Gabriel Henrique **Lopes Gomes Alves Nunes**

PhD candidate in Computer Science | MSc in Computer Science, BSc in Physics

nunesgh.com nunesgh.com/scholar nunesgh.com/lattes nunesgh.com/orcid
Belo Horizonte, Minas Gerais, Brazil Born September 22, 1990 (32 years old) in Brazil

Cotutelle Doctoral candidate in Computer Science at the Federal University of Minas Gerais (UFMG), Brazil, and at Macquarie University, Australia. Master in Computer Science and Bachelor in Physics from UFMG. Interested in Formal Methods, Quantitative Information Flow, Responsible Computing, Artificial Intelligence, and Neuroscience.

Member of Topete Research Group and INSCRYPT | T-Rex Laboratory.

Sections

Education

02/2023 – 07/2025 Doctoral Degree in Computer Science with an International Macquarie University Research Excellence (iMQRES) Scholarship at the School of Computing of Macquarie University. Supervised by Prof. Annabelle McIver.

07/2021 – 07/2025 Doctoral Degree in Computer Science with a CAPES Scholarship at the Graduate Program in Computer Science of UFMG. Supervised by Prof. Mário Alvim.

- Research area: Quantitative Information Flow theory and its application to precisely characterize how different methods of noise introduction affect the trade-off between privacy and utility in microdata and statistical data publications.

03/2019 – 04/2021 Master Degree in Computer Science with a CNPq Scholarship at the Graduate Program in Computer Science of UFMG. Supervised by Prof. Mário Alvim, from UFMG, and by Prof. Annabelle McIver, from Macquarie University.

- Dissertation defended and approved in April 28, 2021, titled A formal quantitative study of privacy in the publication of official educational censuses in Brazil.

03/2014 – 07/2018 Bachelor Degree in Physics at UFMG.

03/2012 – 12/2013 Bachelor Degree in Nanotechnology at Federal University of Rio de Janeiro. Unfinished.

02/2011 – 06/2011 Bachelor Degree in Medicine at Medical Sciences of Minas Gerais. Unfinished.

Experience

07/2022 – 11/2022 **Student Researcher, Google LLC, New York, New York, USA**

- Internship supervised by Andrés Muñoz Medina.

Computer Science | Privacy | Machine Learning | Quantitative Information Flow

12/2020 – 03/2021 **Information Security Analyst, Research Development Foundation, UFMG, Belo Horizonte, Minas Gerais, Brazil**

- Information Security Analyst in the project PRICE - Privacy in Educational Censuses.

Computer Science | Privacy | Transparency | Quantitative Information Flow

09/2019 – 11/2019 **Visiting Scholar, Macquarie University, Sydney, New South Wales, Australia**

- Internship at the Department of Computing. Supervised by Prof. Annabelle McIver.

Computer Science | Privacy | Transparency | Quantitative Information Flow

06/2018 – 01/2017 **Reporter, Neowin LLC, Remote**

- Coverage of the latest science and technology news. Portfolio: published articles.

News

06/2016 – 03/2016 **Scientific Initiation, UFMG, Belo Horizonte, Minas Gerais, Brazil**
- Research on electronic structures and electrical properties of surfaces using scanning tunneling microscopy (STM) and photoluminescence spectroscopy.
- FAPEMIG Scholarship. Supervised by Prof. Gustavo Sáfar.

Physics | Scanning Tunneling Microscopy | Photoluminescence Spectroscopy

01/2016 – 10/2014 **Undergraduate Tutoring & Technological and Industrial Initiation, Room of Physics Demonstrations, UFMG, Belo Horizonte, Minas Gerais, Brazil**
- Development of a high-resolution and low-cost optical spectrometer and of an electrical Paul's Trap.
- PROGRAD/UFMG & CNPq Scholarships. Supervised by Prof. Elmo Salomão.

Physics | Spectrometer | LabVIEW | SolidWorks

01/2014 – 08/2013 **Scientific Initiation, Federal University of Rio de Janeiro, Rio de Janeiro, Rio de Janeiro, Brazil**
- Application of vibrational spectroscopy and theoretical calculations to bioinorganic metal-amino acid complexes.
- CNPq Scholarship. Supervised by Prof. Joanna Ramos.

Chemistry | Spectroscopy

Awards

Google LARA Research Scholarship February 2022

9^{th} Google Latin America Research Awards (LARA).
A robust and explainable QIF-based framework for assessing big data privacy risks.

Computer Science | Quantitative Information Flow | Disclosure Control | Microdata | Differential Privacy | Privacy

Languages

	Understanding		Speaking		Writing
	Listening	Reading	Spoken Interaction	Spoken Production	
Portuguese	C2	C2	C2	C2	C2
English	C2	C2	C1	C1	C2
Spanish	B1	B1	B1	B1	B1

Common European Framework of Reference for Languages

Exam	Listening	Reading	Writing	Speaking	Overall	Level	Date
TOEFL iBT	30	28	26	24	108	-	07/2020
IELTS Academic	8.0	8.0	6.5	6.5	7.5	C1	11/2015

Skills

Programming Languages C, **C++**, Dafny, Java, LabVIEW, MATLAB, **Python**, Rust.
Tools Alloy, **Apache Beam**, **Git**, **Jupyter**, **LaTeX**, Linux, SolidWorks, **Vim**.

Publications, Technical Work, & Presentations

Flexible and scalable privacy assessment for very large datasets, with an application to official governmental microdata
July 2022

22nd Privacy Enhancing Technologies Symposium (PETS 2022). DOI: 10.56553/popets-2022-0114.
We present a systematic refactoring of the conventional treatment of privacy analyses, basing it on mathematical concepts from the framework of Quantitative Information Flow (QIF). The approach we suggest brings three principal advantages: it is flexible, allowing for precise quantification and comparison of privacy risks for attacks both known and novel; it can be computationally tractable for very large, longitudinal datasets; and its results are explainable both to politicians and to the general public. We apply our approach to a very large case study: the Educational Censuses of Brazil, curated by the governmental agency INEP, which comprise over 90 attributes of approximately 50 million individuals released longitudinally every year since 2007. These datasets have only very recently (2018-2021) attracted legislation to regulate their privacy - while at the same time continuing to maintain the openness that had been sought in Brazilian society. INEP's reaction to that legislation was the genesis of our project with them. In our conclusions here we share the scientific, technical, and communication lessons we learned in the process.
Co-authors: Prof. Mário Alvim, Natasha Fernandes, Prof. Annabelle McIver, Prof. Carroll Morgan.

Computer Science | Quantitative Information Flow | Disclosure Control | Microdata | Privacy

A formal quantitative study of privacy in the publication of official educational censuses in Brazil
April 2021

Universidade Federal de Minas Gerais. DOI: hdl:1843/38085.
In this thesis, we provide a thorough quantitative study of privacy risks in the release of the official Brazilian Educational Censuses provided annually by INEP, which is Brazil's governmental agency responsible for the development and maintenance of educational statistics systems. More precisely, we formally analyze privacy risks in databases released as microdata, i.e. data at each individual's record level, and protected by the technique of de-identification, i.e. the removal of direct identifying information such as the individuals' names or personal identification numbers.

Computer Science | Quantitative Information Flow | Disclosure Control | Microdata | Differential Privacy | Privacy | Utility

On Privacy and Accuracy in Data Releases
August 2020

31^{st} International Conference on Concurrency Theory (CONCUR 2020). DOI: 10.4230/LIPIcs.CONCUR.2020.1.
In this paper we study the relationship between privacy and accuracy in the context of correlated datasets. We use a model of quantitative information flow to describe the the trade-off between privacy of individuals' data and and the utility of queries to that data by modelling the effectiveness of adversaries attempting to make inferences after a data release. We show that, where correlations exist in datasets, it is not possible to implement optimal noise-adding mechanisms that give the best possible accuracy or the best possible privacy in all situations. Finally we illustrate the trade-off between accuracy and privacy for local and oblivious differentially private mechanisms in terms of inference attacks on medium-scale datasets.
Co-authors: Prof. Mário Alvim, Natasha Fernandes, Prof. Annabelle McIver.

Computer Science | Privacy and Utility Trade-off | Quantitative Information Flow | Inference Attacks

Case Study on Privacy and Transparency in Data Publishing
February 2020

9^{th} Summer School in Computer Science, UFMG. (YouTube)
In this lecture, we addressed some anonymization techniques that have been proposed and applied in an attempt to balance the right to privacy while maintaining the usefulness of databases, their advantages and disadvantages, and presented real cases of individuals who have been reidentified, both in Brazil and worldwide.

Computer Science | Privacy | Transparency

An Introduction to Raman Spectroscopy
November 2017

Didactic or instructional material.
Raman Spectroscopy applications are vast in Physics, Chemistry, Geology and in other areas, because it is possible to characterize different materials through their vibrational spectra. It is an efficient and non-destructive method, hence not only useful inside a laboratory, but also for some real-world problems. In this study, some of the classical Raman Spectroscopy theory shall be develop so it can be applied to a specific case on an experimental example. By the end of this study, one will have covered all the basic ideas behind the Raman Spectroscopy technique.
Supervised by Prof. Leandro Malard.

Physics | Raman Spectroscopy

A Geometric Introduction to Lie Groups
November 2016

III National Scientific Initiation and Master Program (PICME) Symposium.
Co-authors: André Nascimento, Cássio Feitosa, Cleber Barreto, Diego Carriel. Supervised by Romero Solha.

Mathematics | Lie Groups

Coupling optical techniques with scanning tunneling microscopy to investigate organic films
September 2016

XV Brazilian Materials Research Society (SBPMat) Meeting.
Co-authors: Otávio Alonso, Prof. Rogerio Magalhães-Paniago, Prof. Angelo Malachias, Prof. Gustavo Sáfar.

Physics | Scanning Tunneling Microscopy | Photoluminescence Spectroscopy

Projects

PRICE - Privacy in Educational Censuses

2020 - 2021

PRICE INSCRYPT Information Security Analyst

The new Brazilian privacy legislation legally holds entities as responsible for the quality, confidentiality, and privacy of data they keep about individuals. INEP, the National Institute of Educational Studies and Research of the Ministry of Education, publishes very detailed educational data annually. The PRICE project was a study commissioned by INEP on how to transform the data to be published in a way that the privacy of students is not violated, while maintaining its utility for statistical research.

Technical Work:

- Report 01: Report on the international panorama and the INEP context regarding methods of handling privacy control in statistical disclosure. (2020)
- Report 02: Report on the risks to privacy arising from the current form of disclosure of microdata from INEP Educational Censuses. (2020)
- Report 03: Technical report on treatment methods applicable to the dissemination microdata of INEP's Educational Censuses (2020) [a]
- Report 04: Technological solution and its documentation. (2021)
- Report 05: Final technical report of the pilot project. (2021)
- Report 06: Technical Implementation Report. (2021)
- Report 07: Assisted Operation Report. (2021)
- Report 08: Project closure report. (2021)

Decentralized Execution Term (TED) INEP-UFMG 8750.
Coordinator: Prof. Mário Alvim.

Computer Science | Privacy | Transparency | Python

[a] Content and knowledge support.

Workshop on database anonymization techniques

November 30, 2018

Educational Statistics Directorate (DEED/INEP)
Regional Planning and Development Center (CEDEPLAR/UFMG)

The workshop aims to present INEP professionals with the state of the art of data anonymization techniques with the most recurrent use, their advantages and disadvantages, in order to support organizational decisions regarding the adoption of one or more techniques, considering the technical capacity of the teams , infrastructure, operation and any existing legal limitations.
Coordinator: Prof. Mário Alvim.

Computer Science | Privacy | Transparency

Lumus Max Optical Spectrometer

2014 - 2015

Lumus Max (in Portuguese) Room of Physics Demonstrations (in Portuguese)

Development of a high-resolution and low-cost optical spectrometer. Some parts of the hardware were designed using Dassault Systèmes' SolidWorks and the software was implemented using National Instruments' LabVIEW visual programming language.
Coordinator: Prof. Elmo Salomão.

Physics | Spectrometer | LabVIEW | SolidWorks

Electrical Paul's Trap

2014 - 2015

Electrical Paul's Trap (in Portuguese) Room of Physics Demonstrations (in Portuguese)

Development of an electrical Paul's Trap (quadrupole ion trap).
Coordinator: Prof. Elmo Salomão.

Physics

Events

- 22nd Privacy Enhancing Technologies Symposium (YouTube) — 2022
  PoPETs/PETS — *Symposium. Sydney, NSW, Australia, and Online.*
- 9^{th} Summer School in Computer Science, at the Department of Computer Science (PDF) (YouTube) — 2020
  Universidade Federal de Minas Gerais — *Seminary. Belo Horizonte, MG, Brazil.*
- 8^{th} Summer School in Computer Science, at the Department of Computer Science — 2019
  Universidade Federal de Minas Gerais — *Seminary. Belo Horizonte, MG, Brazil.*
- VII Summer School in Computer Science, at the Department of Computer Science — 2018
  Universidade Federal de Minas Gerais — *Seminary. Belo Horizonte, MG, Brazil.*
- III National Scientific Initiation and Master Program (PICME) Symposium (PDF) — 2016
  Universidade Federal de Minas Gerais — *Symposium. Belo Horizonte, MG, Brazil.*
- X CBPF'S School, at the Brazilian Center for Physics Research — 2015
  Centro Brasileiro de Pesquisas Físicas — *Seminary. Rio de Janeiro, RJ, Brazil.*
- XXV School of Physics, at the Department of Physics — 2014
  Universidade Federal de Minas Gerais — *Seminary. Belo Horizonte, MG, Brazil.*
- 6^{th} School of Nanoscience and Nanotechnology — 2012
  Universidade Federal do Rio de Janeiro — *Seminary. Rio de Janeiro, RJ, Brazil.*