

CURRICULUM VITAE – KUNDAN KUMAR

PERSONAL INFORMATION	<p>Kundan Kumar Ph.D. Candidate in Computer Science (Minor in Statistics), Iowa State University Ames, Iowa, USA</p> <p>✉ Email 🌐 Website in LinkedIn 🐙 GitHub 📺 YouTube 📱 Substack</p>	
RESEARCH OVERVIEW	<p>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:</p> <ul style="list-style-type: none">• 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. <p>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.</p> <p>Research Interests: Physics-informed RL, LLM-assisted decision-making, AI for clean electricity planning, neural operators for power systems, federated optimization.</p>	
EDUCATION	<p>Ph.D. in Computer Science (Minor: Statistics) Iowa State University, Ames, IA</p> <p><i>Thesis: Physics-Informed Deep Reinforcement Learning for Smart Grid Optimization</i> Advisor: Prof. Christopher Quinn & Prof. Ravikumar Gelli</p>	<p><i>2020–Present</i></p>
RESEARCH EXPERIENCE	<p>Iowa State University Graduate Research Assistant</p> <ul style="list-style-type: none">• 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. <p>Iowa State University Graduate Research Assistant</p> <ul style="list-style-type: none">• 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.	<p><i>Ames, IA</i> <i>Aug 2022 – Present</i></p> <p><i>Ames, IA</i> <i>Aug 2020 – Jul 2022</i></p>
PROFESSIONAL EXPERIENCE	<p>National Renewable Energy Laboratory (NREL) Machine Learning Engineer (Intern)</p>	<p><i>Golden, CO</i> <i>May 2024 – Jan 2025</i></p>

- 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 re-designing 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