

Omar Ayman Bakr

Fresh Machine Learning Engineer

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PROFESSIONAL SUMMARY

A recent Mechatronics Engineering graduate specializing in Machine Learning with a focus on Computer Vision, backed by a rigorous foundation in Linear Algebra, Probability, and advanced Data Structures. Demonstrates strong problem-solving ability with over [200+ LeetCode problems solved](#). Seeking to leverage a strong quantitative background and vision-focused expertise to develop innovative solutions in Computer Vision and Deep Learning applications.

TECHNICAL SKILLS

- **Programming Languages:** Python, C++, C, MATLAB, SQL
- **AI Frameworks & Libraries:** PyTorch, Scikit-learn, Pandas, NumPy, imblearn, Matplotlib, Seaborn, Plotly
- **Developer Tools:** Git, GitHub, VS Code, PyCharm, Jupyter Notebook, Conda, Linux/Fedora, Docker
- **Databases:** PostgreSQL, pgAdmin4
- **Core Concepts:** Data Structures, Algorithms, Calculus (Single & Multivariable), Linear Algebra, Probability

PROJECTS

Volleyball Group Activity Recognition (In Progress)

- Reproducing the CVPR 2016 hierarchical group-activity recognition pipeline on the Volleyball Dataset (55 videos, 4,830 clips, 8 group activities, 9 player actions, 60+GB) across 8 progressively complex baselines (B1–B8).
- Built the data pipeline: master JSON unifying three annotation sources, cached via pickle and a memory-mapped LMDB store; a generic PyTorch `Dataset` + `collate_fn` supporting both full-image and per-player crop modes with variable player counts.
- Implemented B1 (single-frame ResNet-50 fine-tuning) and B3 (two-stage person-then-group classifier with pooled per-player features); B4–B8 (LSTM-based temporal modeling with attention pooling and team-split architectures) in progress.
- Built shared training/evaluation scaffolding with multi-GPU `DataParallel` support; configs via Hydra; metrics tracked in TensorBoard.

Keywords: PyTorch, ResNet-50, Hydra, TensorBoard, LMDB, DataParallel, Group Activity Recognition, Transfer Learning, Computer Vision.

Credit Card Fraud Detection on Severely Imbalanced Data

- Tackled extreme class imbalance ($< 0.2\%$ fraud rate) by benchmarking 11 ML models, prioritizing algorithmic solutions over data resampling, using the popular Kaggle Credit Card Fraud dataset with 285K transactions.
- Implemented custom Focal Loss function in PyTorch from mathematical foundations, training both Logistic Regression and Neural Network models to specifically address minority class detection without data-level interventions.
- Conducted systematic model comparison across diverse algorithm families including ensemble methods (Random Forest), boosting algorithms (XGBoost, LightGBM, CatBoost, AdaBoost, Gradient Boosting), and deep

learning approaches.

- Achieved optimal fraud detection with XGBoost (F1: 0.89, AP: 0.87, ROC-AUC: 0.98), outperforming baseline Logistic Regression by 16% in F1-score while maintaining high precision on the minority fraud class.

Keywords: Imbalanced Classification, Focal Loss Implementation, XGBoost, PyTorch, Model Benchmarking, Fraud Detection, Ensemble Methods.

New York City Taxi Trip Duration Prediction

- Engineered comprehensive feature sets by integrating 5 external data sources including NYC traffic volumes (2016 DOT data), historical weather patterns, geospatial borough boundaries, and holiday calendars, transforming 10 original features into 55 engineered features.
- Deployed a local OSRM routing server using Docker to query OpenStreetMap data, generating real-world routing features (shortest path distance and estimated travel time) for 1M+ trip records.
- Implemented a complete preprocessing pipeline featuring log transformation of target variable to reduce variance, strategic outlier removal (trips > 1000 km), one-hot encoding, and polynomial feature generation (degree 2) to capture non-linear interactions.
- Achieved strong predictive performance with Ridge Regression, securing RMSE of 0.397 and R^2 score of 71.6% on test set (224,734 samples), demonstrating effective feature engineering on large-scale geospatial data.

Keywords: Feature Engineering, OSRM API, Docker, Geospatial Analysis, External Data Integration, Ridge Regression, Time Series Features.

EDUCATION

Bachelor of Science, Mechatronics Engineering
Helwan University

2019 – 2024

- Graduated with Honors (Grade: Very Good, GPA: 3.0/4.0).
- Engineered a [mathematical model](#), implemented it on MATLAB for a green hydrogen generator to control input voltage and current while predictively monitoring critical safety parameters (e.g., operating temperature).