Praveen Rangavajhula

praveen.rangavajhula@uga.edu | LinkedIn | GitHub | Mobile: +1-706-765-9109

Profile Summary

Graduate student in Computer Science at the University of Georgia with research experience in autograd systems, privacy-preserving optimization, and sustainability-focused federated learning. Motivated to advance machine learning that is both interpretable and efficient, reducing energy costs while making models more transparent and trustworthy. Currently a PhD student in Machine Learning at the University of Georgia.

Education

- **University of Georgia (UGA)** — *Athens, GA*
  Ph.D. in Computer Science — *Jan 2026 – Present*
- **University of Georgia (UGA)** — *Athens, GA*
  M.S. in Computer Science (GPA: 3.91) — *Aug 2023 – Dec 2025*
- **BITS Pilani** — *Pilani, India*
  B.E. in Mechanical Engineering — *Aug 2019 – July 2023*

Skills

- **Programming Languages**: Python, Scala, Java, C, SQL
- **Machine Learning Libraries**: PyTorch, TensorFlow, Scikit-Learn, OpenCV
- **Data Science Tools**: NumPy, Pandas, Matplotlib, Seaborn, Jupyter, scikit-image
- **ML Techniques & Concepts**: Supervised Learning, Deep Learning, Optimization, Backpropagation, Federated Learning, Differential Privacy, Autograd Systems

Projects & Research

- **Custom Autograd Engine for Machine Learning Research** — *University of Georgia*
  Master's Project – Graduate Research (under Prof. John A. Miller) — *Dec 2024 – Dec 2025*
  - **Automated Differentiation**: Designed and implemented a custom autograd engine in Scala, enabling automatic computation graph construction and backpropagation.
  - **Gradient Caching for Efficiency**: Integrated gradient caching mechanisms to store intermediate values, reducing redundant recomputation and improving training efficiency.
  - **Dynamic Computation Graph**: Implemented a dynamic graph structure that supports complex tensor operations, allowing for efficient forward and backward passes in deep learning models.
  - **Scalability and Modularity**: Developed reusable tensor and optimization modules, making the engine extensible for future integration with larger ML frameworks, including potential applications in large-scale model training.
- **Federated Learning for Carbon Footprint Tracking** — *University of Georgia*
  Volunteer Research Project (with Profs. Fei Dou and Lakshmish Ramaswamy) — *Jan 2025 – May 2025*
  - **Sustainable Federated Learning**: Implementing **Federated Learning** using **Flower** and **PyTorch** to track **carbon emissions of deep learning models (MobileNetV3, ResNet20)** across distributed nodes.
  - **Carbon-Aware Model Evaluation**: Analyzing trade-offs between **model accuracy, energy efficiency, and environmental impact** in federated deep learning settings.
  - **Edge AI Experimentation**: Conducted experiments on **Jetson devices** to evaluate federated learning models (MobileNetV3, ResNet20) under low-power, decentralized settings.
- **RNN-Based Optimization for Time-Series Forecasting** — *University of Georgia*
  Master's Project – Graduate Research (under Prof. John A. Miller) — *Aug 2024 – Dec 2024*
  - **Mathematical Derivation**: Manually derived **backpropagation through time (BPTT)** equations for RNNs and GRUs, analyzing gradient flow behavior and applying **gradient clipping** to improve training stability.
  - **Implementation in Scala**: Implemented RNNs and GRUs from scratch using the derived equations, achieving a SMAPE reduction from 60% to 16% on forecasting tasks.
  - **Scalability**: Designed modular `RecurrentBase` and `RNNCell` components for large-scale forecasting tasks.
- **Differentially Private Optimizer – Research Project** — *University of Georgia*
  Course Project – Privacy-Preserving Machine Learning (under Prof. Jaewoo Lee) — *Aug 2024 – Dec 2024*
  - **DP-Lion: Private Optimizer Design**: Developed **DP-Lion**, a novel differentially private optimizer for deep learning, improving training stability and performance over DP-SGD and DP-Adam.
  - **Benchmarking on CIFAR-10**: Achieved **69% accuracy** on ResNet20 with privacy guarantees, outperforming most existing DP optimizers in empirical evaluations.

- **Evaluation Against DeepMind Benchmarks**: Integrated techniques from DeepMind's private optimization research and compared DP-Lion against their reported baselines.
- **Research Focus**: Used Opacus to privatize DP-Lion and baseline optimizers (DP-SGD, DP-Adam, DP-RMSprop), conducting empirical comparisons as part of a graduate privacy-preserving ML course project.
- **Code**: GitHub Repository

- **Spotify Song Genre Classification** *University of Georgia*
  Course Project – Data Mining (under Prof. Fei Dou) *Aug 2024 – Dec 2024*
  - **Data Processing & Feature Engineering**: Processed **114,000 song samples**, extracting insightful **audio features** (e.g., **danceability-valence correlation**).
  - **Model Development**: Trained and compared **Decision Trees, Random Forests, SVM, kNN, and Neural Networks**, achieving **85.6% accuracy**.
  - **Experimentation & Metrics**: Designed and evaluated experiments using **precision-recall, ROC-AUC**, and **confusion matrices** to optimize classification.
  - **Code**: GitHub Repository

- **Diabetes Progression Prediction** *Kaggle Project*
  Data-Driven Modeling & Predictive Analytics *Sept 2024*
  - **Exploratory Data Analysis (EDA)**: Performed **data cleaning, feature engineering, and transformation (Box-Cox)** to improve regression model performance.
  - **Predictive Modeling**: Built and evaluated a **Linear Regression model from scratch**, benchmarking against **Scikit-Learn** implementations.
  - **Model Evaluation & Diagnostics**: Used **residual analysis, Q-Q plots, VIF checks**, and **homoscedasticity tests** to diagnose and improve model performance.
  - **Regularization & Feature Selection**: Analyzed the impact of **Lasso, Ridge, and Elastic Net** regularization techniques to mitigate multicollinearity.
  - **Code**: GitHub Repository

- **Spatio-Temporal Audio Classification** *University of Georgia*
  Course Project – Machine Learning in IoT (under Prof. Fei Dou) *Jan 2024 – May 2024*
  - **Model Adaptation**: Adapted a published **ConvLSTM-based architecture** to classify underwater acoustic signals on the **VTUAD dataset**.
  - **Learning Outcome**: Gained initial hands-on exposure to deep learning pipelines, model reproduction, and working with spatio-temporal data in ML.