
LUCAS CARVALHO CORDEIRO

lucas.cordeiro@manchester.ac.uk

Kilburn Building, Oxford Rd, Manchester M13 9PL

+44 · 07858412433

CAREER SUMMARY

- **Core competency** in algorithms, software engineering, formal methods, automated program verification and synthesis, software testing, security, and embedded & cyber-physical systems.
- 146 **reviewed publications**, including 37 journal papers, 109 workshop/conference contributions, and 1 book chapter; h-index 24, **Best Paper Award** at SBC SBESC'15 and ACM SAC'08, **Distinguished Paper Award** at ACM ICSE'11, and 32 awards from the international competitions on software verification (SV-COMP) and testing (Test-Comp) 2012-2022.
- **Director** of the ARM Centre of Excellence at the University of Manchester, UK.
- **Consultant Director** of the Digital Security Unit at the Artificial Intelligence and Digital Science Research Center / Technology Innovation Institute, UAE.
- **Leader** of the Systems and Software Security Research Group at the University of Manchester, UK.
- **Leader** of the Software Security and Automated Reasoning theme in the Advanced Computer Science MSc program at the University of Manchester, UK.
- **Developer** of BMCLua, CBMC, DepthK, DSValidator, DSSynth, DSVerifier, ESBMC, ESBMC-GPU, ESBMC^{QtOM}, JBMC, Map2Check, STB225, and XMPM.
- Active **international research collaborations** with the University of Oxford (UK), University of Southampton (UK), University of Stellenbosh (South Africa), Federal University of Minas Gerais (Brazil), Federal University of Viçosa (Brazil), and Federal University of Roraima (Brazil).
- Proven track record of securing **research funding** from government agencies such as the British Council, CAPES, CNPq, EPSRC, FAPEAM, Royal Society, UKRI, and industrial funding from Intel, Motorola, Nokia Institute of Technology, and Samsung (**career total over USD11,791,474**).
- **Supervised** 2 PhD theses, 28 MSc dissertations, 15 final year projects, 6 scientific initiations, and 10 internships.
- **Affiliated** with the Formal Methods Group at the University of Manchester (UK) and the Post-graduate Program in Electrical Engineering (PPGEE) and Informatics (PPGI) at the Federal University of Amazonas (Brazil).
- URL of **Google Scholar** (<https://scholar.google.com/citations?user=Lje1SFgAAAAJ&hl=en&oi=ao>) and **DBLP** (http://dblp.uni-trier.de/pers/hd/c/Cordeiro:Lucas_C) pages.

PROFESSIONAL EXPERIENCE

The University of Manchester

May 2018 - Present

Reader

Kilburn Building University of Manchester, Oxford Rd, Manchester M13 9PL

- Continue working on formal methods, automated verification, program synthesis, and security.
- Develop and deliver undergraduate and graduate modules on algorithms, formal methods, and security.
- Leader of the Software Security and Automated Reasoning theme in the Advanced Computer Science MSc program.
- Leader of the Systems and Software Security Research Group.

- Leader of the Trusted Digital Systems Cluster at the Centre for Digital Trust and Society (from May/2018 to September/2022).
- Director of the ARM Centre of Excellence.
- Leader of a research team with four Research Assistants, seven Ph.D. students, six M.Sc. students, and six B.Sc. students.
- Mentor of the New Academic Programme.
- Advisor of a Ph.D. cohort of approximately 40 students.
- Coordinator of public engagement to promote the Department of Computer Science in public events.
- Member of the EPSRC Peer Review Full College.

University of Oxford / Diffblue

July 2016 - April 2018

Researcher / Research Engineer

Wolfson Building, Parks Rd, Oxford OX13QD, UK

- Extended an existing abstract interpretation framework for simplifying and verifying (*goto*) programs.
- Developed tools to synthesize, verify, and validate digital control systems with uncertainties.
- Implemented features related to the CounterExample Guided Inductive Synthesis (CEGIS) framework.
- Extended the CProver framework to support exception handling and the Java standard libraries.
- Fixed issues in different components of the CProver framework (*e.g.*, coverage, slice).
- Assistance in the supervision of post-graduate students working on related projects.
- Participation in regular meetings with colleagues and industrial partners in Oxford.

Federal University of Amazonas

September 2009 - June 2016

Adjunct Professor

Gen. Rodrigo Octávio, 6200, Coroado I, 69080-900, Manaus, Brazil

- Continued work on ESBMC, which is an award-winning SMT-based context-bounded model checker for C programs.
- Continued work on program verification, developed approaches to verify C/C++ programs via mathematical induction, discrete-time systems (digital filters and controllers), and the Lua programming language.
- Developed and delivered undergraduate and graduate modules on algorithms, software verification, real-time systems, digital systems, and embedded systems.
- Course Leader of Electrical Engineering from 2011 to 2015, including the sub-areas of Electronics, Telecommunications, and Electric Power Systems.
- Leader of a research team with three Ph.D. students, two M.Sc. students, and two B.Sc. students.
- Secured competed research funding from Samsung, Nokia Institute of Technology, CNPq, FAPEAM, British Council, and Royal Society.

R&D Center for the Industrial Pole of Manaus (CT-PIM)

March 2007 - September 2008

Set-top Box Software Engineer

R. Salvador, 391, Adrianópolis, 69057-040, Manaus, Brazil

- Development of the Linux drivers for the ISDB-T (Brazilian market) tuner and DVB-T (European market) tuner and demodulator silicon chips.
- Port of an ATSC-T (US market) tuner driver to a digital TV platform (Set-top Box).
- Development and integration of the DVB-S2 tuner used in satellite applications into the Linux user space.
- Port of an IPTV middleware, development of software applications, and a Video on Demand portal for the Set-top Boxes of NXP.
- Conception and implementation of automated unit and functional tests for the Linux device drivers via unit test framework tools and shell scripts (test automation).
- Coach customers to develop/customize software applications in digital TV platforms.
- Involved in several activities related to IP Set-top Box development at NXP semiconductors from San Jose (USA) and Southampton (England).

BenQ-Siemens Eletroeletrônica S.A

January 2005 - March 2007

*Software Engineer**R. Jutai, 661 - Distrito Industrial, Manaus, 69075-130, Brazil*

- Requirements definition, project planning, and tracking focused on features of the linux Mobile Phone Manager (XMPM). The features under coordination included GPRS, help system, connectivity, software installation, phone settings, localization, and internationalization.
- Responsible for following-up progress and status of the features developed by different partners (deliverables, integration status, test status, defects, and change requests) and reporting status to the project leader.
- Configuration management planning, change management, version and release management, build management, and bug tracking process of the linux Mobile Phone Manager (XMPM) project for generations 75 and 85 of Siemens Mobile Phones.

Institut fuer Automatisierungs- und Softwaretechnik

September 2003 - March 2004

*Trainee**Pfaffenwaldring 47, 70550 Stuttgart, Germany*

- Microcontroller programming, development, and implementation of interface circuits for hardware transducers.
- Integration of a real-time operating system (uCOS-II) and a bluetooth based communication into the microcontroller M16C from Renesas.
- Design and modeling of electronic circuits with the Eagle tool.

CONSULTANCY**Technology Innovation Institute**

October 2022 - Present

*Consultant Director**Masdar City, Abu Dhabi, UAE*

- Serve as the Consultant Director of the Digital Security Unit.
- Act as an advisor in the Digital Security Unit research programs.
- Contribute to the building and refinement of the strategy and road map of the Digital Security Unit.
- Drive the Digital Security Unit towards meeting KPIs that contribute to the research centre's success by increasing the number of research papers, patents, key project deliverables with demonstrable output, and university collaborations.

EDUCATION**University of Southampton***May 2011*

Ph.D. in Computer Science.

Thesis: *SMT-Based Bounded Model Checking of Multi-threaded Software in Embedded Systems.*

Supervisor: Prof. Dr. Bernd Fischer.

Scholarship holder of ORSAS/ECS.

Federal University of Amazonas*October 2007*

M.Sc. in Informatics.

Dissertation: *An Agile HW/SW Development Methodology for Embedded Systems.*

Supervisor: Prof. Dr. Raimundo S. Barreto.

Federal University of Amazonas*December 2004*

B.Sc. in Electrical Engineering.

Project: *Developing Real-Time Applications with LEGO Mindstorms.*

Scholarship holder of CAPES/DAAD from 03/2003 to 03/2004, in order to attend classes of the MSc on Information Technology at the University of Stuttgart (Germany).

Overall GPA: 8.313

GRANTS

1. “*Bounded Model Checking for Verifying and Testing Ethereum Consensus Specifications*”, Ethereum Foundation, 2023-2024, USD 114,680 (**I am the Co-Investigator**).
2. “*Using Artificial Intelligence/Machine Learning to assess source code in Escrow*”, UKRI Impact Acceleration Account, 2023-2024, GBP 86,339 (or USD 104,702) (**I am the Principal Investigator**).
3. “*Soteria - Demonstrating the Security Capabilities of the Morello System in the ecommerce Vertical Industrial Segment*” over the call for “ISCF digital security by design: technology enabled business-led demonstrator”, 2021-2024, 2,647,375.00 GBP (or USD 3,603,355) in collaboration with Prof. Mikel Lujan, Dr. Konstantin Korovin, Dr. Giles Reger, Dr. Christos Kotselidis, Dr. Elvira Uyarra, Dr. Richard Allmendinger, and Dr. Pierre Olivier from the University of Manchester (UK) (**I am the Co-Investigator**).
4. “*ELEGANT: sEecure and seamLess EdGe-to-cloud ANalyTics*”, EU over the call for “Software Technologies”, 2021-2023, EU 586,500 (or USD 687,084) in collaboration with Dr. Christos Kotselidis from University of Manchester (UK) (**I am the Co-Investigator**).
5. “*EnnCore: End-to-End Conceptual Guarding of Neural Architectures*”, EPSRC over the call for “Security for all in an AI-enabled society”, 2021-2024, GBP 2,151,950 (or USD 2,660,817) in collaboration with Prof. Gavin Brown, Prof. Mikel Lujan, Dr. Mustafa Mustafa, Dr. Andre Freitas from University of Manchester (UK) and Dr. Xiaowei Huang from University of Liverpool (UK) (**I am the Principal Investigator**).
6. “*SCorCH: Secure Code for Capability Hardware*”, EPSRC over the call for “ISCF Digital Security by Design”, 2020-2023, GBP 1,300,000 (or USD 1,627,593) in collaboration with Dr. Konstantin Korovin, Dr. Mustafa Mustafa, Dr. Olivier Pierre, and Dr. Giles Reger from University of Manchester (UK) and Prof. Daniel Kroening from University of Oxford (UK) (**I am the Co-Investigator**).
7. “*Formal Verification of Firmware*”, Intel Corporation, 2021-2024, GBP 66,000.00 (or USD 89,292) (**I am the Principal Investigator**).
8. “*ARM Centre of Excellence at the University of Manchester*”, Arm Ltd. 2017-2021, GBP 250,000 (or USD 335,712) in collaboration with Prof. Gavin Brown, Prof. Mikel Lujan, Dr. David Jackson (**I am the Principal Investigator**).
9. “*Developing Critical Mass in Cybersecurity*”, UK Research and Innovation – Early Career Researchers, 2018-2020, GBP 65,108 (or USD 83,481) in collaboration with Dr. Giles Reger from University of Manchester (UK) (**I am the Principal Investigator**).
10. “*Counterexample-Guided Optimization Applied to the Daily Schedule of the Electrical Power Systems using Satisfiability Modulo Theories*”, National Centre for Scientific and Technological Development, 2018-2021, BRL60,000 (or USD15,114) in collaboration with Prof. Erlon Finardi from Federal University of Santa Catarina (Brazil) (**I am the Principal Investigator**).
11. “*Investigation and Development of Verification Algorithms of Embedded Software in Unmanned Aerial Vehicles using Machine Learning*”, Amazonas State Research Funding Agency, 2017–2018, BRL 87,400 (or USD 22,812) in collaboration with Prof. João Edgar Chaves Filho from Federal University of Amazonas (Brazil) (**I am the Co-Investigator**).
12. “*Support for Scientific Production of the Research Group on Software and Systems Verification*”, Amazonas State Research Funding Agency, 2017–2018, BRL16,992 (or USD 5,168) (**I am the Principal Investigator**).

-
13. “*DSVerifier: A Bounded Model Checking Tool to Verify Digital Systems with Uncertainties*”, EPSRC Impact Acceleration Account, 2016-2017, GBP 8,462 (or USD 11,141) in collaboration with Prof. Daniel Kroening from University of Oxford (UK) **(I am the Co-Investigator)**.
 14. “*Verification of C/C++ Programs Based on Multi-Core Processors*”, Nokia Institute of Technology, 2014-2016, BRL451,231 (or USD171,594) **(I am the Principal Investigator)**.
 15. “*Hardware and Software Verification Based on Mathematical Induction for Embedded Systems*”, Amazonas State Research Funding Agency, 2014-2016, BRL249,853 (or USD95,014) **(I am the Principal Investigator)**.
 16. “*SMT-based Bounded Model Checking of Multi-threaded Programs*”, British Council, 2014-2015, GBP3,000 (or USD4,554) **(I am the Principal Investigator)**.
 17. “*Continuous Verification of C++ Programs Using SMT-based Bounded Model Checking*”, Nokia Institute of Technology, 2011-13, BRL287,631 (or USD109,380) **(I am the Principal Investigator)**.
 18. “*SMT-Based Bounded Model Checking Timed LTL Properties for Embedded Software*”, Royal Society International Exchange Grant, 2011-13. GBP11,600 (or USD17,609) in collaboration with Prof. Bernd Fischer from University of Southampton (UK) **(I am the Co-Investigator)**.
 19. “*Verification of Temporal Properties in Embedded Software using Satisfiability Modulo Theories*”, National Centre for Scientific and Technological Development, 2013-2016, BRL14,000 (or USD5,324) **(I am the Principal Investigator)**.
 20. “*Research and training of human resources, at undergraduate and graduate courses, in the areas of industrial automation, software development for mobile devices, and digital TV*”; Samsung / Institute of Development in Informatics, 2013-2016, BRL7,190,550 (or USD2,734,414) in collaboration with Dr. Cícero Costa, Dr. Marly Costa, Dr. João Chaves Filho, Dr. Vicente Lucena Jr., Dr. Andre Cavalcante, and Dr. Waldir Sabino Jr. from Federal University of Amazonas (Brazil) **(I am the Co-Investigator)**.

PUBLICATIONS - JOURNAL ARTICLES

- 1 Izumi, F., Filho, E., Cordeiro, L., Maia, O., Fabricio, R., Farias, B., Silva, A. “A Fuzzing-Based Test-Creation Approach for Evaluating Digital TV Receivers via Transport Streams”. In *Software Testing, Verification and Reliability*, v32(1), pp. 1-30, 2022.
- 2 Cavalcante, T., Bessa, I., Lima Filho, E., Cordeiro, L. “Formal Synthesis of Non-fragile State-Feedback Digital Controllers Considering Performance Requirements for Step Response”. In *Scientific Reports*, 2022.
- *3 Monteiro, F., Gadelha, M., Cordeiro, L. “Model Checking C++ Programs”. In *Software Testing, Verification and Reliability*, v32(1), pp. 1-30, 2022.
- 4 Aljaafari, F., Menezes, R., Manino, E., Shmarov, F., Mustafa, M., Cordeiro, L. “Combining BMC and Fuzzing Techniques for Finding Software Vulnerabilities in Concurrent Programs”. *IEEE Access*, 2022.
- 5 Gadelha, M., Menezes, R., Cordeiro, L. “ESBMC 6.1: Automated Test Case Generation using Bounded Model Checking”. In *International Journal on Software Tools for Technology Transfer*, v.23(6), pp. 857-861, 2021.
- 6 Alhawi, O., Rocha, H., Gadelha, M., Cordeiro, L., Batista, E. “Verification and Refutation of C Programs based on k -Induction and Invariant Inference”. In *International Journal on Software Tools for Technology Transfer*, v.23(2), pp. 115-135, 2021.

-
- 7 de Oliveira, R., Guimaraes, F., de Lucena, M., Cordeiro, L., de Lima Filho, E., de Lucena Jr., V. “Hardware Update through Digital TV Signals”. In *Electronics*, v.10(24), pp. 1-20, 2021.
 - 8 Cavalcante, A., Bessa, I., de Lima Filho, E. Cordeiro, L. “Formal Non-fragile Verification of Step Response Requirements for Digital State-Feedback Control Systems”. In *Journal of Control, Automation and Electrical Systems*, v.31(3), pp. 1-21, 2020.
 - *9 Abate, A., Bessa, I., Cordeiro, L., David, C., Kesseli, P., Kroening, D., Polgreen, E. “Automated Formal Synthesis of Provably Safe Digital Controllers for Continuous Plants”. In *Acta Informatica*, v.57(1), pp. 223–244, 2020.
 - 10 Cordeiro, L. C., De Lima Filho, E. B., Bessa, I. V. “A Survey on Automated Symbolic Verification and its Application for Synthesizing Cyber-Physical Systems”. In *IET Cyber-Physical Systems: Theory and Applications*, v.5(1), pp. 1–24, 2020.
 - 11 Trindade, A. and Cordeiro, L. “Automated Formal Verification of Stand-alone Solar Photovoltaic Systems”. In *Solar Energy*, v.193, pp. 684-691, 2019.
 - *12 Chaves, L. C., Ismail, H. I., Bessa, I. V., Cordeiro, L. C., De Lima Filho, E. B. “Verifying Fragility in Digital Systems with Uncertainties using DSVerifier v2.0”. In *Journal of Systems and Software*, v.153, pp. 22-43, 2019.
 - *13 Chaves, L., Bessa, I., Ismail, H., Frutuoso, A., Cordeiro, L. C., de Lima Filho, E. B. “DSVerifier-Aided Verification Applied to Attitude Control Software in Unmanned Aerial Vehicles”. In *IEEE Trans. Reliability*, v.67(4), pp. 1420–1441, 2018.
 - 14 Farias, A. O., Queiroz, G. A. C., Bessa, I. V., Medeiro, R. L. P., Cordeiro, L. C., Palhares, R. M. “Sim3Tanks: A Benchmark Model Simulator for Process Control and Monitoring”. In *IEEE Access*, v.6, pp. 62234–62254, 2018.
 - 15 Araújo, R., Ribeiro, A., Bessa, I. V., Cordeiro, L. C., Chaves Filho, J. E. “Counterexample Guided Inductive Optimization based on Satisfiability Modulo Theories”. In *Science of Computer Programming*, v.165, pp. 3–23, 2018.
 - 16 Cordeiro, L. C., Kroening, D., Schrammel P.: “Benchmarking of Java Verification Tools at the Software Verification Competition (SV-COMP),” In *Software Engineering Notes*, v.43(4), pp. 1–5, ACM, 2018.
 - 17 Monteiro, F. R., Alves, E. H., Silva, I., Ismail, H. I., Cordeiro, L. C., de Lima Filho, E. B. “ESBMC-GPU: A Context-Bounded Model Checking Tool to Verify CUDA Programs”. In *Science of Computer Programming*, v.152, pp. 63–69, 2018.
 - 18 Trindade, A. B., Degelo, R. F., dos Santos, E. G., Ismail, H. I., da Silva, H. C., Cordeiro, L. C. “Multi-Core Model Checking and Maximum Satisfiability Applied to Hardware-Software Partitioning”. In *International Journal of Embedded Systems*, v.9(6), pp. 570-582, 2017.
 - *19 Pereira, P., Albuquerque, H., Silva, I., Marques, H., Rodrigues, F., Ferreira, R. S., Cordeiro, L. C. “SMT-Based Context-Bounded Model Checking for CUDA Programs”. In *Concurrency and Computation: Practice and Experience*, v.29(22), pp. 1-20, 2017.
 - 20 Lucena Filho, W. C., Cordeiro, L. C., Silva Junior, W. S., Carvalho, C. B. “A Power Control and Anticolision Mechanism for RFID Systems”. In *IEEE Latin America Transactions*, v. 15(10), pp. 1933-1940, 2017.
 - *21 Alves, E. H. S., Cordeiro, L. C., Lima Filho, E. B. “A Method to Localize Faults in Concurrent C Programs”. In *Journal of Systems and Software*, v.132, pp. 336–352, 2017.
 - *22 Sousa, F. R. M., Garcia, M. A. P., Cordeiro, L. C., Lima Filho, E. B. “Bounded Model Checking of C++ Programs based on the Qt Cross-Platform Framework”. In *Software Testing, Verification*

- and *Reliability*, v.27(3), pp. 1–24, 2017.
- 23 Bessa, I. V., Ismail, H. I., Palhares, R., Cordeiro, L. C., Chaves Filho, J. E. “Formal Non-Fragile Stability Verification of Digital Control Systems with Uncertainty”. In *IEEE Transactions on Computers*, v.66(3), pp. 545–552, 2017.
 - 24 Sousa, F. R., Januario, F. A., Cordeiro, L. C., Lima Filho, E. B. “BMCLua: A Translator for Model Checking Lua Programs”. In *Software Engineering Notes*, v.42(3), pp. 1–11, 2017.
 - *25 Gadelha, M. Y. R., Ismail, H. I., Cordeiro, L. C. “Handling Loops in Bounded Model Checking of C Programs via k -Induction”. In *International Journal on Software Tools for Technology Transfer*, v.19(1), pp. 97–114, 2017.
 - 26 Abreu, R. B., Gadelha, M. Y. R., Cordeiro, L. C., Lima Filho, E. B., Silva Jr., W. S. “Bounded Model Checking for Fixed-Point Digital Filters”. In *Journal of the Brazilian Computer Society*, v.22(1), pp. 1–20, SBC, 2016.
 - 27 Bessa, I. V., Ismail, H. I., Cordeiro, L. C., Chaves Filho, J. E. “Verification of Fixed-point Digital Controllers using Direct and Delta Forms Realizations”. In *Design Automation for Embedded Systems*, v.20(2), pp. 95–126, 2016.
 - 28 Cordeiro, L. C. and Lima Filho, E. B. “SMT-Based Context-Bounded Model Checking for Embedded Systems: Challenges and Future Trends”. In *Software Engineering Notes*, v.41(3), pp. 1–6, ACM, 2016.
 - 29 Trindade, A., Cordeiro, L. “Applying SMT-based Verification to Hardware/Software Partitioning in Embedded Systems”. In *Design Automation for Embedded Systems*, v.20(1), pp. 1–19, 2016.
 - *30 Morse, J., Cordeiro, L., Nicole, D., Fischer, B. “Model Checking LTL Properties over C Programs with Bounded Traces”. In *Journal of Software and Systems Modeling, Springer*, v.14(1), pp. 65–81, 2015.
 - 31 Morse, J., Cordeiro, L., Nicole, D., Fischer, B. “Applying Symbolic Bounded Model Checking to the 2012 RERS Greybox Challenge”. In *Intl. Journal on Software Tools for Technology Transfer* (Print), v.16(5), pp. 519–529, 2014.
 - 32 Rosa, R., Lucena Jr., V., Cordeiro, L., Chaves Filho, J. “Dynamic and Automated Product Derivation for Consumer Electronics Software Applications”. In *IEEE Transactions on Consumer Electronics*, v.59(4), pp. 883–891, 2013.
 - *33 Cordeiro, L., Fischer, B., and Marques-Silva, J. P. “SMT-Based Bounded Model Checking for Embedded ANSI-C Software”. In *IEEE Transactions on Software Engineering*, v.38(4), pp. 957–974, 2012.
 - 34 Freitas, M., Valenzuela, V., Gadelha, M., Silva Junior, W., Cordeiro, L., and Lucena Junior, V. “A Distributed Extension of the Hybrid PRS System using Video Processing to Command a Robot via Bluetooth”. In *Intl. Journal of Computer Science and Network Security*, v.12, pp. 29–35, 2012.
 - 35 Cordeiro, L., Mar, C., Valentin, E., Cruz, F., Patrick, D., Barreto, R., and Lucena Junior, V. “An Agile Development Methodology Applied to Embedded Control Software under Stringent Hardware Constraints”. In *Software Engineering Notes*, ACM, v.33, pp. 24, 2008.
 - 36 Cordeiro, L., Barreto, R., Barcelos, R., Oliveira, M., Lucena Junior, V., and Maciel, P. “TXM: An Agile HW/SW Development Methodology for Building Medical Devices”. In *Software Engineering Notes*, ACM, v.32, pp. 28, 2007.
 - 37 Cordeiro, L., Melo Junior, A., Paz Jr. D., Paz, E., Souza F., Alkmin J., Aragão, A., and Campelo, N. “Mapas de Isorresistividades Elétricas Aparentes do Solo Superficial da Cidade de Manaus”.

PUBLICATIONS - CONFERENCE CONTRIBUTIONS

- 1 Manino, E., Carvalho, D., Dong, Y., Rozanova, J., Song, X., Mustafa, M., Freitas, A., Brown, G., Lujan, M., Huang, X., Cordeiro, L. “EnnCore: End-to-End Conceptual Guarding of Neural Architectures”. In *AAAI’s Workshops on Artificial Intelligence Safety (SafeAI)*, pp. 1-8, 2022.
- 2 Alshmrany, K., Aldughaim, M., Bhayat, A., Cordeiro, L. “FuSeBMC v4: Smart Seed Generation for Hybrid Fuzzing (Competition Contribution)”. In *24th International Conference on Fundamental Approaches to Software Engineering (FASE)*, LNCS 13241, pp. 336–340, 2022.
- 3 Song, K., Matulevicius, N., de Lima Filho, E., Cordeiro, L. C. “ESBMC-Solidity: An SMT-Based Model Checker for Solidity Smart Contracts”. In *44th International Conference on Software Engineering (ICSE 2022)*, pp. 65–69, 2022.
- 4 Monteiro, F., Gadelha, M., Cordeiro, L. C. “Summary of Model Checking C++ Programs”. In *15th IEEE International Conference on Software Testing, Verification and Validation (ICST)*, pp. 461, 2022.
- 5 Wu, T., Schrammel, P., Cordeiro, L. C. “Wit4Java: A violation-witness validator for Java Verifiers (Competition Paper)”. In *28th International Conference on Tools and Algorithms for the Construction and Analysis of Systems (TACAS)*, LNCS 13244, pp. 484–489, 2022.
- 6 Brausse, F., Shmarov, F., Menezes, R., Gadelha, M., Korovin, K., Reger, G., Cordeiro, L.: “ESBMC-CHERI: towards verification of C programs for CHERI platforms with ESBMC”. In *International Symposium on Software Testing and Analysis (ISSTA)*, 773–776, 2022.
- 7 Menezes, R., Moura, D., Cavalcante, H., de Freitas, R., Cordeiro, L.: “ESBMC-Jimple: verifying Kotlin programs via jimple intermediate representation”. In *International Symposium on Software Testing and Analysis (ISSTA)*, pp. 777–780, 2022.
- 8 Manino, E., Rozanova, J., Carvalho, D., Freitas, A., Cordeiro, L.: “Systematicity, Compositionality and Transitivity of Deep NLP Models: a Metamorphic Testing Perspective”. In *Findings of the Association for Computational Linguistics (ACL)*, pp. 2355–2366, 2022.
- 9 Junior, M., Bessa, I., Manino, E., Song, X., Cordeiro, L. C. “CEG4N: Counter-Example Guided Neural Network Quantization Refinement”. In *5th Workshop on Formal Methods for ML-Enabled Autonomous Systems (FoMLAS)*, 2022 (to appear).
- 10 Erdayandi, K., Cordeiro, L. C., Mustafa, M. O. “Towards Privacy Preserving Local Energy Markets”. In *Competitive Advantage in the Digital Economy (CADE)*, pp. 127-134, 2022.
- 11 Erdayandi, K., Paudel, A., Cordeiro, L. C., Mustafa, M. O. “Privacy-Friendly Peer-to-Peer Energy Trading: A Game Theoretical Approach”. In *IEEE Power & Energy Society General Meeting (GM)*, pp. 1-6, 2022 (to appear).
- 12 Alshmrany, K., Bhayat, A., Brausse, F., Cordeiro, L., Korovin, K., Melham, T., Mustafa, M., Olivier, P., Reger, G., Shmarov, F. “Position Paper: Towards a Hybrid Approach to Protect Against Memory Safety Vulnerabilities”. In *IEEE Secure Development Conference*, 2022 (to appear).
- 13 Deveza, J., Santos, L., de Freitas, L., Cordeiro, L. C. “Control flow graph, formal verification and constraint programming techniques”. In *10th Latin American Workshop on Cliques in Graphs (LAWCG)*, 2022 (to appear).
- 14 Alshmrany, K., Menezes, R., Gadelha, M., Cordeiro, L. “FuSeBMC: A White-Box Fuzzer for Finding Security Vulnerabilities in C Programs (Competition Contribution)”. In *24th International Conference on Fundamental Approaches to Software Engineering (FASE)*, LNCS 12649, pp. 363–367, 2021.

-
- 15 Alshmrany, K., Aldughaim, M., Bhayat, A., Cordeiro, L. “FuSeBMC: An Energy-Efficient Test Generator for Finding Security Vulnerabilities in C Programs”. In *15th International Conference on Tests and Proofs (TAP)*, LNCS 12740, pp. 85–105, 2021.
 - 16 Li, M., Cordeiro, L. “Assisted Counterexample-Guided Inductive Optimization for Robot Path Planning”. In *XI Brazilian Symposium on Computing Systems Engineering (SBESC)*, pp. 1–8, 2021.
 - 17 Matulevicius, N., Cordeiro, L. “Verifying Security Vulnerabilities for Blockchain-based Smart Contracts”. In *XI Brazilian Symposium on Computing Systems Engineering (SBESC)*, pp. 1–8, 2021.
 - 18 Cordeiro, L. “Exploiting the SAT Revolution for Automated Software Verification: Report from an Industrial Case Study”. In *10th Latin-American Symposium on Dependable Computing (LADC)*, pp. 1–2, 2021.
 - 19 Trindade, A., Cordeiro, L. “Synthesis of Solar Photovoltaic Systems: Optimal Sizing Comparison”. In *12th Working Conference on Verified Software: Theories, Tools, and Experiments (VSTTE)*, LNCS 12549, pp. 87–105, 2020.
 - 20 Gadelha, M., Cordeiro, L., Nicole, D. “An Efficient Floating-Point Bit-Blasting API for Verifying C Programs”. In *13th International Workshop on Numerical Software Verification (NSV)*, LNCS 12549, pp. 178–195, 2020.
 - 21 Valadão, M., Pereira, A., Amoedo, D., Lima Filho, E., Carvalho, C., Costa, A., Cordeiro, L., Silva Júnior, W. “Classificação Automática de Modulações Utilizando Redes Neurais Artificiais com Regularização Bayesiana e Algoritmo de Retropropagação de Levenberg-Marquardt”. In *38th Brazilian Symposium on Telecommunications and Signal*, pp. 1–5, 2020.
 - 22 Rocha, H., Menezes, R., Cordeiro, L., Barreto, R. “Map2Check: Using Symbolic Execution and Fuzzing (Competition Contribution)”. In *26th International Conference on Tools and Algorithms for the Construction and Analysis of Systems (TACAS)*, LNCS 12079, pp. 403–407, 2020.
 - 23 Gadelha, M., Menezes, R., Monteiro, F., Cordeiro, L., Nicole, D. “ESBMC: Scalable and Precise Test-Case Generation based on the Floating-Point Theory (Competition Contribution)”. In *23rd International Conference on Fundamental Approaches to Software Engineering (FASE)*, LNCS 12076, pp. 525–529, 2020.
 - 24 Monteiro, F., Gadelha, M., Cordeiro, L. “Boost the Impact of Continuous Formal Verification in Industry”. In *10th Workshop on Tools for Automatic Program Analysis (TAPAS)*, pp. 1–7, 2019.
 - 25 Alhawi, O., Mustafa, M. A., Cordeiro, L. “Finding Security Vulnerabilities in Unmanned Aerial Vehicles Using Software Verification”. In *IEEE International Workshop on Secure Internet of Things (SIOT)*, pp. 1–9, 2019 (to appear).
 - 26 Sena, L., Bessa, I., Gadelha, M., Cordeiro, L., Mota, E. “Incremental Bounded Model Checking of Artificial Neural Networks in CUDA”. In *IX Brazilian Symposium on Computing Systems Engineering (SBESC)*, pp. 1–8, 2019.
 - 27 Gadelha, M., Steffinlongo, E., Cordeiro, L., Fischer, B., Nicole, D. “SMT-Based Refutation of Spurious Bug Reports in the Clang Static Analyzer,” In *41st ACM/IEEE International Conference on Software Engineering (ICSE)*, pp. 11–14, 2019.
 - 28 Gadelha, M. Y. R., Monteiro, F. R., Cordeiro, L. C., Nicole, D. A. “ESBMC v6.0: Verifying C Programs Using k-Induction and Invariant Inference - (Competition Contribution),” In *25th International Conference on Tools and Algorithms for the Construction and Analysis of Systems (TACAS)*, LNCS 11429, pp. 209–213, 2019.
 - 29 Cordeiro, L. C., Kroening, D., Schrammel, P. “JBMC: Bounded Model Checking for Java Byte-code - (Competition Contribution),” TACAS (3) In *25th International Conference on Tools and*

-
- Algorithms for the Construction and Analysis of Systems* (TACAS), LNCS 11429, pp. 219–223.
- 30 Souza, P., Lima Filho, E., Cordeiro, L., Silva Júnior, W. “Compressão de Sinais de Eletrocardiograma Utilizando Técnicas de Codificação Distribuída,” In *37th Brazilian Symposium on Telecommunications and Signal Processing* (SBrT), pp. 1-5, 2019.
- 31 Gadelha, M., SOUSA, F., Cordeiro, L., Nicole, D. “Towards Counterexample-guided k-Induction for Fast Bug Detection”. In *26th ACM Joint European Software Engineering Conference and Symposium on the Foundations of Software Engineering (ESEC/FSE)*, pp. 765–769, 2018.
- 32 Monteiro, F., Garcia, M., Cordeiro, L., de Lima Filho, E.: “Bounded model checking of C++ programs based on the Qt cross-platform framework (journal-first abstract)”. In *33rd IEEE/ACM International Conference on Automated Software Engineering (ASE)*, pp. 954, 2018.
- 33 Gadelha, M., Monteiro, F., Morse, J., Cordeiro, L., Fischer, B., Nicole, D. “ESBMC 5.0: An Industrial-Strength C Model Checker”. In *33rd IEEE/ACM International Conference on Automated Software Engineering (ASE)*, pp. 888–891, 2018.
- 34 Cordeiro, L., Kesseli, P., Kroening, D., Schrammel, P., Trtik, M. “JBMC: A Bounded Model Checking Tool for Verifying Java Bytecode”. In *30th International Conference on Computer Aided Verification (CAV)*, LNCS 10981, pp 183–190, 2018.
- 35 Chaves, L., Bessa, I. V., Cordeiro, L. C., Kroening, Daniel. “DSValidator: An Automated Counterexample Reproducibility Tool for Digital Systems”. In *21st ACM International Conference on Hybrid Systems: Computation and Control* (HSCC), pp. 253–258, 2018.
- 36 Menezes, R., Rocha, H., Cordeiro, L. C., Barreto, R. S. “Map2Check using LLVM and KLEE”. In *24th International Conference on Tools and Algorithms for the Construction and Analysis of Systems* (TACAS), LNCS 10806, pp. 437–441, 2018.
- *37 Abate, A., Bessa, I.; Cattaruzza, D., Cordeiro, L., David, C., Kesseli, P., Kroening, D., Polgreen, E. “Automated Formal Synthesis of Digital Controllers for State-Space Physical Plants”. In *29th International Conference on Computer-Aided Verification* (CAV), LNCS 10426, pp. 462–482, 2017.
- 38 Chaves, L., Bessa, I., Cordeiro, L., Kroening, D., Lima Filho, E. “Verifying Digital Systems with MATLAB”. In *26th ACM SIGSOFT International Symposium on Software Testing and Analysis* (ISSTA), pp. 388–391, 2017.
- *39 Abate, A., Bessa, I., Cattaruzza, D., Cordeiro, L., David, C., Kesseli, P., Kroening, D. “Sound and Automated Synthesis of Digital Stabilizing Controllers for Continuous Plants”. In *20th ACM International Conference on Hybrid Systems: Computation and Control* (HSCC), pp. 197–206, 2017.
- 40 Rocha, W., Rocha, H., Ismail, H., Cordeiro, L., Fischer, B. “DepthK: A k -Induction Verifier Based on Invariant Inference for C Programs (Competition Contribution)”. In *23th Intl. Conf. on Tools and Algorithms for the Construction and Analysis of Systems* (TACAS), LNCS 10206, pp. 360–364, 2017.
- 41 Mello, D., Freitas, M., Cordeiro, L. C., Silva Junior, W. S., Bessa, I. V., Lima Filho, E. B., Clavier, L. “Verification of Magnitude and Phase Responses in Fixed-Point Digital Filters”. In: *35th Brazilian Symposium on Telecommunications and Signal Processing* (SBrT), pp. 1-5, 2017.
- 42 Amoedo, D. A., Melo, W. C., Cordeiro, L. C., Lima Filho, E. B., da Silva Júnior, W. S., Carvalho, C. B. “Classificação Automática de Modulações Mono e Multiportadoras utilizando Método de Extração de Características e Classificadores SVM”. In: *35th Brazilian Symposium on Telecommunications and Signal Processing* (SBrT), pp. 1-5, 2017.

-
- *43 Abate, A., Bessa, I., Cattaruzza, D., Chaves, L., Cordeiro, L., David, C., Kesseli, P., Kroening, D., Polgreen, E. “DSSynth: An Automated Digital Controller Synthesis Tool for Physical Plants”. In *32nd IEEE/ACM International Conference on Automated Software Engineering (ASE)*, pp. 919–924, 2017.
 - 44 Araújo, R., Ribeiro, A., Bessa, I. V., Cordeiro, L. C., Chaves Filho, J. E. “Counterexample-Guided Inductive Optimization Applied to Mobile Robots Path Planning”. In *14rd Latin American Robotics Symposium (LARS)*, pp. 1–8, 2017.
 - 45 Albuquerque, H., Araújo, R., Bessa, I., Cordeiro, L. C., Lima Filho, E. B. “OptCE: A Counterexample-Guided Inductive Optimization Solver”. In *XX Brazilian Symposium on Formal Methods (SBMF)*, LNCS 10623, pp. 125–141, 2017.
 - 46 Gadelha, M. Y. R., Cordeiro, L. C., Nicole, D. “Encoding floating-points using the SMT theory in ESBMC: An empirical evaluation over the SV-COMP benchmarks”. In *XX Brazilian Symposium on Formal Methods (SBMF)*, LNCS 10623, pp. 91–106, 2017.
 - 47 Cavalcante, T. R. F., Bessa, I. V., Cordeiro, L. C. “Planning and Evaluation of UAV Mission Planner for Intralogistics Problems”. In: *VII Brazilian Symposium on Computing Systems Engineering (SBESC)*, pp. 9–16, 2017.
 - 48 Rocha, H. O., Cordeiro L. C., Barreto, R. S. “Hunting Memory Bugs in C Programs with Map2Check (Competition Contribution)”. In *22th Intl. Conf. on Tools and Algorithms for the Construction and Analysis of Systems (TACAS)*, LNCS 9636, pp. 934–937, 2016.
 - 49 Araujo, R., Bessa, I. V., Cordeiro, L. C., Chaves Filho, J. E. “SMT-based Verification Applied to Non-convex Optimization Problems”. In *VI Brazilian Symposium on Computing Systems Engineering (SBESC)*, pp. 1–8, 2016.
 - 50 Pereira, P. A., Albuquerque, H., Marques, H., Silva, I., Carvalho, C. B., Santos, V., Ferreira, R. S., Cordeiro, L. C. “Verifying CUDA Programs using SMT-Based Context-Bounded Model Checking”. In *31st ACM Symposium on Applied Computing (SAC)*, Software Verification and Testing, pp. 1648–1653, 2016.
 - 51 Garcia, M. A., Sousa, F. R., Cordeiro, L. C., Lima Filho, E. B. “ESBMC^{QtOM}: A Bounded Model Checking Tool to Verify Qt Applications”. In *23rd International SPIN symposium on Model Checking of Software (SPIN)*, LNCS 9641, pp. 97–103, 2016.
 - 52 Pereira, P. A., Sousa, F. R., Cordeiro, L. C., Costa Filho, C. F. F., Costa, M. G. F. “Complementary Training Programme for Electrical and Computer Engineering Students Through an Industrial-Academic Collaboration”. In *46th Annual Frontiers in Education Conference (FIE)*, pp. 1–9, 2016.
 - 53 Ismail, H. I., Bessa, I. V., Cordeiro, L. C., Chaves Filho, J. E., Lima Filho, E. B. “DSVerifier: A Bounded Model Checking Tool for Digital Systems”. In *Proc. 22nd International SPIN Symposium on Model Checking of Software (SPIN)*, LNCS 9232, pp. 126–131, 2015.
 - 54 Rocha, H. O., Barreto, R. S., Cordeiro, L. C., “Memory Management Test-Case Generation of C Programs using Bounded Model Checking”. In *Proc. 13th International Conference on Software Engineering and Formal Methods (SEFM)*, LNCS 9276, pp. 251–267, 2015.
 - 55 Trindade, A. B., Ismail, H. I., Cordeiro, L. C. “Multi-Core Model Checking to Hardware-Software Partitioning in Embedded Systems”. In *Proc. V Brazilian Symposium on Computing Systems Engineering (SBESC)*, pp. 102–105, 2015.
 - 56 Alves, E. H. S., Cordeiro, L. C., Lima Filho, E. B. “Fault Localization in Multi-Threaded C Programs using Bounded Model Checking”. In *Proc. V Brazilian Symposium on Computing Systems Engineering (SBESC)*, pp. 96–101, 2015.

-
- 57 Rocha, H., Ismail, H. I., Cordeiro, L. C., Barreto, R. S. “Model Checking Embedded C Software using k -Induction and Invariants”. In *Proc. V Brazilian Symposium on Computing Systems Engineering (SBESC)*, pp. 90–95, 2015. **SBC Best Paper Award**.
- 58 Sousa, F. R. M., Cordeiro, L. C., Lima Filho, E. B., “Bounded Model Checking of C++ Programs Based on the Qt Framework”. In *Proc. IEEE 4th Global Conference on Consumer Electronics (GCCE)*, pp. 179–180, 2015.
- 59 Pereira, P. A., Albuquerque, H., Marques, H., Silva, I., Santos, V., Carvalho, C. B., Ferreira, R. S., Cordeiro, L. C. “Verificação de Kernels em Programas CUDA usando Bounded Model Checking”. In *Proc. XV Brazilian Symposium on High-Performance Computing (WSCAD-SSC)*, pp. 24–35, 2015.
- 60 de Oliveira, R., Cordeiro, L., Lucena Jr., V. “Hardware Reconfiguration Based on Broadcast Digital TV Signal”. In *Proc. IEEE International Conference on Consumer Electronics (ICCE)*, pp. 624-626, 2015.
- *61 Morse, J., Ramalho, M., Cordeiro, L., Nicole, D., Fischer, B. “ESBMC v1.22 (Competition Contribution)”. In *Proc. 20th International Conference on Tools and Algorithms for the Construction and Analysis of Systems (TACAS), LNCS 8413*, pp. 405-407, 2014.
- 62 Bessa, I., Abreu, R., Cordeiro, L., Chaves Filho, J. “SMT-Based Bounded Model Checking of Fixed-Point Digital Controllers”. In *Proc. 40th Annual Conference of the IEEE Industrial Electronics Society (IECON)*, pp. 295-301, 2014.
- 63 Rosa, R., Cordeiro, L., Lucena Jr., V. “A Secondary Screen Architecture to Accurately Capture Viewers’ Interactions in an iTV Environment”. In *Proc. IEEE 3rd Global Conference on Consumer Electronics (GCCE)*, pp. 264-265, 2014.
- 64 Januário, F., Cordeiro, L., Lima Filho, E., Lucena Jr., V. “BMCLua: Verification of Lua Programs in Digital TV Interactive Applications”. In *Proc. IEEE 3rd Global Conference on Consumer Electronics (GCCE)*, pp. 707-708, 2014.
- 65 Trindade, A., Cordeiro, L. “Aplicando Verificação de Modelos para o Particionamento de Hardware/Software”. In *4th Brazilian Symposium on Computing Systems Engineering (SBESC)*, pp. 1-6, 2014.
- 66 Januário, F., Cordeiro, L., Lima Filho, E., Lucena Jr., V. “BMCLua: Verificação de Programas Lua em Aplicações Interativas de TV Digital”. In *4th Brazilian Symposium on Computing Systems Engineering (SBESC)*, pp. 1-6, 2014.
- 67 Bessa I., Ismail, H., Cordeiro, L., Chaves Filho, J. “Verification of Delta Form Realization in Fixed-Point Digital Controllers Using Bounded Model Checking”. In *4th Brazilian Symposium on Computing Systems Engineering (SBESC)*, pp. 49-54, 2014.
- 68 Ramalho, M., Cordeiro L., Cavalcante, A., Lucena Jr, V. “Verificação Baseada em Indução Matemática de Programas C/C++”. In *3rd Brazilian Symposium on Computing Systems Engineering (SBESC)*, 2013.
- 69 Silva, V. Cordeiro L., Lucena Jr, V. “Verificação de Aplicações AmI Usando Java PathFinder”. In *3rd Brazilian Symposium on Computing Systems Engineering (SBESC)*, 2013.
- 70 Abreu, R., Cordeiro, L., Lima Filho, E. “Verifying Fixed-Point Digital Filters using SMT-Based Bounded Model Checking”. In *31st Brazilian Symposium on Telecommunications (SBrT)*, 2013. DOI:10.14209/sbrt.2013.57
- 71 Januario, F., Cordeiro, L., Lima Filho, E. B. “Verificação de Códigos Lua Utilizando BMCLua”. In *31st Brazilian Symposium on Telecommunications (SBrT)*, 2013. DOI:10.14209/sbrt.2013.92

-
- 72 Freitas, M., Ramalho, M., Cordeiro, L., Silva Jr., W., Lima Filho, E. “Verificação de Propriedades de Filtros Digitais Implementados com Aritmética de Ponto Fixo”. In *31st Brazilian Symposium on Telecommunications (SBrT)*, 2013. DOI:10.14209/sbrt.2013.226
- 73 Ramalho, M., Freitas, M., Sousa, F., Marques, H., Cordeiro, L., and Fischer, B. “SMT-Based Bounded Model Checking of C++ Programs”. In *Proc. 20th IEEE Intl. Conf. and Workshops on Engineering of Computer-Based Systems (ECBS)*, pp. 147-156, 2013.
- *74 Morse, J., Cordeiro, L., Nicole, D., and Fischer, B. “Handling Unbounded Loops with ESBMC 1.20 (Competition Contribution)”. In *Proc. 19th Intl. Conf. on Tools and Algorithms for the Construction and Analysis of Systems (TACAS), LNCS 7795*, pp. 621-624, 2013 (**won the Bronze Medal in the overall ranking**).
- 75 Cohen, D., Barreto, R., Oliveira, H., and Cordeiro, L. “A Car Racing Based Strategy for the Dynamic Voltage and Frequency Scaling Technique”. In *Proc. 21st IEEE Intl. Symp. on Industrial Electronics (ISIE)*, pp. 774-779, 2012.
- *76 Cordeiro, L., Morse, J., Nicole, D., and Fischer, B. “Context-Bounded Model Checking with ESBMC 1.17 (Competition Contribution)”. In *Proc. 18th Intl. Conf. on Tools and Algorithms for the Construction and Analysis of Systems (TACAS), LNCS 7214*, pp. 533-536, 2012 (**won the Bronze Medal in the overall ranking**).
- 77 Lima, F., Cordeiro, L., and Souza, R. “Sistema de Monitoramento a Distância para Unidade de Célula a Combustível”. In *8th Brazilian Congress of Energy Planning (CBPE)*, 2012.
- 78 Rocha, H., Barreto, R., Cordeiro, L., and Dias-Neto, A. “Understanding Programming Bugs in ANSI-C Software Using Bounded Model Checking Counter-Examples”. In *Proc. 9th Intl. Conf. on Integrated Formal Methods (iFM), LNCS 7321*, pp. 128-142, 2012.
- 79 Caldas, R., Barreto, R., Cordeiro, L., and Campos, S. “A Formal Method for Modeling, Verification and Synthesis of Embedded Reactive Systems”. In *Proc. Intl. Conf. on Applied Computing (AC)*, pp. 379-386, 2011.
- 80 Morse, J., Cordeiro, L., Nicole, D., and Fischer, B. “Context-Bounded Model Checking of LTL Properties for ANSI-C Software”. In *Proc. 9th Intl. Conf. on Software Engineering and Formal Methods (SEFM), LNCS 7041*, pp. 302-317, 2011.
- 81 Lucena Junior, V., Neto, J., Chaves Filho, J. E., Silva Junior, W., and Cordeiro, L. “Gift Young Engineers: An Extra-Curricular Initiative for Updating Computer and Electrical Engineering Courses”. In *Proc. 41st ASEE/IEEE Frontiers in Education Conference (FIE)*, pp. 1-6, 2011.
- 82 Barreto, R., Cordeiro, L., and Fischer, B. “Verifying Embedded C Software with Timing Constraints using an Untimed Model Checker”. In *Proc. Brazilian Symposium on Computing System Engineering (SBESC)*, pp. 89-100, 2011.
- *83 Cordeiro, L. and Fischer, B. “Verifying Multi-threaded Software using SMT-based Context-Bounded Model Checking”. In *Proc. ACM/IEEE 33rd International Conference on Software Engineering (ICSE)*, v. 1, pp. 331-340, 2011. **ACM SIGSOFT Distinguished Paper Award**.
- 84 Cordeiro, L., Fischer, B., and Marques-Silva, J. “Continuous Verification of Large Embedded Software using SMT-Based Bounded Model Checking”. In *Proc. 17th IEEE Intl. Conf. and Workshops on Engineering of Computer-Based Systems, (ECBS)*, pp. 160-169, 2010.
- 85 Cordeiro, L. C. “SMT-Based Bounded Model Checking for Multi-threaded Software in Embedded Systems”. In *Proc. ACM/IEEE 32nd International Conference on Software Engineering (ICSE), Doctoral Symposium, v.2.*, pp. 373-376, 2010.
- 86 Cordeiro, L., Fischer, B., Chen, H., and Marques-Silva, J. “Semiformal Verification of Embedded Software in Medical Devices Considering Stringent Hardware Constraints”. In *Proc. 6th IEEE*

Intl. Conf. on Embedded Software and Systems (ICESS), pp. 396-403, 2009.

- *87 Cordeiro, L., Fischer, B., and Marques-Silva, J. “SMT-Based Bounded Model Checking for Embedded ANSI-C Software”. In *Proc. 24th IEEE/ACM Intl. Conf. on Automated Software Engineering (ASE)*, pp. 137-148, 2009.
- 88 Cordeiro, L., Mar, C., Valentin, E., Cruz, F., Patrick, D., Barreto, R. S., and Lucena Junior, V. “A Platform-Based Software Design Methodology for Embedded Control Systems: An Agile Toolkit”. In *Proc. 15th IEEE Intl. Conf. and Workshops on the Engineering of Computer Based Systems (ECBS)*, pp. 408-417, 2008.
- 89 Cruz, F., Barreto, R., Cordeiro, L., and Maciel, P. “ezRealtime: A Domain-Specific Modeling Tool for Embedded Hard Real-Time Software Synthesis”. In *Proc. Design, Automation and Test in Europe (DATE)*, pp. 1510-1515, 2008.
- 90 Teófilo, M., Cordeiro, L., Barreto, R., and Pereira, J. “Mandos: A User Interaction Method in Embedded Applications for Mobile Telephony”. In *Proc. 1st IEEE International Conference on Advances in Computer-Human Interaction (ACHI)*, pp. 271-276, 2008.
- 91 Cruz, F., Barreto, R., Cordeiro, L., and Maciel, P. “Towards a Model-Driven Engineering Approach for Developing Embedded Hard Real-Time Software”. In *Proc. 23rd ACM Symposium on Applied Computing (SAC)*, pp. 308-314, 2008. **ACM SIGAPP Best Paper Award.**
- 92 Cordeiro, L., Barreto, R., and Oliveira, M. “Towards a Semiformal Development Methodology for Embedded Systems”. In *Proc. 3rd Intl. Conf. on Evaluation of Novel Approaches to Software Engineering (ENASE)*, pp. 5-12, 2008.
- 93 Cordeiro, L., Barreto, R., Barcelos, R., Oliveira, M., Lucena Junior, V., and Maciel, P. “Agile Development Methodology for Embedded Systems: A Platform-Based Design Approach”. In *Proc. 14th IEEE Intl. Conf. and Workshop on the Engineering of Computer Based Systems (ECBS)*, pp.195-202, 2007.
- 94 Cordeiro, L., Becker, C., and Barreto, R. “Applying Scrum and Organizational Patterns to Multi Site Software Development”. In *Proc. 6th Latin American Conference on Pattern Languages of Programming (SugarLoafPlop)*, pp. 46-67, 2007.
- 95 Cordeiro, L. and Louzado, D. “Aplicando Padrões de Gerência de Configuração de Software em Projetos Geograficamente Distribuídos”. In *Proc. 5th Latin American Conference on Pattern Languages of Programming (SugarLoafPlop)*, pp. 207-221, 2005.
- 96 Alkmin J., de Melo Junior, A., da Paz, E., Campelo, N., Souza, F., Cordeiro, L., Carvalho, J., and Aragão, A. “Comparação entre mapas de isorresistividades elétricas aparentes do solo superficial de Manaus, a partir de séries de dados completos e estatísticos”. In *1st Regional Symposium of Brazilian Geophysical Society*, 2004.
- 97 Alkmin J., de Melo Junior, A., da Paz, E., Campelo, N., Souza, F., Cordeiro, L., Carvalho, J., and Aragão, A. “Malhas de Aterramento do Sistema Elétrico da Manaus Energia: um Estudo de Caso”. In *Second Conf. on Technological Innovation in Energy*, 2003.

PUBLICATIONS - REVIEWED WORKSHOP CONTRIBUTIONS

- 1 Monteiro, F. R., Garcia, M. A. P., Cordeiro, L. C., De Lima Filho, de Lima Filho, E. B. “Bounded model checking of C++ programs based on the Qt cross-platform framework (journal-first abstract),” In *33rd ACM/IEEE International Conference on Automated Software Engineering (ASE)* p. 954, 2018.
- 2 Abate, A., Bessa, I., Cattaruzza, D., Cordeiro, L. C., Cristina, D., Kesseli, P., Kroening, D., Polgreen, E. “Safe, Automated and Formal Synthesis of Digital Controllers for Continuous Plants,” In *7th Workshop on Synthesis, SYNT’18*, pp. 1, 2018.

-
- 3 Gadelha, M. Y. R., Morse, J., Cordeiro, L. C., Nicole, D. “Using clang as a Frontend on a Formal Verification Tool”. In *European LLVM Developers Meeting* (EuroLLVM), pp. 1, 2018.
 - 4 Souza, A. S., Cordeiro, L. C., Januário, F. A. P. “Verificação de Programas Multi-Threads Baseados no Framework Multiplataforma Qt”. In *IV Regional Meeting of Engineering* (ENCOENG), pp. 131–140, 2016.
 - 5 Rodrigues, F. S., Cordeiro, L. C., Lima Filho, E. B. “Verificação de Programas C++ Baseados no Framework Multiplataforma Qt”. In *IV Regional Meeting of Computer and Information Systems* (ENCOSIS), pp. 181–190, 2015.
 - 6 Lima, M. S., Silva, E. S., Cordeiro, L. C. “Verificação de Modelos Aplicada aos Filtros Espaciais em Processamento Digital de Imagens”. In *IV Regional Meeting of Computer and Information Systems* (ENCOSIS), pp. 136–145, 2015.
 - 7 Rocha, H., Cordeiro, L., Barreto, R., and Netto, J. “Exploiting Safety Properties in Bounded Model Checking for Test Cases Generation of C Programs”. In *Proc. 4th Brazilian Workshop on Systematic and Automated Software Testing (SAST)*, pp.121-130, 2010.
 - 8 Cordeiro, L. and Fischer, B. “Bounded Model Checking of Multi-threaded Software using SMT solvers”. In *8th Intl. Workshop on Satisfiability Modulo Theories (SMT)*, 2010.

PUBLICATIONS - BOOK CHAPTERS

1. Rocha, H. O., Ismail, H. I., Cordeiro, L. C., Barreto, R. S. “Model Checking Embedded C Software Using k -Induction and Invariants”. In: *Embedded Software Verification and Debugging*, Markus Winterholer; Djones Lettnin. (Org.), 1ed., v. 1, pp. 159–182, Springer, 2017.
DOI:10.1007/978-1-4614-2266-2.7

TEACHING

Undergraduate level

- *Algorithms and Data Structures*, University of Manchester, since 2020.
- *Algorithms and Imperative Programming*, University of Manchester, from 2018 to 2019.
- *Computer Organization and Design*, Federal University of Amazonas, from 2013 to 2015.
- *Advanced Programming*, Federal University of Amazonas, 2011, 2013.
- *Real-Time Programming*, Federal University of Amazonas, from 2011 to 2015.
- *Computer Networks*, Federal University of Amazonas, 2009.
- *C++ Programming*, Federal University of Amazonas, 2008.
- *Introduction to Algorithms*, Federal University of Amazonas, 2007.

Graduate level

- *Software Security*, University of Manchester, since 2020.
- *Verification of Software and Systems*, Federal University of Amazonas, from 2014 to 2016.
- *Algorithms for Automation and Systems*, Federal University of Amazonas, from 2013 to 2015.
- *Real-Time Systems*, Federal University of Amazonas, from 2011 to 2013.
- *Design and Analysis of Algorithms*, Federal University of Amazonas, 2011.
- *Embedded Systems and Linux for Digital TV*, Baptist Superior College of Amazonas, 2008.

SUPERVISIONS

Ph.D. Students (current)

- Tong Wu (2022-2025). *Hybrid Fuzzing Concurrent Software using Model Checking and Machine Learning* (supervisor).

- Rafael Menezes (2021-2024). *Formal Verification of Firmware* (supervisor).
- Kunjian Song (2021-2024). *Formal Verification of CHERI-C++ Programs* (supervisor).
- Mohannad Aldughaim (2020-2023). *Bounded Model Checking of Software Using Interval Methods via Contractors* (supervisor).
- Xidan Song (2020-2023). *Architectures for Symbolic Bounded Model Checking of Software using Multi-core Processors and Clusters* (supervisor).
- Fatimah Aljaafari (2019-2023). *Verifying Software Vulnerabilities in IoT Cryptographic Protocols* (supervisor).
- Kaled Alshmrany (2018-2023). *Finding Security Vulnerabilities in Network Protocol Implementations*. (supervisor).
- Erickson Alves (2018-2023). *Verifying Implementations of Neural Networks using Fixed- and Floating-Point Arithmetic* (supervisor).
- João Matos Júnior (2018-2023). *Black-box Differential Approach for Adversarial Input Generation* (supervisor).

Ph.D. Students (graduated)

- Alessandro Bezerra Trindade (2015-2020). *Automated Verification of Stand-alone Solar Photovoltaic Systems: Optimal Sizing and Project Validation*, first position as lecturer at UFAM.
- Herbert de Oliveira Rocha (2012-2016). *Verification of Software Systems Based on Code Transformation using Bounded Model Checking* (co-supervisor), first position as lecturer at UFRR.

MPhil Student (graduated)

- Omar Alhawi (2018-2021). *Automatic Detection and Repair of Software Vulnerabilities in Unmanned Aerial Vehicles*, first position as cyber-security expert at the Greater Manchester Police.

M.Sc. Students (graduated)

- Sena, L. (2020-2022) *Automated Verification and Refutation of Quantized Neural Networks*. M.Sc. Electrical Engineering, Federal University of Amazonas. First position as a Java Backend Developer at ELO.
- Lu, Y. (2020-2021) *Scaling up Bounded-Model-Checking for Internet of Things devices*. M.Sc. in Advanced Computer Science, University of Manchester.
- He, H. (2020-2021). *Incremental Bounded Model Checking using Machine Learning Techniques*. M.Sc. in Advanced Computer Science, University of Manchester.
- Wang, S. (2020-2021). *Develop and Evaluate a Security Analyzer for Finding Vulnerabilities in Java programs*. M.Sc. in Advanced Computer Science, University of Manchester. First position as a Java backend developer in a Internet financial company (Chengdu).
- Wu, T. (2020-2021). *Develop and Evaluate a Security Analyzer for Finding Vulnerabilities in Java programs*. M.Sc. in Advanced Computer Science, University of Manchester.
- Song, K. (2020-2021). *SMT-Based Bounded Model Checking for Solidity Smart Contracts*. M.Sc. in Advanced Computer Science, University of Manchester. He is pursuing his Ph.D. in Computer Science at the University of Manchester.
- Matulevicius, N. (2020-2021). *Verifying Information Flow Security for Blockchain-based Smart Contracts*. M.Sc. in Advanced Computer Science, University of Manchester. First position as a Full-Stack Web Dev at All Media Lithuania.
- Rafael Menezes (2018-2021). *Automatic Generation of Test Cases using Bounded Model Checking* (supervisor). M.Sc. in Informatics, Federal University of Amazonas. He is pursuing his Ph.D. in Computer Science at the University of Manchester.
- Vi L. Tan (2019-2020). *Security Analyser Tool for Finding Vulnerabilities in Java Programs*. M.Sc. in Advanced Computer Science, University of Manchester. First position as a software developer at Paradox Interactive.

-
- Felipe Rodrigues Monteiro Sousa (2020). *Formal Verification to Ensuring the Memory Safety of C++ Programs*. M.Sc. in Informatics, Federal University of Amazonas. First position as software engineer at Amazon Web Service.
 - Samih R. Alkhamissi (2019). *Finding Software Vulnerabilities in Unmanned Aerial Vehicles*. M.Sc. in Advanced Computer Science, University of Manchester. First position as teaching assistant at King Abdulaziz University.
 - Thiago Rodrigo Félix Cavalcante (2019). *Verification and Synthesis of Static State Feedback Controllers with Formal Guarantees of Non-Fragile Performance*. M.Sc. in Electrical Engineering, Federal University of Amazonas. First position as software engineer at Intera Tecnologia.
 - Higo Ferreira Albuquerque (2019). *An Optimization Approach Guided by Counterexamples using SAT and SMT Solvers*. M.Sc. in Electrical Engineering, Federal University of Amazonas. First position as software engineer at Samsung.
 - Phillipe Arantes Pereira (2019) *SMT-Based Context-Bounded Model Checking for CUDA Programs*. M.Sc. in Electrical Engineering, Federal University of Amazonas. First position as IT coordinator / full stack developer at WebRota.
 - Erickson Higo da Silva Alves (2018). *A Method to Localize Faults in Concurrent C Programs*. M.Sc. in Electrical Engineering, Federal University of Amazonas. First position as software engineer at Samsung.
 - Lennon Corrêa Chaves (2018). *Formal Verification Applied to Attitude Control Software of Unmanned Aerial Vehicles*. M.Sc. in Electrical Engineering, Federal University of Amazonas. First position as software engineer at CESAR.
 - Raimundo Willame Rocha de Melo (2017). *Model Checking Embedded C Software using k-Induction and Invariants*. M.Sc. in Electrical Engineering, Federal University of Amazonas. First position as software engineer at Samsung.
 - Mário Angel Praia Garcia (2016). *Bounded Model Checking of C++ Programs based on the Qt Cross-Platform Framework*. M.Sc. in Electrical Engineering, Federal University of Amazonas. First position as software engineer at Samsung.
 - Hussama Ibrahim Ismail (2015). *Applying Model Checking to Digital Controllers Implemented in Fixed-Point Processors*. M.Sc. in Electrical Engineering, Federal University of Amazonas. First position as software engineer at ST Microelectronics.
 - Francisco de Assis Pereira Januário (2015). *Verification of Lua Programs in Digital TV Interactive Applications*. M.Sc. in Electrical Engineering, Federal University of Amazonas. First position as lecturer at FUCAPI.
 - Alessandro Bezerra Trindade (2015). *Applying SMT-based Verification to Hardware/Software Partitioning in Embedded Systems*. M.Sc. in Electrical Engineering, Federal University of Amazonas. First position as lecturer at UFAM.
 - Renato Barbosa Abreu (2014). *Verifying Fixed-Point Digital Filters using SMT-Based Bounded Model Checking*. M.Sc. in Electrical Engineering, Federal University of Amazonas. First position as system engineer at Nokia Institute of Technology.
 - Mikhail Yasha Ramalho Gadelha (2013). *Induction-Based Verification for C++ Programs*. M.Sc. in Electrical Engineering, Federal University of Amazonas. First position as lecturer at FUCAPI.

PROFESSIONAL ACTIVITIES

Program committee member

- *IEEE Secure Development Conference (SecDev 2022)*, October 18-20, 2022.
- *31th International Joint Conference on Artificial Intelligence*, July 23-29, 2022.
- *11th Brazilian Symposium on Computing Systems Engineering*, Online, November 22-25, 2021.
- *30th International Joint Conference on Artificial Intelligence*, Montreal, Canada, August 21-26, 2021.
- *10th Brazilian Symposium on Computing Systems Engineering*, Online, November 23-27, 2020.
- *13th International Workshop on Numerical Software Verification*, Los Angeles, USA, July 19, 2020.

- *The 42nd International Conference on Software Engineering*, New Ideas and Emerging Results, Seoul, South Korea, May 23-29, 2020.
- *9th Brazilian Symposium on Computing Systems Engineering*, Natal, Rio Grande do Norte, Brazil, November 19-22, 2019.
- *The 34rd IEEE/ACM International Conference on Automated Software Engineering*, San Diego, USA, November 11-15, 2019.
- *The 34th ACM Symposium on Applied Computing, Software Verification and Testing*, Limassol, Cyprus, April 8-12, 2019.
- *VIII Workshop of Theses and Dissertations of CBSOft*, São Carlos, São Paulo, Brazil, September 17-21, 2018.
- *19th Symposium on High Performance Computing Systems*, São Paulo, SP, Brazil, October 1-3 2018.
- *8th Brazilian Symposium on Computing Systems Engineering*, Salvador, Bahia, Brazil, November 6-9, 2018.
- *8th Latin-American Symposium on Dependable Computing*, Foz do Iguaçu, Brazil, October 8-10, 2018.
- *VII Workshop of Theses and Dissertations of CBSOft*, Fortaleza, CE, Brazil, September 18-22, 2017.
- *7th Brazilian Symposium on Computing Systems Engineering*, Curitiba, PR, Brazil, November 7-10, 2017.
- *10th International Workshop on Numerical Software Verification*, Heidelberg, Germany, July 22-23 2017.
- *24nd Intl. SPIN Symposium on Model Checking of Software*, Santa Barbara, CA, United States, July 13-15, 2017.
- *International Conference on Management Engineering, Software Engineering and Service Sciences*, Wuhan, China, Jan 14-16, 2017.
- *6th Brazilian Symposium on Computing Systems Engineering*, João Pessoa, PB, Brazil, November 1-4, 2016.
- *38th Intl. Conference on Software Engineering*, Austin, TX, USA, May 14 - 22, 2016.
- *22nd Intl. SPIN Symposium on Model Checking of Software*, Stellenbosch, South Africa, August 24-26, 2015.

Competition chair

- *Intel Embedded Systems Contest* of the 6th Brazilian Symposium on Computing Systems Engineering, João Pessoa, PB, Brazil, November 1-4, 2016.

Jury committee member

- *Intl. Competition on Software Testing* of the Intl. Conf. on Fundamental Approaches to Software Engineering (FASE), 2020.
- *Intl. Competition on Software Verification* of the Intl. Conf. on Tools and Algorithms for the Construction and Analysis of Systems (TACAS), (2013, 2014, 2016, 2017, 2019, and 2021).

Co-organizer/session organizer

- *XXII Brazilian Symposium on Information and Computational Systems Security*, Santa Maria, SC, Brazil, September 12-15, 2022.
- *3rd ISSNIP Biosignals and Biorobotics Conference*, Manaus, AM, Brazil, January 9-11, 2012.

Reviewer for major journals and conferences

- IEEE Transactions on Software Engineering, IEEE Transactions on Reliability, IEEE Transactions on Dependable and Secure Computing, ACM Computing Surveys, IEEE Software, Formal Aspects of Computing, Science of Computer Programming, Journal of Systems and Software, Formal Methods in System Design, The Computer Journal, Philosophical Transactions of the Royal Society of London,

International Journal of Computational Science and Engineering, International Journal on Software Tools for Technology Transfer, and LNCS Transactions on Computational Science.

· LICS 2017, ASE 2015, CAV 2014, ASE 2013, and ISMVL 2010.

AWARDS

Three gold medals in the *4th Intl. Competition on Software Testing (Test-Comp) at the 25th Intl. Conf. on Fundamental Approaches to Software Engineering (FASE'22)*, European Joint Conference on Theory and Practice of Software (ETAPS).

One silver medal in the *11th Intl. Competition on Software Verification (SV-COMP) at the 28th Intl. Conf. on Tools and Algorithms for the Construction and Analysis of Systems (TACAS'22)*, European Joint Conference on Theory and Practice of Software (ETAPS).

One gold and one bronze medal in the *3rd Intl. Competition on Software Testing (Test-Comp) at the 24th Intl. Conf. on Fundamental Approaches to Software Engineering (FASE'21)*, European Joint Conference on Theory and Practice of Software (ETAPS).

One bronze medal in the *10th Intl. Competition on Software Verification (SV-COMP) at the 27th Intl. Conf. on Tools and Algorithms for the Construction and Analysis of Systems (TACAS'21)*, European Joint Conference on Theory and Practice of Software (ETAPS).

One silver and one bronze medal in the *9th Intl. Competition on Software Verification (SV-COMP) at the 26th Intl. Conf. on Tools and Algorithms for the Construction and Analysis of Systems (TACAS'20)*, European Joint Conference on Theory and Practice of Software (ETAPS).

One bronze medal in the *2nd Intl. Competition on Software Testing (Test-Comp) at the 23rd Intl. Conf. on Fundamental Approaches to Software Engineering (FASE'20)*, European Joint Conference on Theory and Practice of Software (ETAPS).

One gold and one bronze medal in the *8th Intl. Competition on Software Verification (SV-COMP) at the 25th Intl. Conf. on Tools and Algorithms for the Construction and Analysis of Systems (TACAS'19)*, European Joint Conference on Theory and Practice of Software (ETAPS).

One silver and two bronze medals in the *7th Intl. Competition on Software Verification at the 24th Intl. Conf. on Tools and Algorithms for the Construction and Analysis of Systems (TACAS'18)*, European Joint Conference on Theory and Practice of Software (ETAPS).

One silver and one bronze medal in the *6th Intl. Competition on Software Verification at the 23th Intl. Conf. on Tools and Algorithms for the Construction and Analysis of Systems (TACAS'17)*, European Joint Conference on Theory and Practice of Software (ETAPS).

Productivity in Research Grant from the National Council for Scientific and Technological Development (CNPq), 2016.

One gold and one silver medal in the *5th Intl. Competition on Software Verification at the 22th Intl. Conf. on Tools and Algorithms for the Construction and Analysis of Systems (TACAS'16)*, European Joint Conference on Theory and Practice of Software (ETAPS).

Best paper award in the *V Brazilian Symposium on Computing Systems Engineering*, Brazilian Computer Society (SBC), 2015.

Two gold and two bronze medals in the *4th Intl. Competition on Software Verification at the 21th Intl. Conf. on Tools and Algorithms for the Construction and Analysis of Systems (TACAS'15)*, European Joint Conference on Theory and Practice of Software (ETAPS).

One gold medal in the *3rd Intl. Competition on Software Verification at the 20th Intl. Conf. on Tools and Algorithms for the Construction and Analysis of Systems (TACAS'14)*, European Joint Conference on Theory and Practice of Software (ETAPS).

Two silver and three bronze medals in the *2nd Intl. Competition on Software Verification at the 19th Intl. Conf. on Tools and Algorithms for the Construction and Analysis of Systems (TACAS'13)*, European Joint Conference on Theory and Practice of Software (ETAPS).

Two gold and one bronze medals in the *1st Intl. Competition on Software Verification at the 18th Intl. Conf. on Tools and Algorithms for the Construction and Analysis of Systems (TACAS'12)*, European Joint Conference on Theory and Practice of Software (ETAPS).

Distinguished paper award in the *33rd International Conference on Software Engineering (ICSE'11)*, ACM Special Interest Group on Software Engineering (SIGSOFT).

Best paper award in the *23rd ACM Symposium on Applied Computing: Track on Real-Time Systems*, ACM Special Interest Group on Applied Computing (SIGAPP).

ORSAS Graduate Fellowship, *Overseas Research Students Awards Scheme* (ORSAS).

RECENT PRESENTATIONS

- 1 Cordeiro, L. C., “Exploiting the SAT Revolution for Automated Software Verification: Report from an Industrial Case Study”. In *10th Latin-American Symposium on Dependable Computing (LADC)* (invited talk), 2021.
- 2 Cordeiro, L. C., “Automated Software Verification and Synthesis in Unmanned Aerial Vehicle” in the Digital Trust & Security Guest Lecture Series and the Aerospace Research Institute at the University of Manchester (invited talk), 2018.
- 3 Cordeiro, L. C. “Verifying digital systems with MATLAB”, *26th ACM SIGSOFT International Symposium on Software Testing and Analysis (ISSTA)*, Santa Barbara, California, United States, 2017.
- 4 Cordeiro, L. C. “DSSynth: An Automated Digital Controller Synthesis Tool for Physical Plants”. *34th IEEE/ACM International Conference on Automated Software Engineering (ASE)*, San Diego, California, United States 2017.
- 5 Cordeiro, L. C. “Verifying CUDA Programs using SMT-Based Context-Bounded Model Checking”, *31st ACM/SIGAPP Symposium on Applied Computing (SAC)*, Pisa, Italy, 2016.

PERSONAL

Citizenship: Brazilian and Portuguese.

Languages: Portuguese (native), English (native standard), and German (high-school level).