Ghalya Alwhishi

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EDUCATION

Concordia University | *Ph.D of Information System Engineering* *Montreal, QC* | **2024**

- Cumulative **GPA 3.77** (94.25%)
- Thesis: "Multi-Valued Model Checking IoT and Intelligent Systems with Trust and Commitment Protocols"
- The main objective was to provide an efficient and reliable formal verification approach for modelling and verifying complex systems, focusing on IoT and intelligent applications.
- Research involved logical system modelling , formal verification techniques, and full implementation using Java.

Concordia University | *Master of Software Engineering* *Montreal, QC* | **2013**

- Course-Based Master Program
- The program included 12 courses with projects in Software Engineering field.

Aljabl-Algharbi University | *Bachelor of Computer Science* *Alzentan, Libya* | **2001**

SKILLS

• **Programming Language**	*Python, Java, and C++.*	**Programming skills:** Strong
• **Deep Reinforcement Learning**	*PPO*	**Skills: Strong**
• **Kolmogorov–Arnold networks**	*Vanilla KAN, Convolutional KAN, KAN-MLP hybrids*	**Skills: Strong**
• **Training Large Language Models**	*Transformers (Hugging Face), PyTorch, DeepSpeed*	**Skills: Strong**
• **System Verification Methods**	*Classical and multi-valued model checking*	**Technical skills:** Strong
• **Modelling Languages**	*ISPL, ISPL+, VISPL and Promela*	**Modelling skills:** Expert
• **Verification Tools Proficiency**	*NuSMV, UPPAAL, MCMAS, SPIN, SYNOPSYS FORMALITY and CADENCE CONFORMAL*	**Performance skills:** Expert

ACADEMIC AND RESEARCH EXPERIENCE

- Associate Researcher at Concordia University. Integrating Deep Reinforcement Learning in IoT Verification. July 30, 2024, to January 30, 2025.
- **Technical Program Committee (TPC) Member:** Served as a TPC member for MECOM 2024, MECOM 2025, reviewing multiple conference papers. Additionally, acted as a (sub) reviewer for AAMAS 2023-2024 and ECAI 2024. Reviewed papers for *IEEE Transactions on Services Computing* and the *Journal of Applied Non-Classical Logics*.
- **Relevant Coursework**:

- Reinforcement Learning: Qwik Start Authorized by Google Cloud and Coursera. (Grade received 100%). **2024**
- Machine Learning Introduction for Everyone: Issued by Coursera. Authorized by IBM. (Grade received: 90%).**2024**
- Fundamentals of Reinforcement Learning (Grade received: 95.45%). Authorized by University of Alberta, Alberta Machine Intelligence Institute and Coursera. **2024**

➢ **Concordia University,** Department of Information Systems Eng. | PhD Student *Canada* | **2020-2023**

- Conducted a systematic and comprehensive literature review of system verification methods.
- Evaluated the performance of the most notable system verification tools.
- Determined the limitations of the existing techniques and relevant tools.
- Produced new model checking techniques along with new temporal logics.
- Developed a new transformation-based verification tool named MV-Checker.
- Conducted several experiments in verifying IoT and IS systems with trust and commitment protocols under uncertain and inconsistent environments.
- Published several high-impact research papers in the top 1% of journals, contributing significant advancements in the fields of system verification, IoT, and Information Systems.

➢ **Concordia University,** Department of Software Engineering | Master *Canada* | **2010-2013**

A primary member of several projects in:

- Tools and Techniques for Software Engineering.
- Software measurement
- User Interface Development
- Intelligent Systems
- Software Systems Requirements Specification
- Software Quality Assurance
- Software Maintenance
- Advanced Software Architecture
- Quality Project Management
- Software Project Management
- Humen Computer Interface Design
- Data Mining
- Machin Learning

MOST IMPORTANT CONTRIBUTIONS and EXPERIENCES

1. Publication of High-Impact Journal Articles (2022–2025)

I have established a strong publication record with six peer-reviewed journal papers (five as first author), and five peer-reviewed international conference papers. Among these, three are published in ***Information Fusion*** **(Q1, top 1% in AI and Computer Science)** and one in ***Expert Systems with Applications*** **(Q1)** [4]. These works introduce novel verification frameworks addressing uncertainty, inconsistency, and dynamic interactions in IoT systems. In addition, I currently have a paper (**accepted with minor revision) at *IEEE Transactions on Neural Networks and Learning Systems (TNNLS)*, one of the most prestigious journals in AI and machine learning**. Together, these achievements highlight both the originality and impact of my research and my ability to publish at the highest international level, contributing to academic advancements in formal methods and to practical applications in intelligent system assurance.

2. Development of Multiple Verification Tools (2020-2025)

I developed several innovative verification tools to support formal system analysis under uncertainty and scale, including:

- **T5-CTL:** A transformer-based large language model trained to translate natural language specifications into CTL formulas. This tool significantly automates the verification process, bridging the gap between informal requirements and formal methods.
- **DRL-Model Checker:** A deep reinforcement learning-based model checker using Proximal Policy Optimization (PPO). It autonomously verifies CTL properties, bypassing the need for exhaustive state exploration or manual model transformations.
- **MV-Checker:** A multi-valued model checker for formal reasoning under uncertainty and inconsistency.
- **9V-Checker:** A trust-aware model checker built on 9-valued logic, enabling more expressive trust-based reasoning.
- **MCMASt-Interactor:** A multi-valued trust-based extension of the established MCMAS verifier.
- **MCMASc-Interactor:** A multi-valued commitment-based extension for MCMAS.
- **NuSMV-Interactor:** A multi-valued model checker for MV-CTL-based systems using NuSMV verifier.

Impact and Innovation: Together, these tools have had a broad impact:

- **Research Adoption:** Used across multiple projects and academic papers, particularly in autonomous monitoring, IoT, and trust/commitment-aware systems.
- **Scalability:** The DRL model checker enables the analysis of systems with large state spaces, which is particularly beneficial in scenarios where classical methods often fail.
- **Accessibility:** By simplifying the verification pipeline and integrating intelligent agents, the tools reduce the barrier for practitioners to adopt formal methods.
- **Open Access:** All tools were developed with the intention of being open source, supporting reproducible research and community collaboration.

3. **Doctoral Research in Multi-Valued Verification of IoT Systems (Concordia, 2020–2024)**
   My PhD at Concordia University focused on formal verification of IoT and intelligent systems under uncertainty and inconsistency using multi-valued logic. I introduced multiple novel multi-valued model checking approaches supported by tools development and experimental validation.
   Impact: This research bridged theoretical formalism with practical tool creation, leading to top-tier journal publications and the development of new logical languages for more expressive specifications and verification of autonomous systems.
4. **Graduate-Level Guest Lectures on Model Checking Tools (Concordia, Summer 2025)**
   During the Summer 2025 term at Concordia University, I delivered lectures to graduate students. These lectures focused on the introduction to model checking and hands-on guidance in using formal verification tools, including NuSMV and UPPAAL. The sessions covered both theoretical foundations (CTL and LTL semantics) and practical application through tool-based exercises.
   Impact: These lectures helped graduate students understand the relevance of formal verification and gain experience in using industrial-strength tools for verifying correctness in real-time and distributed systems.
5. **Supervision & Guest Lecture for Graduate LLM-Based Verification Projects (Khalifa University, Fall 2025)**
   Invited as a guest lecturer to deliver a session on LLM-based formal verification and temporal logic translation. In addition, I supervised three graduate student groups (3, 3, and 4 members) working on projects involving the training and benchmarking of large language models for translating natural language requirements into Linear Temporal Logic (LTL). My supervision covered dataset preparation, model selection, architecture comparison (decoder-only vs. encoder–decoder), evaluation metrics, and

interpretation of results. These projects provided students with hands-on experience in state-of-the-art LLM training and formal verification workflows and contributed to developing research directions that can be extended into publishable work.

6. **Advancing Equity, Diversity, and Inclusion in Research and Teaching (2010–2025)**
   Over the course of my Master's (2010–2013) and PhD (2019–2025) studies, I actively engaged with students from diverse academic, cultural, and national backgrounds. Throughout my coursework, I collaborated on technical projects that fostered inclusive learning environments and cross-cultural exchange. In my PhD lab, I regularly cooperated with colleagues from different disciplines and backgrounds, contributing to a collaborative and respectful research culture. My research also embodies inclusive principles, addressing heterogeneous and uncertain data in IoT systems, which reflects the diversity and complexity of real-world environments. From 2023 to 2025, I specifically mentored students from underrepresented groups, providing training in formal verification, RL, and AI. I further champion open science by publishing tools and datasets to ensure research accessibility and reproducibility.
   Impact: These experiences have helped cultivate inclusive, collaborative spaces in both teaching and research, while reinforcing the values of equity, diversity, and accessibility in science and education.
7. **TPC and Journal Reviewing (2023–2025)**
   I served as a reviewer for top-tier journals (*IEEE Transactions on Services Computing, Journal of Applied Non-Classical Logics* and *IEEE Transactions on Neural Networks and Learning Systems (TNNLS*) and was a Technical Program Committee (TPC) member in *the MECOM 2024/2025* conference. I also reviewed papers for international conferences like *AAMAS and ECAI*.
   Impact: Contributed to maintaining scientific quality and fostering scholarly communication in the fields of AI and formal verification.
8. **Dataset Creation for LLM-Based CTL Translation (2025)**
   I generated a large-scale dataset of over 30,000 pairs of natural language specifications and CTL formulas to train a custom LLM model for translating informal system requirements into formal logic.
   Impact: This work established a unique large-scale dataset and proof-of-concept model, laying the foundation for LLM-driven formal methods and new directions in specification automation.

TEACHING EXPERIENCE

- **Professional Development**
  - **Teaching with Technology and Inquiry.** *University of Toronto – edX*
    Completed a practice-based course focused on integrating technology and inquiry-based learning in education. Covered themes such as student-centered lesson design, peer collaboration, formative and summative assessments, digital tools, and equity in the classroom. Developed a complete inquiry-enhanced lesson plan applying course principles.
  - **University Teaching.** *The University of Hong Kong – Coursera*
    Completed an introductory course on teaching in higher education. Topics included evidence-based instructional strategies, aligning outcomes with assessment, student-centered learning design, and effective feedback practices. Emphasized research-informed methods and practical approaches for enhancing student learning at the university level.
- **Concordia University | lecturer:** Multiple lectures in Software Quality Methodology. Department of (CIISE) | **Summer term 2025.**
- **Khalifa University | Guest lecturer and project co-supervision:** Delivered guest lecture in computer science, focusing on formal verification and AI applications, and co-supervised Master's projects on translating natural language into temporal logics using large language models (LLMs). Guided students through dataset creation, model fine-tuning, and benchmark-based evaluation to ensure novelty and strong research outcomes. | **Fall term 2025.**

- **Aljabl-Algharbi University | Lecturer.** Python and Jave programming / Operating Systems / Object-oriented programming (OOP). ***Libya*** **| 2014-2018**
- **Aljabl-Algharbi University,** Department of Computer Science | ***Teaching Assistant***, ***Libya*** **| 2003-2009**
  - Engaged as a Teaching Assistant, contributing to educational activities and academic support.
- **Ebn-Khaldoun High School |** *Visual Basic programming teacher* ***Libya*** **| 2003-2009**
  - Conducted classes in the Visual Basic programming language for secondary school students.

SUPERVISION AND MENTORING ACTIVITIES:

1. Collaborative Mentoring During Master's Program (2010–2013)

As part of my course-based master's in software engineering, I worked closely with classmates on 12 major course projects, each aligned with a specific course in software engineering, programming, or system design. I regularly supported and mentored peers by leading discussions, assisting with technical implementation, and sharing effective problem-solving approaches.

Impact: These experiences fostered teamwork, improved project outcomes, and established the foundation for my later commitment to mentoring and guiding students.

2. Research Mentorship and Collaboration During PhD (2019–2024)

During my PhD, I mentored junior lab members in formal methods, temporal logics, and model checking. This guidance supported the lab's development and testing of multi-valued and trust-based verification tools and contributed to successful collaborative publications.

Impact: My mentorship supported junior students in quickly integrating into the lab's research activities, enhanced the quality of collaborative projects, and facilitated the adoption of new verification frameworks by peers.

3. Informal Guidance and Tool Training in DRL-based Research (2024–2025)

As a Research Associate at Concordia University, I developed and published work on DRL-based model checking. During this period, I offered ad hoc support and informal mentoring to students who were interested in applying DRL techniques to verification problems. This included explaining PPO training strategies, semantic correctness measurement, and using FSM environments for CTL formula satisfaction.

Impact: This mentoring enhanced students' ability to experiment with AI-driven verification approaches, increased confidence in applying reinforcement learning to formal methods, and broadened the lab's expertise in emerging verification techniques.

4. Graduate-Level Lecturing on Formal Verification Tools (Summer 2025)

In the Summer 2025 term, I served as a guest lecturer at Concordia University and delivered a series of graduate-level lectures on formal verification tools, including NuSMV and MCMAS. These lectures covered foundational concepts of model checking along with practical sessions, integrating hands-on demonstrations and lab activities. I was responsible for preparing and presenting lecture content and promoting active student engagement by fostering a supportive and inclusive learning environment.

Impact: These lectures provided graduate students with practical expertise in industrial-strength verification tools, strengthened their ability to apply theoretical knowledge to real-world systems, and contributed to building a collaborative and inclusive learning culture.

5. Monitoring and Co-Supervising Graduate Projects on LLM-Based Verification (2025)

In cooperation with my PhD supervisor, I am currently co-supervising three graduate projects applying large language models (LLMs) to translate natural language system specifications into logical formulas (CTL, LTL). My contributions include guiding students on data preparation, model training and evaluation, and integrating LLM outputs into formal verification pipelines. I also provide feedback on methodology and support students in framing their research questions and publications.

Impact: These co-supervision activities contribute directly to advancing cutting-edge research on LLM-driven formal methods, while training graduate students to work at the intersection of AI and verification. This work strengthens capacity in both academic and applied contexts by equipping students with transferable expertise in formal verification, machine learning, and natural language processing.

6. Teaching Assistantship and Student Support (2003-2010)

Before pursuing graduate studies in Canada, I worked as a Teaching Assistant at Al-Jabal Al-Gharbi University in Libya. I supported undergraduate computer science students by assisting in labs, grading, answering questions during tutorials, and reviewing concepts.

Impact: This role strengthened students' academic foundations, improved course pass rates, and gave me early experience in mentoring, teaching, and fostering supportive learning environments.

INTERESTS

- Open systems modelling and verification.
- Reinforcement Learning methods for systems verification.
- Kolmogorov–Arnold networks for systems security.
- Python Programming.
- Project management.

PUBLICATIONS

Academic Journals

1. Alwhishi, G., Bentahar, J., Elwhishi, A., Pedrycz, W., Drawel, N.: Multi-valued model checking iot and intelligent systems with commitment protocols in multi-source data environments. Information Fusion p. 102048 (2023).
2. Alwhishi, G., Bentahar, J., Elwhishi, A., Pedrycz, W.: Mv-checker: A software tool for multi-valued model checking intelligent applications with trust and commitment. Expert Systems with Applications p. 123113(2024)
3. Baharloo, N., Bentahar, J., Alwhishi, G., Drawel, N., Pedrycz, W.: Veri fying trust over iot-ad hoc network-based applications under uncertainty. Ad Hoc Networks p. 103380(2024)
4. Alwhishi, G., Bentahar, J., Elwhishi, A., & Pedrycz, W. (2024). Multi-valued verification of commitment systems with uncertainty and inconsistency in multi-source data settings. Information Fusion, 102502.
5. Alwhishi, G., Bentahar, J., Elwhishi, A., & Pedrycz, W. (2025). Trust verification in information fusion-based autonomous monitoring systems using 9-valued logic. *Information Fusion*, 103468.
6. Alwhishi G, Bentahar J, Andam A, Elwhishi A, Hedabou M. Scalable and Efficient Deep Reinforcement Learning-based Model Checker for Computation Tree Logic. (Submitted to Neural Network and Learning Systems Journal/**(accepted with minor revision)**

Conferences

1. Alwhishi, G., Bentahar, J., Drawel, N., 2022a. Reasoning about uncertainty over IoT systems, in: 2022 International Wireless Communications and Mobile Computing (IWCMC), IEEE. pp. 306–311.
2. Alwhishi, G., Drawel, N., Bentahar, J., 2022c. Model checking intelligent information systems with 3-valued timed commitments, in: International Conference on Mobile Web and Intelligent Information Systems, Springer. pp. 237–251.

3. Alwhishi, G., Bentahar, J., Elwhishi, A., 2022b. Verifying timed commitment specifications for IoT-cloud systems with uncertainty, in: 2022 9th International Conference on Future Internet of Things and Cloud (FiCloud), IEEE. pp. 173–180.
4. Alwhishi, G., Bentahar, J., Elwhishi, A., 2023. Three-valued model checking smart contract systems with trust under uncertainty, in: The International Conference on Deep Learning, Big Data and Blockchain, Springer. pp. 119–133.
5. Alwhishi, G., Bentahar, J., Elwhishi, A.: Multi-valued model checking a smart glucose monitoring system with trust. In: 2023 International Wireless Communications and Mobile Computing (IWCMC), pp. 1697–1702. IEEE (2023).

AWARDS AND SCHOLARSHIPS

- Recipient of scholarship awarded by Libyan Ministry of Education to pursue Masc. Program in Canada 300000$ 2010-2013
- Recipient of scholarship awarded by Libyan Ministry of Education to pursue PhD. Program in Canada 300000$ 2020-2024

REFERENCES

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