

ALI AL-BAYATY

Email: albayaty@pdx.edu

Phone: +1 203-936-9559

ORCID: 0000-0003-2719-0759

SUMMARY

Passionate about teaching students, developing innovative curricula, and conducting academic research on quantum gates, circuits, and algorithms, by bridging theoretical foundations in academia with practical applications in industry. My research focuses on geometrically constructing cost-effective quantum operators, enhancing the searching circuitry of Grover's algorithm and the quantum approximate optimization algorithm (QAOA), and developing generic quantum libraries for lower quantum costs and efficient physical qubits routing (mapping) for the layouts (architectures) of real quantum computers.

EDUCATION

Portland State University	Oregon, USA
Ph.D. in Electrical and Computer Engineering	March 2025
Department of Electrical and Computer Engineering	GPA: 3.89 / 4.00
Dissertation Title: <i>Layout-Aware Quantum Circuitry and Algorithmic Extensions to Grover's Algorithm</i>	
Portland State University	Oregon, USA
Graduate Certificate in Computational Intelligence	July 2021
Department of Systems Science	
University of New Haven	Connecticut, USA
Master of Science in Electrical Engineering	May 2014
Department of Electrical Engineering	GPA: 3.94 / 4.00
Thesis Title: <i>Graphical-based Robotics Programming Language</i>	
University of New Haven	Connecticut, USA
Graduate Certificate in Computer Programming	July 2012
Department of Computer Science	
Al-Nahrain University	Baghdad, IRAQ
Master of Science in Computer Engineering	March 2006
Department of Computer Engineering	Grade: 73.455%
Thesis Title: <i>Development of 1D Barcode Reader Software Tool</i>	
Al-Nahrain University	Baghdad, IRAQ
Bachelor of Science in Computer Engineering	September 2002
Department of Computer Engineering	Grade: 74.450%
Project Title: <i>PC-based Simple Robotic System</i>	

MEMBERSHIP & AWARDS

- IBM Qiskit Global Summer School (Quantum Excellence Badge), in 2025
- Adjunct faculty member in the Department of ECE at Portland State University, April 2025 – Present
- Dr. Robert D. Dryden Memorial Endowed Scholarship (Portland State University), in 2024
- El-Mansy Family Fellowship (Portland State University), in 2023
- IBM Quantum Challenge (Quantum Advanced Badge), in 2020
- U.S. Fulbright International Exchange Alumni Association, since 2014
- IEEE-HKN (Eta Kappa Nu) Honor Society Membership, since 2012
- U.S. Fulbright Foreign Students Scholarship, in 2010
- Iraqi Engineers Union Membership, since 2002

SELECTED PUBLICATIONS

Journals:

- [1] A. Al-Bayaty and M. Perkowski, "A concept of controlling Grover diffusion operator: A new approach to solve arbitrary Boolean-based problems," *Scientific Reports*, vol. 14, no. 23570, pp. 1–16, 2024. Nature.
- [2] A. Al-Bayaty and M. Perkowski, "BHT-QAOA: The generalization of quantum approximate optimization algorithm to solve arbitrary Boolean problems as Hamiltonians," *Entropy*, vol. 26, no. 10, p. 843, 2024.
- [3] A. Al-Bayaty and M. Perkowski, "The impact of optimization approximation algorithms on the performance of the BHT-QAOA," *Academia Quantum*, vol. 2, no. 4, 2025.
- [4] A. Al-Bayaty and M. Perkowski, "A Boolean-based designer describes oracular Grover's algorithms without any knowledge of quantum computing, reversible logic, and exhaustive search programming," *Journal of Applied Logics (JAL IfCoLog Journal)*, vol. 12, no. 4, pp. 1093–1117, May 2025.
- [5] A. Al-Bayaty and M. Perkowski, "Cost-effective synthesization of Grover's algorithm on IBM quantum computers using different axis of the Bloch sphere," *submitted to APL Quantum (APQ)*, Dec. 2024.
- [6] A. Al-Bayaty, S. Chen, A. Al-Shuwaili, A. AlZubaidi, and M. Perkowski, "A geometrical design tool for building cost-effective layout-aware n-bit quantum gates using the Bloch sphere approach," *submitted to Physical Review Letters*, 2026.
- [7] I. Agarwal, M. Saraivanov, A. Al-Bayaty, and M. Perkowski, "EQB: Synthesizing permutative quantum gates and circuits using rotation-based group decomposition," *Journal of Applied Logics (JAL IfCoLog Journal)*, vol. 12, no. 4, pp. 1007–1034, May 2025.
- [8] S. Yang, A. Al-Bayaty, and M. Perkowski, "A cost-effective layout-aware quantum circuit synthesis for triangular, square, and heavy-hex layouts," *submitted to Quantum Information & Computation (QIC)*, 2025.
- [9] S. Chen, A. Al-Bayaty, X. Song, and M. Perkowski, "Stesso: A reconfigurable decomposition of quantum reversible circuits with (n+1)-bit Toffoli gates and quasi-symmetrical structures," *submitted to ACM Transactions on Quantum Computing*, 2025.
- [10] S. Chen, A. Al-Bayaty, X. Song, and M. Perkowski, "Solving segment display problems using quantum Grover's search algorithm," *submitted to Quantum Science and Technology (QST)*, Dec. 2025.
- [11] S. Yang, A. Al-Bayaty, and M. Perkowski, "Minimization of AND-XOR expressions with decoders for quantum circuits," *submitted to Physical Review A*, 2026.
- [12] A. AlZubaidi and A. Al-Bayaty, "PSSF: Early osteoarthritis detection using physical synthetic knee X-ray scans and AI radiomics models," *submitted to International Journal of Imaging Systems and Technology*, 2026. Wiley
- [13] A.A. Hashim, A. Al-Shuwaili, A. Saeed, and A. Al-Bayaty, "IGAN: A new inception-based model for stable and high-fidelity image synthesis using generative adversarial networks," *submitted to Machine Learning: Science and Technology*, 2026. IOPscience
- [14] S. Bleiler, A. Al-Bayaty, S. Chen, and M. Perkowski, "Visualizing the state space of quantum trits, quadits, and pairs of qubits via toric geometry," *submitted to La Matematica*, 2026.
- [15] G.A. Khalid, M.I. Abdulmawjod, and A. Al-Bayaty, "A comprehensive analysis of respiratory patterns and physiological parameters in asthma, bronchitis, and croup," *Electrical Engineering Technical Journal*, vol. 1, no. 1, pp. 35–49, 2024.
- [16] H. Ghouse, U.C. Ishmael, E.D. Obando-Paredes, H.S. Shakir, and A. Al-Bayaty, "Field canals improvement projects duration prediction: A comparative analysis of machine learning models," *AUIQ Technical Engineering Science*, vol. 1, no. 2, p. 3, 2024.
- [17] F. Al-Saedi and A. Al-Bayaty, "Development of a barcode reader system," *International Journal of Computer Trends and Technology (IJCTT)*, vol. 30, no. 1, pp. 50–58, 2015.

Conferences:

- [1] A. Al-Bayaty, A. Al-Shuwaili, A. AlZubaidi, and M. Perkowski, "Improving the circuit realization of Grover's quantum search algorithm by replacing Hadamard with \sqrt{X} gates," in *Proceedings of the 2026 2nd International Conference on Computing and Emerging Sciences (ICCES '26)*, Association for Computing Machinery, New York, NY, USA, Feb. 2026, pp. 258–265. <https://doi.org/10.1145/3797491.3797543>
- [2] A. AlZubaidi, A. Al-Shuwaili, and A. Al-Bayaty, "PhysioBridge: Physiology-constrained self-supervised foundation model for cross-device ECG-PPG learning with conformal risk control," in *Proceedings of the 2026 2nd International Conference on Computing and Emerging Sciences (ICCES '26)*, Association for Computing Machinery, New York, NY, USA, Feb. 2026, pp. 203–209. <https://doi.org/10.1145/3797491.3797535>

- [3] S. Yang, A. Al-Bayaty, and M. Perkowski, "Minimization of a new structure of binary quantum circuits using multi-valued logic," *submitted to ISMVL 2026 (IEEE 56th International Symposium on Multiple-Valued Logic)*, 2025.
- [4] A.A. Majed, G.A. Khalid, A.F. Humadi, A. Al-Talabi, and A. Al-Bayaty, "Advancements in uroflowmetry: A comprehensive review of non-invasive urodynamic assessment and developmental prototypes for home monitoring," in *AIP Conference Proceedings*, Oct. 2024, vol. 3232, no. 1.
- [5] A.A. Majed, G.A. Khalid, A.F. Humadi, T.A. Shihab, and A. Al-Bayaty, "Development and evaluation of a portable home-based uroflowmetry system for early detection of urinary track system diseases," in *AIP Conference Proceedings*, Oct. 2024, vol. 3232, no. 1.
- [6] G.A. Khalid, H. Obaida, M.M. Kasem, and A. Al-Bayaty, "Design and manufacturing of stereotactic frame for biomechanical investigations," in *AIP Conference Proceedings*, October 2024, vol. 3232, no. 1.
- [7] A. Al-Bayaty and C. Martinez, "CLIP 4 robotics: A click-based programming language," in *20th HCI International Conference Proceedings*, Las Vegas, NV, USA, Jul. 2018, pp. 3–10. Springer.

Preprints:

- [1] A. Al-Bayaty, "A conceptual technology-dependent framework of ternary quantum gates," 2026, *arXiv:2604.23242*.
- [2] A. Al-Bayaty and M. Perkowski, "GALA-n: Generic architecture of layout-aware n-bit quantum operators for cost-effective realization on IBM quantum computers," 2023, *arXiv:2311.06760*.
- [3] A. Al-Bayaty, X. Song, and M. Perkowski, "CALA-n: A quantum library for realizing cost-effective 2-, 3-, 4-, and 5-bit gates on IBM quantum computers using Bloch sphere approach, Clifford+T gates, and layouts," 2024, *arXiv:2408.01025*.
- [4] A. Al-Bayaty and M. Perkowski, "Superposition states on different axes of the Bloch sphere for cost-effective circuits realization on IBM quantum computers," 2023, *arXiv:2311.09326*.
- [5] A. Al-Bayaty and M. Perkowski, "Cost-effective realization of n-bit Toffoli gates for IBM quantum computers using the Bloch sphere approach and IBM native gates," 2024, *arXiv:2410.13104*.
- [6] A. Al-Bayaty and M. Perkowski, "p-SWAP: A generic cost-effective quantum Boolean-phase SWAP gate using two CNOT gates and the Bloch sphere approach," 2024, *arXiv:2410.16641*.
- [7] A. Al-Bayaty and M. Perkowski, "The impact of optimization approximation algorithms on the performance of BHT-QAOA," 2025, *Preprints:2025070025*.
- [8] A. Al-Bayaty, "Layout-aware quantum circuitry and algorithmic extensions to Grover's algorithm," Ph.D. dissertation, Portland State University, Portland, OR, USA, 2025.
- [9] A. Al-Bayaty, S. Chen, S. Bleiler, and M. Perkowski, "A cost-effective quantum Boolean-phase SWAP gate with only two CNOT gates," 2025, *arXiv:2507.17164*.
- [10] A. Al-Bayaty and M. Perkowski, "A geometrical design tool for building cost-effective layout-aware n-bit quantum gates using the Bloch sphere approach," 2026, *arXiv:2601.00484*.
- [11] S. Yang, A. Al-Bayaty, and M. Perkowski, "A new layout-aware quantum circuit synthesis with Davio lattices using triangular connectivity," 2025, *arXiv:2506.20098*.
- [12] S. Bleiler, A. Al-Bayaty, S. Chen, and M. Perkowski, "Visualizing the state space of quantum trits, quadits, and pairs of qubits via toric geometry," 2025, *arXiv:2510.01455*.
- [13] S. Chen, A. Al-Bayaty, X. Song, and M. Perkowski, "Stesso: A reconfigurable decomposition of n-bit Toffoli gates using symmetrical logical structures and adjustable support qubits," 2025, *arXiv:2510.26116*.
- [14] S. Chen, A. Al-Bayaty, X. Song, and M. Perkowski, "Solving segment display problems using quantum Grover's search algorithm," 2025, *arXiv:2512.19969*.
- [15] S. Yang, A. Al-Bayaty, and M. Perkowski, "Minimization of AND-XOR expressions with decoders for quantum circuits," 2026, *arXiv:2601.02515*.
- [16] A.A. Hashim, A. Al-Shuwaili, A. Saeed, and A. Al-Bayaty, "IGAN: A new inception-based model for stable and high-fidelity image synthesis using generative adversarial networks," 2026, *arXiv:2601.08332*.
- [17] A. Alzubaidi and A. Al-Bayaty, "PSSF: Early osteoarthritis detection using physical synthetic knee X-ray scans and AI radiomics models," 2026, *arXiv:2601.11642*.
- [18] A. Al-Bayaty, "Software-defined robotics -- idea & approach," 2017, *arXiv:1708.05935*.
- [19] A.F. Hussein, A.K. AlZubaidi, A. Al-Bayaty, and Q.A. Habash, "An IoT real-time biometric authentication system based on ECG fiducial extracted features using discrete cosine transform," 2017, *arXiv:1708.08189*.
- [20] A. Al-Bayaty and M. Perkowski, "BSA: The Bloch sphere approach as a geometrical design tool for building cost-effective quantum gates," 2024, *Protocols.io*. <https://dx.doi.org/10.17504/protocols.io.bp2l6dkkdvqe/v4>
- [21] A. Al-Bayaty and M. Perkowski, "Grover controlled-diffuser (CUs) for quantum Boolean oracles of Grover's algorithm," 2024, *Protocols.io*. <https://dx.doi.org/10.17504/protocols.io.e6nvw1wj9lmk/v2>

- [22] A. Al-Bayaty and M. Perkowski, “BHT-QAOA: Generalizing quantum approximate optimization algorithm to solve Boolean problems as Hamiltonians,” 2024, *Protocols.io*.
<https://dx.doi.org/10.17504/protocols.io.dm6gp9bd8vzp/v1>

Books and Chapters:

- [1] A. Al-Bayaty and M. Perkowski, “COVID-19 features detection using machine learning models and classifiers,” in *The Science behind the COVID Pandemic and Healthcare Technology Solutions*, S. Adibi, A. Rajabifard, S.M. Shariful Islam, and A. Ahmadvand, Eds., Cham, Springer, 2022, vol. 15, ch. 18, pp. 379–403. https://doi.org/10.1007/978-3-031-10031-4_18
- [2] A.B. Mahdi, Z.A. Al-Ibraheemi, Z.H. Atta, H.F. Mashkooor, H.A. Hussein, A. Al-Bayaty, and A. AlZubaidi, “Advanced Image Enhancement and Deep Learning Models for COVID-19 Features Detection in Chest X-Ray and CT Images,” in *Innovative Computing and Communications* (Springer Series on Lecture Notes in Networks and Systems, vol. 1433), A.E. Hassanien, S. Anand, A. Jaiswal, P. Kumar, Eds., Singapore, Springer, 2025, vol. 4, ch. 7, pp. 101–117. https://doi.org/10.1007/978-981-96-7131-1_7
- [3] A. AlZubaidi and A. Al-Bayaty, *Introduction to Prosthetic Hand Engineering: Theory and Applications*, 1st ed. Series: Simplified Engineering Approaches, vol. 1, Jul. 2017, ISBN: 978-1974102822.
- [4] A. Al-Bayaty, *Video Game Engine Development Guide Using Xilinx SoC Board*, 1st ed. Series: Simplified Engineering Approaches, vol. 4, Sep. 2017, ISBN: 978-1976400940.

Software^(a):

- [1] A. Al-Bayaty. “Grover Controlled-Diffuser.” GITHUB.com. Accessed: Jan. 26, 2025. [Online.] Available: https://github.com/albayaty/grover_controlled_diffuser
- [2] A. Al-Bayaty. “GALA-n Quantum Library.” GITHUB.com. Accessed: Jan. 26, 2025. [Online.] Available: https://github.com/albayaty/gala_quantum_library
- [3] A. Al-Bayaty. “CALA-n Quantum Library.” GITHUB.com. Accessed: Jan. 26, 2025. [Online.] Available: https://github.com/albayaty/cala_quantum_library
- [4] A. Al-Bayaty and M. Perkowski. “Matrix Utilities.” SWI-PROLOG.org. Accessed: Jan. 26, 2025. [Online.] Available: https://www.swi-prolog.org/pack/list?p=matrix_utls

^(a) My Grover Controlled-Diffuser and both GALA-n and CALA-n quantum libraries have officially become part of the IBM Qiskit Ecosystem, available at <https://www.ibm.com/quantum/ecosystem>

MOOC CERTIFICATES

- Control of Mobile Robots, *Georgia Institute of Technology*, Coursera.org
- Autonomous Mobile Robots, *Zürich University*, edX.org
- Fundamentals of Image and Video Processing, *Northwestern University*, Coursera.org
- Introduction to R, *Microsoft and DataCamp*, edX.org
- Introduction to jQuery, *Microsoft*, edX.org
- Real-Time Communications 101 (SBC, VoLTE, WebRTC & SDN), *Sonus Academy*

ACADEMIC & TEACHING CONTRIBUTIONS

1. Participated as a Graduate Teaching Assistant (GTA) at Portland State University for the classes:
 - ECE-171 (Digital Circuits)
 - ECE-172 (Digital Systems)
 - ECE-508 (Computational Tools Workshop)
 - MTH-510 (Quantum Algorithms for Data Science and Machine Learning I & II)
2. Awarded the “Most Interesting Topic” for my presentation “Quantum Circuitry and Algorithmic Extensions to Grover’s Algorithm” on the Department of Electrical and Computer Engineering’s annual Ph.D. Day, in 2024
3. Presented three seminars to three Iraqi universities on the topics of:
 - *Introduction to Quantum Computing*: Al-Nahrain University (College of Engineering), on Apr. 27, 2023
 - *Machine Learning for Medical and Biomedical Applications*: Middle Technical University (Electrical Engineering Technical College), on May 2, 2023
 - *Machine Learning for Medical and Health Applications*: Uruk University (College of Medical and Health Technology), on May 8, 2023

4. Presented 29 seminars and presentations to the graduate students at Portland State University (Department of Electrical and Computer Engineering and Department of Mathematics and Statistics) on the topics of:
 - Prolog, Python, and Qiskit programming
 - Classical reversible gates and quantum circuits
 - Minimizing and synthesizing quantum Boolean oracles
 - Grover's algorithm using the standard Grover diffuser and my invented controlled-diffuser
 - Solving Boolean problems using my invented BHT-QAOA (Boolean-Hamiltonians Transform for QAOA)
 - The advantageous technique of my invented Bloch sphere approach (BSA)
 - My GALA- n and CALA- n quantum libraries
5. Presented three practical seminars to the IBM quantum teams (New York and Zürich) on Qiskit DemoDays (<https://github.com/Qiskit/feedback/wiki/Qiskit-DemoDays>) for the IBM Qiskit ecosystem
6. Presenter in the "RTP (Radiotherapy Planning) Technology Systems" course at the Continuous Education Department, Al-Nahrain University, for biomedical simulation system using MATLAB, February 2006
7. Laboratory assistant for the "Computer Networking" graduate class at the Computer Engineering Department, Al-Nahrain University, 2003–2004
8. Laboratory assistant for the "C Programming Language" undergraduate class at the Computer Engineering Department, Al-Nahrain University, 2003–2004

PROFESSIONAL EXPERIENCE

IRIS (Integrated Refugee & Immigrant Services) Organization

Connecticut, USA

IT Coordinator

10/2015 – 6/2019

- Implemented and deployed Web, DNS, DHCP, and Email servers using LAMP-based platforms
- Maintained Synology NAS—DiskStation and its securities and policies
- Assured the security of the overall system and its related servers from any vulnerabilities and threats using WAF and customized ACLs
- Configured whole networking entities properly to match any future office(s) expansion
- Designed and managed the Wi-Fi networks for IRIS staff, interns, and clients to be used separately to access specified resources and functionalities
- Installed wireless security cameras with remote monitoring capability
- Integrated IRIS clients' files to the unified on-the-cloud web-based database
- Enhanced IRIS website using WordPress platform using PHP, HTML/CSS/JavaScript, and jQuery
- Developed Android software, called AGIR (Assistant Guide for Immigrant & Refugee), for IRIS clients
- Designed and implemented a web portal for IRIS co-sponsors to exchange private data securely
- Deployed internal Email/SMTP server to be used by IRIS staff and other healthcare institutions to privately exchange emails, clients' health/clinical information, and other privacy-related documents according to the HIPAA software compliance
- Managed and administrated the on-the-cloud hosted VoIP server
- Deployed IT Ticketing Server for posting and monitoring technical problems/inquiries from IRIS staff and interns
- Designed, configured, and deployed three on-the-cloud databases for refugee and immigrant purposes of different IRIS departments using LAMP-based servers, named: Randi (Refugees and Immigrants), VandI (Volunteers and Interns), and Gandhi (Immigration Legal Services)

Dynamic Measurement Consultants (DMC), LLC

Connecticut, USA

Accelerometer Board Developer (internship, 480-hour)

7/2012 – 9/2012

- Used PIC24F microcontroller due to its robust controlling purposes for such a project
- Programmed the accelerometer board for a reliable and fast data acquisition rate
- Verified the reliable data conversion using a 12-bit ADC chipset
- Verified the fast data transferring to the host using a USB 2.0 interface

ZTE Corporation

Baghdad, IRAQ

Telecom Engineer

2/2005 – 9/2010

- Configured and administrated the Zsmart billing systems (AIX/Oracle servers) in three provinces: Baghdad, Najaf, and Nasiriyah
- Designed and managed the ZXR10 (ZTE switches and routers) infrastructure for the overall Zsmart billing systems in three provinces: Baghdad, Najaf, and Nasiriyah

- Designed the SDH/STM layouts for Access Networks (MSAN and MSAG) project, in Nasiriya
- Chief of Engineers for CDMA2000 FuratPhone Telecom project, in Nasiriya
- Training Manager for ZTE products (MSS, PDSN, Zsmart systems) at FuratPhone Telecom, in Nasiriya
- Installed, configured, and maintained the MSS and PDSN systems for the CDMA2000 Najaf City project

PROFESSIONAL TRAINING

- Shanghai, China (6/2009 – 7/2009): Training at ZTE R&D in SDH/Optical Transmission/Access Networks
- Shenzhen, China (5/2009 – 6/2009): Certificate from ZTE University in ZXSS10-NGN
- Lannion, France (1/2007 – 2/2007): Certificates from Alcatel University in GSM-ngHLR TOMAS Validation
- Nantes, France (1/2007 – 1/2007): Training at Alcatel R&D in GSM-ngHLR Operation and Maintenance
- Nanjing, China (8/2005 – 9/2005): Training at ZTE R&D in CDMA2000 Push-to-Talk and PDSN
- Shenzhen, China (7/2005 – 8/2005): Certificates from ZTE University in CDMA2000 MSS and SMS
- Amman, Jordan (5/2005 – 6/2005): Pre-sale courses in ZTE products (SoftSwitch and ATM)

REFERENCES

Available upon request