

CURRICULUM VITAE – KUNDAN KUMAR

PERSONAL INFORMATION

Kundan Kumar

Ph.D. Candidate in Computer Science (Minor in Statistics), Iowa State University
Ames, Iowa, USA

[Email](#) | [Website](#) | [LinkedIn](#) | [GitHub](#) | [YouTube](#) | [Substack](#)

RESEARCH OVERVIEW

I am a Ph.D. candidate in Computer Science with a minor in Statistics at Iowa State University, specializing in reinforcement learning, large language models, and trustworthy AI for high-stakes cyber-physical systems. My work focuses on developing scalable, robust, and physics-consistent learning algorithms for complex infrastructures, including smart energy systems, distributed control networks, and datacenter-relevant electricity environments. I integrate deep RL, physics-informed learning, LLM-guided decision layers, multi-agent coordination, federated optimization, uncertainty quantification, adversarial robustness, and hardware-in-the-loop validation to build reliable real-world AI systems. My research emphasizes developing adaptive, interpretable, and resource-efficient learning systems for real-time grid optimization, with a focus on:

- Robustness: resilience to uncertainty, noise, distribution shift, and adversarial behavior.
- Interpretability: transparent and aligned with engineering and human-in-the-loop reasoning.
- Scalability: operable across multi-agent, federated, and city-scale infrastructures.
- Physical consistency: grounded in domain constraints and real-world system dynamics.

My research emphasizes reproducible, collaborative, and impact-driven AI development for real-world energy infrastructure systems. My systems have been deployed and evaluated across DOE/IEEE testbeds, OPAL-RT hardware-in-the-loop platforms, CityLearn (multi-agent RL for urban energy coordination) and OpenDSS-based distribution grid environments.

Research Interests: Physics-informed RL, LLM-assisted decision-making, AI for clean electricity planning, neural operators for power systems, federated optimization.

EDUCATION

Ph.D. in Computer Science (Minor: Statistics)

2020–Present

Iowa State University, Ames, IA

Thesis: *Physics-Informed Deep Reinforcement Learning for Smart Grid Optimization*

Advisor: Prof. Christopher Quinn & Prof. Ravikumar Gelli

RESEARCH EXPERIENCE

Iowa State University

Ames, IA

Graduate Research Assistant

Aug 2022 – Present

- Conducting research on Deep Reinforcement Learning (DRL) for intelligent resource management and security in large-scale distributed energy systems.
- Developed physics-informed DRL algorithms incorporating domain-specific constraints, improving resource allocation efficiency by 30% and reducing voltage violations across IEEE-test systems.
- Designed and implemented adversarial attack detection and mitigation frameworks for AI-driven grid controllers, enhancing robustness under stealthy and adversarial scenarios.
- Proposed transfer learning methodologies enabling DRL agents to adapt to new network sizes and topologies, reducing training time by 40% for unseen configurations.
- Leveraged large language models (LLMs) for reasoning and contextual understanding in simulation environments, enabling human-AI collaboration and adaptive control.

Iowa State University

Ames, IA

Graduate Research Assistant

Aug 2020 – Jul 2022

- Conducted research on Deep Reinforcement Learning (DRL) and Safety-Critical Learning for autonomous and cyber-physical systems.
- Developed perception and control pipelines for vision-based autonomous driving using the CARLA simulator, including object detection, trajectory planning, and policy learning.
- Applied deep computer vision models for object recognition, semantic segmentation, and sensor fusion, enabling robust situational awareness in complex environments.
- Investigated safe exploration, policy regularization, and uncertainty-aware learning to enhance DRL reliability in high-stakes decision-making.

PROFESSIONAL EXPERIENCE

National Renewable Energy Laboratory (NREL)

Golden, CO

Machine Learning Engineer (Intern)

May 2024 – Jan 2025

- Developed novel machine learning models for automated network topology inference and resilient control policy optimization for complex distributed systems under extreme scenarios.
- Designed and implemented semi-supervised learning frameworks to handle limited labeled data in energy networks, achieving up to 98% improvement in model accuracy across variable label availability.
- Co-authored the paper “*Advanced Semi-Supervised Learning with Uncertainty Estimation for Phase Identification in Distribution Systems*,” accepted at IEEE-PES-GM 2025.

Comcast
Software Engineer

Centennial, CO
Jun 2019 – Jan 2020

- Designed and implemented real-time data processing pipelines using Amazon Kinesis and RabbitMQ, handling over 1 TB of data daily for fraud detection and system monitoring.
- Built machine learning models for anomaly detection and user behavior analytics, reducing fraudulent activities by 70% through predictive modeling.
- Developed scalable Spring Boot microservices supporting 10 K+ concurrent requests, maintaining 99.9% uptime for mission-critical systems.
- Created interactive dashboards using Presto DB and Python visualization tools, enabling real-time network performance and fraud trend monitoring.

Hewlett-Packard (HP)
Software Engineer

Boise, ID
Apr 2017 – Dec 2018

- Led the migration of large-scale enterprise applications from HPI to HPE domains, coordinating cross-team integration and achieving a seamless transition with zero service disruption.
- Implemented OAuth 2.0 authentication and RESTful microservices using Spring Boot, securing identity and access workflows for over 50,000 users.
- Architected and deployed a modular microservices ecosystem on Apache/WebLogic, improving system latency and throughput by more than 40% and enabling future scalability.

IBM
Software Engineer

Austin, TX
Mar 2016 – Jun 2017

- Enhanced cloud infrastructure reliability on OpenShift by developing automated scaling and deployment pipelines, reducing operational overhead by nearly 30%.
- Designed a real-time observability and monitoring stack using Flask, Grafana, and custom metrics APIs to track performance across 100+ distributed cloud servers.
- Built an automated anomaly detection and alerting system that reduced incident response time by 60% and significantly improved system uptime.

Tata Consultancy Services (TCS)
Systems Engineer

Mumbai, India
Jul 2012 – Dec 2014

- Designed and maintained high-performance ETL pipelines integrating heterogeneous enterprise data sources, reliably processing over 100 GB of data per day for analytics and reporting systems.
- Optimized large-scale data warehousing workflows through advanced SQL tuning, indexing, and partitioning strategies, reducing critical query execution times by up to 70%.
- Earned the **Excellence Award** for delivering more than \$100k in annual cost savings by redesigning core data processing modules and improving infrastructure efficiency.

TEACHING
EXPERIENCE

Iowa State University
Teaching Assistant

Ames, IA
2020–Present

Courses Taught: Software Development Practices, Object-Oriented Design, User Interface Design, Software Testing, Database Systems

- Mentored 90+ students per semester in software development, systems design, and user interface.
- Led coding labs on CI/CD pipelines, automated testing, containerization (Docker), and modern development workflows.
- Guided student teams through Agile project development, code reviews, Git collaboration, and full-stack deployment.
- Taught object-oriented design, SQL optimization, and scalable system architecture using real-world case studies.
- Designed hands-on modules and interactive demos linking foundational concepts to production-level engineering practices.

SELECTED
PUBLICATIONS

Journal Papers

- **K. Kumar**, A. Hussain, R. Gelli, “Bayesian-Optimized BiLSTM for Wind Power Forecasting with Uncertainty Quantification,” *Electric Power Systems Research*, 2026 ↗ [Here](#).
- **K. Kumar**, R. Gelli, “Physics-Based Deep Reinforcement Learning for Grid-Resilient Volt-VAR Control,” *IEEE Transactions on Smart Grid*, 2025 (Under Review).

Conference Papers

- **K. Kumar**, R. Gelli, “A Multi-Objective Optimization Framework for Carbon-Aware Smart Energy Management,” *IEEE North American Power Symposium (NAPS)*, 2025.
- **K. Kumar**, U. Kumar, J. Wang, H. Padullaparti, “Advanced Semi-Supervised Learning with Uncertainty Estimation for Phase Identification in Distribution Systems,” *IEEE PES General Meeting*, 2025 ↗ [Here](#).
- **K. Kumar**, R. Gelli, “Transfer Learning Enhanced Deep Reinforcement Learning for Volt-VAR Control in Smart Grids,” *IEEE Grid Edge Technologies Conference*, 2025 ↗ [Here](#).
- **K. Kumar**, A. A. Mantha, R. Gelli, “Bayesian Optimization for Deep Reinforcement Learning in Robust Volt-VAR Control,” *IEEE PES General Meeting*, 2024 ↗ [Here](#).
- **K. Kumar**, R. Gelli, “Deep RL-Based Volt-VAR Control and Attack Resiliency in DER-Integrated Distribution Grids,” *IEEE Innovative Smart Grid Technologies (ISGT)*, 2024 ↗ [Here](#).

RESEARCH PROJECTS

Representative projects highlighting my work on adaptive, scalable, and trustworthy AI systems for complex cyber-physical environments.

- **LLM-Guided Multi-Agent Control in Smart Energy Environments**

Integrated large language models into a multi-agent simulation framework to enable high-level reasoning, adaptive coordination, and interpretable decision-making for building-level energy management and demand-response optimization.

- **Federated Deep Reinforcement Learning Testbed for smart Resource Management**

Built a distributed federated DRL testbed to evaluate communication-efficient learning, privacy preservation, and heterogeneous client behavior in large-scale smart energy systems. Demonstrated scalable performance across multi-client and multi-topology configurations.

- **Safe and Robust Reinforcement Learning for Autonomous Controllers**

Developed safety-constrained and adversarially robust RL controllers capable of maintaining stability and operational reliability under disturbances, sensor noise, and targeted attacks. Evaluated generalization and robustness across diverse cyber-physical simulation environments.

SKILLS

Programming Languages: Python, Julia, R, Java, C++, SAS, MATLAB, SQL, JavaScript, Node.js, React.js, REST APIs, SoapUI

Machine Learning & Statistical Analysis: Scikit-learn, TensorFlow, PyTorch, Pandas, NumPy, Matplotlib, Seaborn, OpenAI Gym, Hypothesis Testing, Experimental Design, Bayesian Modeling

Large Language Models (LLMs): Hugging Face Transformers, LangChain, Retrieval-Augmented Generation (RAG), Prompt Engineering, Fine-tuning, Evaluation, Safety & Robustness

High-Performance Computing & Distributed Systems: Spark, Hadoop, Hive, Pig, Kafka, Amazon Kinesis, Presto, SLURM, MPI, OpenMP, Ray

Simulation & Cyber-Physical Systems Tools: OPAL-RT, OpenDSS, CARLA, CityLearn

Visualization & GIS: Tableau, ArcGIS, Leaflet

Optimization & RL Tools: Gurobi, Pyomo, Optuna, BoTorch, Stable-Baselines3, RLlib

Cloud & Deployment: AWS (EC2, S3, Lambda), Google Cloud, Docker, Kubernetes, Git/GitHub

AWARDS AND HONORS

- Professional Advancement Grant (PAG), Iowa State University (2025)
- IEEE Student Travel Awards — NAPS 2025, PES-GM 2024, ISGT 2023
- Selected Participant, ByteBoost HPC Research Workshop (2024)

LEADERSHIP AND SERVICE

Reviewer

- NeurIPS 2025 (Ethics + Datasets & Benchmarks Track) and AAAI 2025 (MARW Workshop)
- IEEE Transactions on Industrial Informatics and Neural Networks and Learning Systems
- IEEE PES-GM, Grid Edge, ISGT (2023–2024)
- Volunteer — Prayaas India, supporting STEM education for underserved communities