

# Ludmila Botelho

## Curriculum Vitae

### Education

- 2021–Now **Ph.D. in Information and Communication Technology**, *Institute of Theoretical and Applied Informatics, Polish Academy of Sciences*, Poland  
Main Subjects: Quantum Computation Theory, Optimization, Quantum Algorithms  
Supervisor: Jarosław Miszcza
- 2018–2020 **Ph.D. in Physics**, *Universidade Federal de Minas Gerais*, Brazil  
Main subjects: Quantum Information Theory, Entanglement and Optimization  
Supervisor: Reinaldo Oliveira
- 2016–2018 **M.Sc. in Physics**, *Universidade Federal de Minas Gerais*, Brazil  
Main subjects: Quantum Information Theory, Tomography, Continuous Variable Systems  
Dissertation Title: Tomography on Continuous Variable Quantum Systems
- 2014–2015 **Student Exchange**, *Waseda University*, Japan  
Title: *Theory of Many-Particle Quantum Systems*. Supervisor: Kazuya Yuasa
- 2011–2016 **B.S in Physics**, *Universidade Federal de Minas Gerais*, Brazil  
Scientific Initiation  
– 2013-2014. Title: *Typical Bell Inequality Violations for Many Parts Quantum States*.  
Supervisor: Raphael Drumond

### Experience

- 2020–Now **Scientist/Programmer**, IITiS PAN, Poland  
Research on Quantum Computation Theory, Quantum Algorithms and its applications.
- *Error mitigation and Quantum Approximate Optimization Algorithms*
    - Research and applications of Error Mitigation with Post-Selection for Variational Quantum Circuits
    - Algorithm design and Quantum Circuit simulations with Qiskit
    - Developed simulations and optimizations for quantum circuits on Julia with Optim and BinaryOptimization
  - *Music and Quantum Annealing*
    - Researched and development of music composition on Quantum Annealing devices
    - Research and development job scheduling algorithm applied to music reduction on Quantum Annealing and Simulated Annealing devices
    - Mathematical formulation of the problem (QUBO and LIP)
    - Parsing data with Music21 and setup experiments
  - *Railroad scheduling optimization*
    - Built initial parsing data code and setup for railroad optimization
  - Data management and analyses in Python with Pandas, NumPy and Matplotlib
  - Conducted study group about Conventional Quantum Algorithms



Technology    Git, Keras, Pandas, Spark, CUDA, QuTip, Qiskit, PennyLane, Matplotlib, Scipy,  
and Tools    Music21, Optim.jl, NumPy, Pytest, PyUnit, CPPUnit, gprof, gdb, Valgrind, VIM,  
Visual Code, Atom,  $\LaTeX$ , Libre Office

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## Publications and Preprints

- 2023    ○ Akash Kundu, Ludmila Botelho, Adam Glos, “*Hamiltonian-Oriented Homotopy QAOA*”, arXiv preprint arXiv:2301.13170 (2023)
- 2022    ○ Ludmila Botelho, Adam Glos, Akash Kundu, Jarosław Adam Mischczak, Özlem Salehi, and Zoltán Zimborás, “*Error mitigation for variational quantum algorithms through mid-circuit measurements*”, Phys. Rev. A **105**, 022441 (2022)
  - Arya, A., Botelho, L., Cañete, F., Kapadia, D., Salehi, Ö. “*Applications of Quantum Annealing to Music Theory*”. In: Miranda, E.R. (eds) Quantum Computer Music. Springer, Cham. (2022)
- 2020    ○ Ludmila Botelho and Reinaldo Vianna, Eur. Phys. J. D , “*Efficient quantum tomography of two-mode Wigner functions*”. **74**, 42 (2020)

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## Courses and Certifications

- 2022    CERN School of Computing 2022
- 2022    Fundamentals of Accelerated Computing with CUDA C/C++, NVIDIA
- 2020    Machine Learning - Stanford University, Coursera
- 2019-2020    Deep Learning Specialization - Coursera
  - Sequence Models
  - Convolutional Neural Networks
  - Structuring Machine Learning Projects
  - Improving Deep Neural Networks: Hyperparameter tuning, Regularization and Optimization
  - Neural Networks and Deep Learning

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## Poster Presentations

- 2022    Near-term Quantum Computing 2020(+3)  
Title: “*Hamiltonian-Oriented Homotopy QAOA*”
- 2022    ICTP Conference on Adiabatic Quantum Computation & Quantum Annealing  
Title: “*Fixed interval scheduling problem with minimal idle time with an application to music arrangement problem*”
- 2021    International Conference on Unconventional Computation and Natural Computation 2021  
Title: “*Self-Organized Maps and Quantum States Classification*”

- 2021 Summer School: Machine Learning in Quantum Physics and Chemistry 2021  
Title: *"Self-Organized Maps and Quantum States Classification"*
- 2021 24th Annual Conference on Quantum Information Processing  
Title: *"Efficient Quantum Tomography of Continuous Variable Quantum States"*
- 2020 Q-Turn 2020  
Title: *"Efficient Quantum Tomography of Continuous Variable Quantum States"*
- 2020 15th Conference on the Theory of Quantum Computation, Communication and Cryptography  
Title: *"Tomography and Entanglement Detection on Continuous Variable Quantum State"*
- 2019 Workshop on Skills for Young Scientists  
Title: *"Tomography and Entanglement Witnesses for Continuous Variable States"*
- 2019 VII Paraty Quantum Information School and Workshop  
Title: *"Tomography and Entanglement Witnesses for Continuous Variable States"*
- 2019 III Postgraduate Workshop in Physics  
Title: *"Tomography and Entanglement on Continuous Variable Quantum States"*
- 2018 Modern Topics in Quantum Information Workshop  
Title: *"Tomography on Continuous Variable States"*
- 2017 VI Paraty Quantum Information School  
Title: *"Tomography Toolbox for Continuous Variable States"*
- 2013 XXII Scientific Initiation Week.  
Title: *"The Quantum Teleport"*

## Talks

- 2022 QWorld Quantum Science Days 2022  
Title: *"Fixed interval scheduling problem with minimal idle time with an application to music arrangement problem"*
- 2022 QWorld Quantum Science Days 2022  
Title: *"Applications of Quantum Annealing to Music Theory"*
- 2022 Institute of Computer Science AGH and IBM Software Laboratory in Krakow  
Title: *"Applications of Quantum Annealing to Music Theory"*
- 2021 Politechnika Śląska  
Title: *"Quantum Annealing and music reduction for chiptune"*
- 2021 1st International Symposium on Quantum Computing and Musical Creativity  
Title: *"Applications of Quantum Annealing to Music Theory"*
- 2021 QWorld Quantum Science Days 2021  
Title: *"Infeasible space reduction for QAOA through encoding change"*
- 2021 7th Qoffee O Clock - QIndia  
Title: *"Tomography and Continuous Variable Quantum State"*
- 2019 Universidade de São Paulo  
Title: *"Tomography and Entanglement on Continuous Variable Quantum States"*

- 2019 III Postgraduate Workshop in Physics  
Title: *"Tomography and Entanglement on Continuous Variable Quantum States"*
- 2015 Winter Festival of Curralinho Title: *"The Brazilian Flag Stars"*
- 2015 IV Cultural Week of Catas Altas  
Title: *"Easy Physics: How does a Telescope Works?"*
- 2013 XXII Scientific Initiation Week.  
Title: *"The Quantum Teleport"*

## Conferences, Schools and Workshops

- 2022 CERN School of Computing 2022, Kraków, Poland
- 2021 Summer School: Machine Learning in Quantum Physics and Chemistry 2021, Warsaw, Poland
- 2020 School on Quantum Information Theory and Thermodynamics at the Nanoscale
- 2019 III Postgraduate Workshop in Physics at *Universidade Federal de Minas Gerais, Physics Department*
- 2019 Workshop on Skills for Young Scientists/Increasing Diversity in STEM
- 2019 VII Paraty Quantum Information School and Workshop
- 2018 Q-Turn: changing paradigms in quantum science
- 2018 Minicourse on Quantum Computation and Simulability
- 2018 Modern Topics in Quantum Information Workshop
- 2017 VI Paraty Quantum Information School
- 2014 Summer School at *Universidade Federal de Pernambuco, Physics Department*
- 2013 XXIV Winter School at *Universidade Federal de Minas Gerais, Physics Department*
- 2013 Summer School at *Instituto de Matemática Pura e Aplicada - Linear Algebra and Foundations of Probability*
- 2013 XXII Scientific Initiation Week at *Universidade Federal de Minas Gerais, Physics Department*
- 2012 XXIII Winter School at *Universidade Federal de Minas Gerais, Physics Department*

## Interests

- Professional I am interested in vanguard science and technologies, such as development and researching of new technologies, methods, algorithms, proofs and etc. I mostly deal with data analysis, statistical analysis, inference schemes and information architecture. I have a some experience analysing and performing optimisations. I am also interested in high performance computing, parallelism and distributed algorithms.
- Personal On my free time, I like playing and listening to music. I also enjoy computer gaming and I would like to develop my own game some day. I also practiced many different martial arts, nowadays I am focused on Capoeira. I have rats as pets. I love cycling and I think it is perfect to commute.

## Professional References

- Prof. Dr. Jarosław Miszczak (current advisor)  
Institute of Theoretical and Applied Informatics, Polish Academy of Sciences  
jmiszczak@iitis.pl
- Dr. Adam Glos  
Algorithmiq  
adamglos92@gmail.com
- Dr. Özlem Salehi  
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