Formal Methods and Verification
- Assisted with research on symbolic computation and its application to program analysis.
- Research on computational real algebraic geometry with focus on computing certificates for elements in Archimedean Quadratic Modules.

Microsoft Research — Redmond, Washington
Research Intern; Mentor: Principal RSDE Mark Marron — Summer 2019

- Verification in Bosque
- Developed a prototype of the verification engine for the Bosque programming language in F^*. Bosque is a language that does not implement loops but offers to programmers transformers and functional programming constructions (limited fold operation) to do their programming tasks.

Universidad de las Americas Puebla — Cholula, Puebla
Research Student; Advisor: Prof. Mauricio J. Osorio Galindo — 2015-2017

- Research on Paraconsistent Logics
- Collaborated with a group of researchers on Paraconsistent Logics. My activities included working on some theorems and generate models using the answer set solver Clasp.

Universidad de las Americas Puebla — Cholula, Puebla
Intern; Advisor: Prof. Ofelia Cervantes Gutierrez — Summer 2015

- Innova4D

– Analyzed and implemented graph algorithms to compute Freeman centralities for the development of a recommendation system.

Publications

[1] **J. Castellanos Joo** and D. Kapur, *Computing certificates in archimedean univariate saturated quadratic modules*, 2026. arXiv: 2605.18980 [cs.SC].

[2] W. Shang, **J. Castellanos Joo**, C. Mou, and D. Kapur, *Computing certificates of strictly positive polynomials in archimedean quadratic modules*, 2025. arXiv: 2503.11119 [math.AC].

[3] **J. Castellanos Joo**, S. Ghilardi, A. Gianola, and D. Kapur, "AXDInterpolator: A tool for computing interpolants for arrays with maxdiff", in *19th International Workshop on Satisfiability Modulo Theories co-located with 33rd International Conference on Computer Aided Verification (CAV 2021)*, CEUR-WS.org, vol. 2908, 2021, pp. 40–52.

[4] M. Osorio and **J. Castellanos Joo**, "Equivalence among *RC*-type paraconsistent logics", *Logic Journal of IGPL*, jzw065, Jan. 2017, ISSN: 1368-9894. DOI: 10.1093/jigpal/jzw065

[5] M. Osorio, J. L. Carballido, C. Zepeda, and **J. Castellanos Joo**, "Weakening and extending $\mathbb{Z}$", *Logica Universalis*, vol. 9, no. 3, pp. 383–409, Aug. 2015, ISSN: 1661-8300. DOI: 10.1007/s11787-015-0128-6

[6] M. Osorio and **J. Castellanos Joo**, "A single proof of classical behaviour in da Costa's C_n systems", *Electronic Notes in Theoretical Computer Science*, vol. 315, pp. 3–16, Sep. 2015, ISSN: 1571-0661. DOI: 10.1016/j.entcs.2015.06.002

Talks

Computing Certificates of Members in Archimedean Quadratic Modules in $\mathbb{A}[X]$ and Certifying the Emptiness in Inconsistent Monogenic Archimedean Quadratic Modules in $\mathbb{A}[\overline{X}]$ September, 2026
Thesis Defense, University of New Mexico

Computing certificates in compact quadratic modules in $\mathbb{R}[x]$ September, 2023
Proposal Thesis Defense, University of New Mexico

AXDInterpolator: A Tool for Computing Interpolants for Arrays with MaxDiff July, 2021
19th International Workshop on Satisfiability Modulo Theories.

Implementation of Uniform Interpolation Algorithms October, 2020
Master Thesis Defense, University of New Mexico

A new interpolation algorithm for the theory of Equality with Uninterpreted Functions September, 2020
Computer Science Colloquium Series, University of New Mexico

A Single Proof of Classical Behaviour in da Costa's C_n systems November, 2014
Ninth Latin American Workshop on Logic/Languages, Algorithms and New Methods of Reasoning LANMR

Teaching Assistant Experience

Grader at University of New Mexico Fall 2023
CS 561 - Algorithms and Data Structures with Prof. Jared Saia

Teaching Assistant at University of New Mexico Fall 2023
CS 105L - Introduction to Computer Programming with Prof. Soraya Abad-Mota

Teaching Assistant at University of New Mexico Spring 2023
CS 357 - Declarative Programming with Prof. Lance Williams

Head Teaching Assistant at University of New Mexico Fall 2022
CS 241 - Data Organization using C with Prof. Soraya Abad-Mota

Teaching Assistant at University of New Mexico Spring 2022
CS 429/529 - Machine Learning with Prof. Trilce Estrada

Teaching Assistant at University of New Mexico Fall 2019
CS 530 - Geometric and Probabilistic Methods in Computer Science with Prof. Lance Williams

Teaching Assistant at University of New Mexico Spring 2019
CS 500 - Theory of Computation with Prof. Deepak Kapur

Teaching Assistant at University of New Mexico Fall 2018
CS 561 - Algorithms and Data Structures with Prof. Jared Saia

Mentorship

Brandon Hidalgo (Bachelor) Computer Science department, University of New Mexico Fall 2024 - Spring 2025
Interface construction for a singular package that implements the algorithm in https://dl.acm.org/doi/10.1145/1993886.1993918. I provided support about documentation of Singular and the student built a Jupyter notebook interface in Java to handle input/output for the system.

Abigail Pribisova (Bachelor) Computer Science department, University of New Mexico Fall 2022 - Spring 2023
Implementation of an algorithm for the theory of contiguous arrays equipped with a max diff operator. The deliverables of this project were a poster presented by the student Abigail at the 18th Annual Computer Science Student Conference 2023 at UNM and a working prototype of the interpolation algorithm.

Skills

- Programming languages
  - Imperative: C/C++, Java, Go, Julia, Rust
  - Scripting: Python, Bash, Makefile
  - Functional: Haskell, Ocaml, Scala
  - Verification: Z3, Mathsat, SMTInterpol, F^*, Prover9, Mace4, Lean
  - Symbolic/Algebraic: Mathematica, Maple, Macaulay2, Singular
  - Document typesetting: LaTeX, Pandoc, Madoko, Markdown, Org
  - Web design: HTML, CSS, Javascript, Typescript, Jekyll

Languages

- **English:** Fluent
- **Spanish:** Native

Software Projects

SatQMCert 2026

A maple package to compute certificates of members in Archimedean Saturated Quadratic Modules. The algorithm is fully symbolic in the sense that it does not depend on numerical algorithm to obtain certificates.

BasicLemma 2026

A maple package to compute Bezout-like polynomials for coprime and non-negative polynomials over compact semialgebraic sets. The package BasicLemma implements the algorithm in Lemma 2.1 from Positivity, sums of squares and the multi-dimensional moment problem II.

StrictlyPositiveCert 2026

A maple package to compute certificates of strictly positive polynomial over Archimedean Quadratic Modules. The package StrictlyPositiveCert implements Algorithm 4 in [2], which computes certificates of strictly positive polynomials over basic semialgebraic sets associated a set of generators for which the quadratic module generated by is Archimedean in the multivariate case.

haskell-grader 2023

Haskell application to automatically evaluate student assignments for CS 357: Declarative Programming at UNM.

AXDInterpolator 2021

This project implements an interpolation algorithm proposed in FoSSaCS 2021 using the Z3 API. The project allows the user to choose Z3, Mathsat, or SMTInterpol as interpolation engines. The tool returns a formula in SMTLIB2 format, which allows compatibility with model checkers and invariant generators using such a format.

EUFInterpolator 2020

Master thesis work implementing new interpolation algorithms for the theory of equality and uninterpreted functions (EUF), octagonal formulas, and its combination.

Bosque Transpiler to F^* 2019

Prototypical implementation of a transpiler embedding a subset of the Bosque semantics into the Proof-oriented programming language F^*.

Workshops Attended

Satisfiability: Theory, Practice, and Beyond 2021
Beyond Satisfiability

Satisfiability: Theory, Practice, and Beyond 2021
Theoretical Foundations of SAT/SMT Solving

AMS Short Course 2019
Sum of Squares: Theory and Applications

Conference Refereeing

Thirteen Latin America Workshop on New Methods of Reasoning 2020
Reviewer

35th International Conference on Logic Programming 2019
Reviewer

11th Latin American Workshop on New Methods of Reasoning 2018
PC member

14th Annual Computer Science Student Conference 2018
Reviewer

17th Latin American Symposium on Mathematical Logic 2017
Reviewer

10th Latin American Workshop on Logic/Languages, Algorithms and New Methods of Reasoning 2016
Reviewer

8th Mexican Congress on Artificial Intelligence 2016
Reviewer

12th International Colloquium on Theoretical Aspects of Computing 2015
Reviewer

Scholarships and Awards

Travel Scholarship for OPLSS 2017
Travel scholarship to attend Oregon Programming Languages Summer School

AMIGO Scholarship 2016 - 2018
Scholarship for Graduate Studies at the University of New Mexico

ANFEI 2015
Best student of the Electronics Engineering 2015 class

Magna Cum Laude (BSc) 2015
Universidad de las Americas Puebla.

Roberto Rocca Scholarship 2014
Scholarship for Undergraduate Studies at Universidad de las Americas Puebla

Society Memberships

Women in Computing association at the University of New Mexico.

Service

CS Advisory Board — University of New Mexico
Graduate Student Representative — 2021 - 2023

- Participated in discussions about the state of the department and proposals of new initiatives regarding graduate and undergraduate matters, as well as research and the position of the department within the university.

CS Graduate Student Association — University of New Mexico
Treasurer — 2017 - 2018

- Developed website for the Computer Science Student Conference 2018 at UNM and keep track of Internal Requisitions.

Clique Student Organization — Universidad de las Américas Puebla
Founder Member — 2014 - 2015

- This organization provided students a proper environment to develop programming skills for programming competitions like the ACM ICPC.