Ratneshwaran Maheswaran
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LinkedIn GitHub Portfolio

Education

University College London (UCL), UK Sep 2024 - Dec 2025
MSc Artificial Intelligence for Biomedicine and Healthcare
Grade: Distinction

The University of Nottingham, UK Sep 2021 - July 2024
BEng (Hons) Electronic and Computer Engineering
Grade: Upper Second-Class Honours

Experience

UCL Centre for Artificial Intelligence October 2025 - Present
Research Assistant *(in collaboration with Freedom from Torture, UK Charity)*

- Prototyping multilingual mental health conversational agents using LLMs and agentic AI frameworks (LangGraph, CrewAI).
- Partnering with Freedom from Torture to ensure trauma-informed, culturally sensitive design and deployment.
- Collaborating with clinical researchers to embed evidence-based therapeutic strategies into AI-driven systems.
- Developing synthetic clinician–patient dialogue datasets to support model training and evaluation.
- Architecting safe and interpretable agentic AI workflows for reasoning and planning in sensitive contexts.
- Integrating and testing LLM services (ChatGPT, Claude, Llama, Groq, AWS Bedrock) within cloud-based pipelines.

Secrier Lab, UCL Genetics Institute March - Present
AI & Genomics Researcher (Part time)

- Built scalable ML pipeline (PyTorch, scvi-tools, Scanpy) for analysing millions of single-cell RNA-seq datapoints across multiple cancer types.
- Applied and benchmarked foundation models (scBERT, scGPT, Geneformer, LangCell) for classification and state prediction, achieving strong performance on Accuracy, F1, AUROC, and AUPRC.
- Developed novel zero-shot annotation techniques and improved cross-dataset generalisation under batch effects using dimensionality reduction (UMAP).
- Produced actionable insights into data-driven cancer classification, with a reproducible framework and pre-print planned for 2026.

Open-Source Assistive Devices (OPAD), University of Nottingham September 2022 - July 2024
President, Faculty of Engineering Society

- Directed 12+ student-led projects developing assistive and medical devices, combining hardware, software, and data pipelines.
- Applied machine learning to optimise device performance and automate data collection, with applications aligned to NHS needs.
- Oversaw technical operations (circuit design, embedded systems, analytics) while coordinating cross-disciplinary student teams.
- Secured £1500 in grant funding to expand development and support community-focused engineering impact.

40seconds.org (Ratneshwaran Foundation) January 2020 - 2023 (Currently in Hiatus)
Founder & CEO (Non-profit)

- Founded global non-profit promoting mental health awareness and human rights among youth.

- Directed 5+ initiatives, 30+ articles, 1 research project, and led 120+ volunteers across 19 countries.
- Raised £2000 for Covid-19 relief; currently sustained by core team during academic commitments.

Research Interests

Agentic AI, Efficient Machine Learning, Foundation Models, Natural Language Processing (NLP), Large-Scale Data Analytics, High-Performance Computing, Computer Vision, Remote Sensing, AI for Sustainability

Skills

Programming: Python, R, Swift, SQL, C/C++, MATLAB, Java
Frameworks & Libraries: PyTorch, TensorFlow, scikit-learn, NumPy, Pandas, Matplotlib, Seaborn, OpenCV, torchvision; Scanpy, LangChain, OpenAI APIs
Computer Vision: Image segmentation (semantic/instance), classification, data augmentation, model evaluation (IoU/Dice, precision/recall), error analysis; model confidence/uncertainty (probability scores, entropy, calibration)
Geospatial & Remote Sensing: GeoTIFF handling, tiling/patch-based inference, CRS/transforms; GeoJSON/Shapefile export; GeoPandas, Rasterio, Shapely; QGIS/PyQGIS (basic)
Compute & Reproducibility: Linux/Unix, bash, HPC (SLURM), Snakemake/Nextflow, conda/poetry, CI (GitHub Actions)
Tools & Platforms: Git, Docker, FastAPI, PostgreSQL, Node.js, React, Streamlit, LaTeX, CUDA, AWS Bedrock, AWS
Hardware & Embedded: STM32, ESP32, Arduino, Raspberry Pi; I^2C/SPI; PID control; ADC & analog circuit design (BJT, MOSFET)

Publications & Open-source Projects

Grounded By Design: Dialog-flow Constrained LLMs for Safe Multilingual Voice PTSD Support 2025–2026

- Built a mobile-first grounding assistant for between-session distress support (English & Tamil) in collaboration with Freedom from Torture.
- Implemented a clinician-derived dialog-flow controller (DAG of trauma-safe states) to constrain LLM behaviour to grounding-only interactions with explicit escalation states.
- Added layered safety mechanisms (risk monitoring + output filtering) to detect crisis signals (e.g., self-harm/violence) and trigger conservative handover to human support.
- Deployed an end-to-end voice pipeline (STT/TTS) and a three-tier system: React web client, edge API layer, and AWS backend services for reasoning and speech.
- Instrumented sessions with SUDS pre/post ratings, transcript capture for auditability, and pre-recorded grounding exercises integrated into the UI.
- Manuscript in preparation.

RareTree Scout: Confidence-Aware Canopy Mapper 2026

- Built an aerial imagery canopy and tree crown delineation pipeline using deep learning segmentation, with exportable crown polygons for GIS analysis.
- Implemented early-stage evaluation with IoU/Dice and qualitative error analysis across challenging cases (occlusions, shadows, mixed canopy density).
- Computed model confidence and uncertainty maps (e.g., max-probability and entropy) and added threshold-based abstention to prioritise human review.
- Added a *RareCandidate* module to flag unusual crowns via embedding-based outlier scoring, supporting long-tail monitoring workflows without forcing species labels.
- Produced QGIS-compatible outputs (GeoJSON/Shapefile and confidence rasters) and a lightweight Python GUI tool for interactive inspection and export.

AI Agent for Literature Review (LitAgent) 2025

- LangGraph-driven multi-agent system automating literature reviews across *arXiv* and *PubMed*, with metadata enrichment from Crossref.
- Integrated agents (*SearchAgent*, *SummarizerAgent*, *CriticAgent*, *ComparatorAgent*) enabling structured synthesis, gap analysis, and future work identification.
- Supports multiple output formats including Markdown, JSON, and CSV for paper metadata.
- Provides both CLI and REST API access, alongside a React/Vite/Tailwind frontend for interactive exploration.
- Incorporates user-configurable search filters and accountability checks via CriticAgent to flag overclaims and weak reproducibility.
- **GitHub**

Enhancing Aspect-Based Sentiment Analysis and Review Reading Comprehension with Adversarial Training and Hierarchical Aggregation in BERT-based Models 2025

- Improved BERT for Aspect Extraction, Sentiment Classification, and Review Comprehension.
- Combined adversarial training with P-SUM/H-SUM, surpassing prior state-of-the-art in domain-specific NLP.
- Demonstrated efficiency of fine-tuned BERT over LLMs for targeted, low-resource tasks.
- Pre-print submission targeted for December 2025.

Zero-Shot Cell Annotation with Foundation Models 2025

- Implemented zero-shot pipelines for single-cell RNA-seq analysis, enabling malignant vs. normal classification and multi-class cell state prediction across ovarian, prostate, kidney, and pancreas cancer datasets.
- Built preprocessing workflows for diverse data formats and integrated evaluation with Accuracy, F1, AUROC, and AUPRC.
- Developed visualization tools (UMAP, performance plots) to assess model generalisation and batch effects.
- **LangCell GitHub**, **Geneformer GitHub**

AI College Assistance App 2025

- Built an AI-powered counselling platform to support students applying abroad (UK, US, Australia).
- Implemented essay feedback using GPT-4, application timelines, portfolio builder, and AI chatbot for personalised guidance.
- Full-stack development with React (TypeScript), FastAPI (Python), PostgreSQL, Firebase, and OpenAI API.
- Designed scalable architecture with separate frontend, backend, and shared utilities.

Eva - Empathetic AI Assistant 2025

- Developed an AI-driven emotional support app featuring a built-in chatbot designed to help users explore their thoughts, with additional features such as breathing exercises, a crisis helpline, and customizable themes.
- Currently in development, this open-source project aims to provide accessible mental health support.
- **GitHub**, **App link**

Python Simplified 2020

- Authored a book on Python Programming, distributed over 30,000 copies to uplift underprivileged students.
- **Apple Books:** Click Here, **Python Simplified (Direct Link):** Click here

Honours

- **Vice-Chancellor's Medal (Top 0.1%), University of Nottingham** – Highest award for exceptional contributions as author, philanthropist, and student leader 2024
- **EEE Undergraduate Studies Award, UoN** – Recognised for academic and departmental contributions 2024
- **Nottingham Advantage Awards, UoN** – Student Leader (2024); OPAD & Peer Mentor (2023)
- **Union Prize & Student Representative of the Year, UoN** – Outstanding contributions to student life 2022
- **Top 6 Teen Heroes, India** – Recognised nationally for social impact and philanthropic leadership 2021
- **Speaker Invitations** – Invited speaker at World Summit AI, TEDx, and university conferences on AI and healthcare innovation