Mohamed Shaban

Contact Information

Cybersecurity Education, Research, and Outreach Center (CEROC)
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[Google scholar]

Education

Doctor of Philosophy in Engineering with a concentration on Computer Science, Tennessee Technological University, USA Jan. 2022 – Jul. 2025
Dissertation: *SPARQ: Toward Efficient Space–Air–Ground Quantum Networks*
GPA: 4.0/4.0

M.Sc. Computer Science from the Faculty of Science Alexandria University, Egypt. Sep. 2015 - May. 2021
Thesis Topic: *Enhancing the Quantum Cost of Reed-Muller Based Boolean Quantum Circuits using Genetic Algorithms*
GPA: 3.62/4.0.

B.Sc. in Computer Science from the Faculty of Science Alexandria University, Egypt Sep. 2011 - Jun. 2015
GPA: 3.65/4.0 - Excellent.

Work Experience

Aug. 2025 – Present

Research Assistant Professor
Cybersecurity Education, Research, and Outreach Center (CEROC), College of Engineering
Tennessee Technological University, Cookeville, TN, USA
Duties & Responsibilities:

- Leading and developing a nationally recognized and externally funded research program in cybersecurity and quantum information science.
- Conducting scholarly research aligned with CEROC's mission, with an emphasis on quantum networking.
- Building a local quantum network at Tennessee Tech University and collaborating with nearby institutions to establish regional quantum networks across Tennessee, with the long-term goal of realizing a scalable quantum Internet.
- Collaborating with faculty and researchers across disciplines to pursue funding opportunities and deliver impactful outcomes.
- Supervising Ph.D. and Master's students in research projects related to quantum networking and cybersecurity.

Apr. 2025 - Jul. 2025

Research Assistant
Oak Ridge National Laboratory (ORNL), Tennessee, USA.
Duties & Responsibilities:
Developed a monitoring system for the ORNL quantum network and conducted research on quantum networking and entanglement distribution in collaboration with the Quantum Communications Group.

Jan. 2022 - Jul. 2025

Research Assistant
Department of Computer Science, Tennessee Technological University, Cookeville, TN, USA.
Duties & Responsibilities:

- Conducting advanced research in quantum information science, machine learning, and cybersecurity, contributing to ongoing projects in these areas.
- Assisting my advisor in supervising graduate students, providing expertise in research methodologies, implementations, running simulations, and writing research papers.
- Assisting my advisor in writing and preparing research grants, including drafting proposals and gathering relevant data.
- Supervising undergraduate students on research projects, helping them design and implement their work.

Jan. 2022 - May. 2022

Teaching Assistant
Department of Computer Science, Tennessee Technological University, Cookeville, TN, USA.
Duties & Responsibilities:

- Assisted students during lab sessions, providing hands-on support and reinforcing concepts covered in lectures.
- Evaluated and graded assignments, providing constructive feedback to enhance student understanding.
- Provided additional support through office hours, addressing student queries and helping with coding challenges.

Courses taught: Introduction to Problem Solving & Computer Programming using C++, Introduction to DevOps with Unix.

Jan. 2018 - Dec. 2021

Head of the Central Control
Faculty of Education, Alexandria University, Alexandria, Egypt.
Duties & Responsibilities:

- Developed a web-based software system to manage student grades for 84 departments, ensuring compliance with Alexandria University regulations. The system provided secure access for students to view their grades online.
- Directed a team responsible for managing grade input, system maintenance, and troubleshooting, ensuring accurate and efficient data handling.
- Implemented enhancements based on feedback to improve system functionality and user experience for professors and students.

Feb. 2017 - Dec. 2021
(On Study Leave)

Teaching Assistant
Faculty of Education, Alexandria University, Alexandria, Egypt.
Duties & Responsibilities:
Taught classes, coordinated mid-term/final exams, coordinated exam evaluation process, evaluated exams, and worked as an invigilator.
Courses taught: Introduction to Computers, Programming Languages, Problem Solving.

Jun. 2016 – Dec. 2021	**Teaching Assistant** Arab Academy for Science, Technology and Maritime Transport (AASTMT), Alexandria, Egypt. **Colleges**: - College of Artificial Intelligence - College of Engineering and Technology - College of Computing and Information Technology - College of Postgraduate Studies **Duties & Responsibilities**: Taught classes, coordinated mid-term/final exams, coordinated exam evaluation process, evaluated exams, and worked as an invigilator. **Courses taught:** Algorithms, Introduction to Computers, Object Oriented Programming, Advanced Object-Oriented Programming, Basic Software, and Problem Solving.
Nov. 2015 - Feb. 2017	**Web Developer** MillenSys healthcare technology and IT solutions. **Duties & Responsibilities**: • Developed and maintained front-end components using HTML, CSS, JavaScript, jQuery, and Kendo UI for responsive user interfaces. • Supported back-end development with ASP.NET MVC and managed databases using Microsoft SQL Server. • Collaborated with senior developers in debugging, testing, and optimizing code. • Maintained version control using Git and contributed to technical documentation.

Publications

Journal Papers

[J1] **M. Shaban**, M. Ismail, and W. Saad, "SPARQ: Efficient entanglement distribution and routing in space-air-ground quantum networks," *IEEE Transactions on Quantum Engineering*, pp. 1–19, 2024.

[J2] J. Holland, **M. Shaban**, M. Chehimi, M. Ismail, A. Younes, and W. Saad, "Efficient protocols for controlled quantum teleportation with single and multi-controllers," *IEEE Transactions on Networking*. Under Review.

[J3] **M. Shaban**, M. Ismail, and W. Saad, "SPARQ: Toward efficient space-air-ground quantum networks," *IEEE Communications Magazine*. Accepted.

[J4] **M. Shaban**, M. Ismail, and M. Kiran, "Towards measuring quantum network performance: Challenges and demonstration," *IEEE Internet Computing*. Under Review, Special Issue on Quantum Networks.

Conference Papers

[C1] **M. Shaban**, M. Ismail, and M. Kiran, "QNTN: Establishing a regional quantum network in tennessee," in *SC24-W: Workshops of the International Conference for High Performance Computing, Networking, Storage and Analysis*, pp. 810–818, 2024.

[C2] **M. Shaban** and M. Ismail, "Secured quantum identity authentication protocol for quantum networks," in *2024 IEEE 100th Vehicular Technology Conference (VTC2024-Fall)*, pp. 1–6, 2024.

[C3] N. Skjellum, **M. Shaban**, and M. Ismail, "Secure and efficient entanglement distribution protocols for near-term quantum internet," in *2024 33rd International Conference on Computer Communications and Networks (ICCCN)*, pp. 1–9, 2024.

[C4] **M. Shaban**, A. Younes, and A. Elsayed, "Enhancing the quantum cost of reed-muller based boolean quantum circuits using genetic algorithms," in *Journal of Physics: Conference Series*, vol. 1447, p. 012031, IOP Publishing, 2020.

[C5] **M. Shaban** and M. Ismail, "Machine learning-enhanced quantum identity authentication over noisy quantum networks," in *Proceedings 2025 IEEE Virtual Conference on Communications (VCC)*, 2025. Under Review.

[C6] **M. Shaban**, M. Ismail, W. Saad, and D. Towsley, "GNN-based proactive entanglement distribution in space-air-ground quantum networks," in *Proceedings 2025 IEEE Virtual Conference on Communications (VCC)*, 2025. Under Review.

[C7] N. Skjellum, **M. Shaban**, and M. Ismail, "SDN-based entanglement routing strategy in smart power grids using reinforcement learning," in *Proceedings of the 6th Workshop on Quantum Computing Opportunities in Energy Innovation, IEEE International Conference on Quantum Computing and Engineering (QCE)*, 2025. Accepted.

Tutorials

- Hands-On Introduction to Quantum Machine Learning, presented at the 37th International FLAIRS Conference (FLAIRS-37), Miramar, FL, USA, May 2024.
  Co-presented with Muhammad Ismail and Samuel Yen-Chi Chen.

Research Grants

- Assisted my advisor in writing and preparing a proposal for the National Science Foundation (NSF) titled **NSF 23-551: Expanding Capacity in Quantum Information Science and Engineering (ExpandQISE)**. Although the proposal was rejected, it was rated as competitive, reflecting the strong potential impact of our work in advancing quantum information science.
- Assisted my advisor in writing and preparing a proposal for the National Science Foundation (NSF) grant titled **Creating and Sustaining a Diverse Community of Expertise in Quantum Information Science (EQUIS) Across the Southeastern United States**. The proposal successfully won $\$1,000,000$, with Tennessee Tech University's share amounting to $\$270,000$. This three-year project started in October 2023.

Projects and Research Activities

- **Quantum Key Distribution (QKD) Testbed Development**
  Designed and developed a QKD testbed platform to enable secure quantum key distribution between two parties. The system integrates optical components for photon generation, polarization, and detection, implementing the BB84 protocol for secure key exchange.
- **Quantum Educational Game for Undergraduate Students**
  Leading the development of an interactive quantum video game that introduces undergraduate students to foundational concepts in quantum information science. The game presents complex topics like qubits, superposition, and entanglement in an engaging and fun way, improving learning outcomes and reducing cognitive barriers.
- **Quantum Network Monitoring System**
  Currently building a monitoring system for quantum network performance at Oak Ridge National Laboratory (ORNL). The system integrates environmental and network-level metrics (e.g., fidelity, QBER, temperature) to provide real-time insights into quantum communication stability and reliability.

- **NSF-Funded Appalachian Regional Quantum Network Planning** *(Ongoing)*
  Actively involved in an NSF-funded initiative to plan a regional quantum network across Tennessee. The project supports the long-term vision of building a quantum Internet infrastructure in the United States by interconnecting research institutions and national labs through entanglement-enabled communication.

Supervision

Current Supervision

I am currently supervising the following students as part of my role at the Cybersecurity Education, Research, and Outreach Center (CEROC), Tennessee Tech University.

Aug. 2025 - Present	Ph.D. Student, **Marwan ElAwady: Quantum Communications and Networking.**
Aug. 2025 - Present	Ph.D. Student, **Nicholas Skjellum: Quantum Communications in Smart Grids.**
Aug. 2025 - Present	MSc Student, **Lance Young: Quantum Communications and Networking.**
Aug. 2025 - Present	MSc Student, **Mikel Gonzalez: Developing an AI chatbot for a quantum game.**

Past Supervision

I assisted my PhD advisor in supervising the following students.

Jan. 2025 - Jul. 2025	PhD Student, **Marwan ElAwady: Quantum communications and Networking.** Department of Computer Science, Tennessee Tech University, TN, USA.
Aug. 2023 - Jul. 2025	PhD Student, **Nicholas Skjellum: Quantum communications in smart grids.** Department of Computer Science, Tennessee Tech University, TN, USA.
Feb. 2024 - Aug. 2024	MSc Student, **Mike Soare: Cybersecurity.** Department of Computer Science, Tennessee Tech University, TN, USA.
Aug. 2022 - Jul. 2023	MSc Student, **Nicholas Skjellum: Quantum communications.** Department of Computer Science, Tennessee Tech University, TN, USA.
June. 2025 - Jul. 2025	Undergraduate Student, **Marcus Writesman: Hybrid key establishment protocol between classical and quantum nodes.** Department of Computer Science, Tennessee Tech University, TN, USA.
Feb. 2024 - Dec. 2024	Undergraduate Student, **David Leathers: Quantum Cryptography**. Department of Computer Science, Tennessee Tech University, TN, USA.
Feb. 2024 - Feb. 2025	Undergraduate Student, **Mikel Gonzalez: Developing a Quantum Game**. Department of Computer Science, Tennessee Tech University, TN, USA.
Feb. 2024 - Sep. 2024	Undergraduate Student, **Lance Young: Quantum Cryptography**. Department of Computer Science, Tennessee Tech University, TN, USA.
Feb. 2024 - Aug. 2024	Undergraduate Student, **Alexander Lujan: Developing a Quantum Game**. Department of Computer Science, Tennessee Tech University, TN, USA.

HONORS AND AWARDS

Apr. 2025	**CEROC Cyber Excellence Award** Student Research Award for outstanding contributions to cybersecurity research.
Jan. 2022	**Research assistant fellowship** Fully funded PhD scholarship at Tennessee Tech. University.

Professional Service

- **Program Committee Member**, Quantum Networking & Communications (QNET) Track, IEEE Quantum Week (QCE) 2025.
- Reviewer for high-impact journals, including:
  - IEEE Transactions on Transportation Electrification (TTE) (Impact Factor 8.3)
  - IEEE Internet Computing Magazine – Special Issue on Quantum Networks (Impact Factor 4.4)
  - Discover Networks (Springer Nature)
- Reviewer for leading international conferences and workshops, including:
  - IEEE Quantum Week (QCE)
  - IEEE International Conference on Communications, Control, and Computing Technologies for Smart Grids (IEEE SmartGridComm)
  - IEEE Conference on Computer Communications (INFOCOM) – Future Telecommunications Workshop
  - IEEE Global Communications Conference (GLOBECOM) – Workshop on Quantum Computing for Communications and Learning

Skills

Technical Skills

- Quantum Networks
- Quantum Communications
- Quantum Cryptography
- Quantum Machine Learning
- Classical Machine learning
- Cybersecurity

Operating Systems: Windows, Mac OS, Android, and Linux.

Languages: MATLAB, Python, Proteus, C, C++, C#, .NET, HTML, XML, CSS, JavaScript, PHP, Java, JQuery, AJAX, SQL Server, and MySQL.

Leadership/supervision Skills

- Supervision of Research of Graduate and Undergraduate students.
- Identify research problems and problem-solving skills
- Ability to work on parallel tasks and under pressure
- Ability to collaborate with faculty from a variety of disciplines