

# Vikrant Singh

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## Professional Summary

AI/ML Engineer and Software Developer with over **7 years** of experience in machine learning, LLMs, backend systems, and data science. Skilled in designing and optimizing advanced AI systems including Retrieval-Augmented Generation (RAG), Neural Architecture Search (NAS), and Transformer architectures. Experienced in geospatial analytics, scalable microservices, and observability tools. Strong foundation in algorithms, data pipelines, and model deployment. Seeking roles in **Data Science** and **Machine Learning** to contribute to innovative AI-driven solutions.

## Experience

### Petanux GmbH

#### AI/ML Engineer

Jan 2025 – Present

Bonn, Germany

- Incorporated **LLMs into chatbot systems**, improving accuracy, reducing hallucinations, and mitigating **prompt injection** vulnerabilities.
- Enhanced chatbot performance by optimizing retrieval workflows and **reducing response latency** to near real-time.
- Built and optimized **RAG pipelines** with Elasticsearch & ChromaDB for hybrid search, streamlining ingestion and retrieval.
- Developed **AI agents** (e.g., kiosk ordering, trading, router agents) using LangChain, **LangGraph**, Autogen, and function calling.
- Refactored backend into **microservices** with Flask/FastAPI and REST APIs, using async workflows and semaphores to reduce pipeline runtime from ~900s to 20–30s.
- Implemented scalable solutions: Redis-based **real-time video player**, RabbitMQ for orchestration, and Elastic-based hybrid DB migration.
- Integrated monitoring stack with **Grafana, Prometheus, Loki, Sentry** to improve observability and reliability.
- Designed scalable **web scrapers** with Playwright, Scrapy, Selenium, and httpx; automated pipelines using **n8n**.
- Contributed to **computer vision** tasks (object detection & segmentation) using PyTorch and TensorFlow.

### Fraunhofer Institute for Communication, Information Processing and Ergonomics

#### Research Assistant

Jul 2020 – Sep 2024

Bonn, Germany

- Optimized flight trajectory predictions by integrating **LSTM with NAS**, and implemented **HMM with Viterbi Algorithm** on OpenSky data.
- Applied **Transformer models** for domain-specific NLP applications.
- Built ETL pipelines for wildfire simulations using **QGIS, PostGIS, GDAL**; created Power BI dashboards for ML outputs.
- Deployed **Liferay portal** in Docker, improving operational efficiency.
- Collaborated across teams, simplifying technical insights for non-technical stakeholders.

### Asteria Aerospace Pvt. Ltd.

#### Software Developer

Jul 2016 – Mar 2019

Bengaluru, India

- Developed real-time **C++ algorithms** for UAV telemetry, improving flight performance and safety.
- Implemented data visualization with **Qt & PyQt**, enhancing mission control usability.
- Integrated geospatial datasets to strengthen UAV mission planning and control.
- Trained clients including Indian police & defense on mission software, and mentored new hires.

### Bison Code LLP

#### Android Developer Intern

Jan 2016 – Jun 2016

Chandigarh, India

- Developed 'Safe Shelter' app prototype with **geofencing** technology for community safety.

## Education

### Universität Paderborn

#### MS in Computer Science

Jun 2024

Paderborn, Germany

### Panjab University

#### BE in Information Technology

Jun 2016

Chandigarh, India

## Master Thesis

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### Knowledge Graph Embeddings

*Supervisor: Prof. Dr. Axel-Cyrille Ngonga Ngomo*

- Developed **function-based knowledge graph embeddings** (polynomial, complex number, neural network spaces).
- Applied **Neural Architecture Search (NAS)** for optimized embedding models, improving accuracy.
- Enhanced **LLMs** by integrating structured knowledge to reduce hallucination and improve factual grounding.

## Projects

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### Step Counting with Sensor Data | *Python, Pandas, SciPy, PyTorch, LSTM, GRU, Random Forest, XGBoost*

- Processed raw accelerometer and gyroscope JSON datasets, applying **Butterworth filtering** and peak detection to generate surrogate labels.
- Implemented sequential models (**LSTM, GRU, CNN-LSTM**) and aggregated-feature models (**Random Forest, XGBoost**) for step prediction.
- Achieved lowest error with GRU model (Validation MSE  $\approx 3.68$ ) and Random Forest regressor (MAE  $\approx 2.05$ ), enabling accurate left-right step counting.

### RAG with LangGraph on Email Data | *Python, Flask, LangGraph, RAG*

- Implemented a Retrieval-Augmented Generation (RAG) pipeline using **LangGraph** to query personal email data with contextual accuracy.
- Explored applications in automated drafting, intelligent search, and personalized assistants.

### Financial Market Investment Strategies | *Python, Prophet, Quantlib, TensorFlow, Yahoo Finance API, Bloomberg API*

- Developed predictive models for cryptocurrency and stock markets using **LSTM** and **Prophet**, supporting portfolio optimization.
- Integrated **Yahoo Finance & Bloomberg API** for sentiment analysis to improve prediction robustness.
- Backtested investment strategies with historical datasets; applied Quantlib for derivatives pricing and risk management.

### Cycling Tour Prediction | *Python, NLP, Geospatial Analysis, Hugging Face, BART*

- Designed NLP pipeline with Hugging Face NER and Facebook BART for zero-shot classification of user queries.
- Integrated **geopy**-based geospatial filtering for distance and elevation-aware cycling route recommendations.

## Technical Skills

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**Languages:** Python, C++, Java, SQL

**Backend:** Flask, FastAPI, REST APIs, Microservices, RabbitMQ, Redis

**AI/ML:** LLMs, RAG, Neural Architecture Search, Transformers, PyTorch, TensorFlow, Hugging Face, LangChain, LangGraph, Autogen, n8n Automations

**Data Engineering:** ETL, dbt, Azure Data Services, Web Scraping (Playwright, Scrapy, Selenium, httpx)

**Data Analysis & Visualization:** Pandas, NumPy, Matplotlib, Seaborn, Plotly, Power BI, Grafana, Prometheus, Loki, Sentry

**Databases:** MySQL, PostgreSQL, ChromaDB, Elasticsearch, Snowflake

**Cloud:** Azure (DataLake, Data Factory)

**Tools:** Git, Docker, Jupyter, n8n, Agile/Scrum

**Other:** QGIS, PostGIS, GDAL