

# NILAKSHAN KUNANANTHASEELAN

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**OBJECTIVE:** To leverage my expertise in developing scalable and efficient AI algorithms, multimodal large language models, and generative AI technologies to contribute to impactful research and innovation. I aim to push the boundaries of machine learning through the development of state-of-the-art solutions in deep learning, computer vision, and generative AI while collaborating with cross-functional teams to drive meaningful advancements in artificial intelligence that address real-world challenges.

## EDUCATION

**PhD in reading** — *Electrical and Computer Science Engineering* JAN 2023 - JUNE 2026 (EXPECTED)  
Monash University, Australia  
Focus: Personalizing foundational models via multimodal signals. | Advisor: [Assoc/Prof Mehrtash Harandi](#)

**Bachelor of Science** — *Electronic and Telecommunication Engineering* NOV 2014 - DEC 2018  
University of Moratuwa, Sri Lanka | Dean's Honour List | GPA: 3.8

## TEACHING EXPERIENCE

**Teaching Assistant** — Monash University, Australia JAN 2023 - PRESENT

- ECE 4076/ECE 5176: Computer Vision (Semester 1 in 2023 and 2024)
- ECE 4179/ECE 5179/ECE 6179: Neural Networks and Deep Learning (Semester 2 in 2023 and 2024)

## WORK EXPERIENCE

**Graduate Research Assistant** — Monash University, Australia JAN 2023 - PRESENT

- Language Grounded Visual Prompts for Enhanced Model Adaptation
  - Developed efficient machine learning algorithms leveraging multimodal signals to personalize foundational models for out-of-distribution (OOD) scenarios.
  - Addressed resource and data constraints in OOD adaptation by integrating world knowledge through multimodality.
  - Utilized model reprogramming techniques to adapt the CLIP model, improving its performance on vision-and-language tasks [[LaViP Project](#)] [2].
- Prompt-Guided Medical Image Segmentation:
  - Developed an algorithm for prompt-guided medical image segmentation by adapting the SAM model, leading to improved segmentation accuracy.
- Mixture of Experts (MoE) for Model Behavior Editing:
  - Explored the potential of the Mixture of Experts (MoE) frameworks to modify foundational model behaviour on specific concepts while retaining zero-shot capabilities on others.
  - Addressed challenges related to weight tampering and the impracticality of large-scale fine-tuning for continual edits.
- Reasoning Abilities of Multimodal Large Language Models (MLLMs):
  - Investigating the reasoning capabilities of MLLMs like LLaVA across different environments based on [VisCoT](#) dataset.

**Teaching Assistant** — Monash University, Australia JAN 2023 - PRESENT

- Assisted in delivering lectures and grading for ECE 4076/ECE 5176: Computer Vision and ECE 4179: Neural Networks and Deep Learning
- Developed supplementary materials and lab exercises to enhance student understanding.
- Mentored students in neural networks and deep learning projects.

**Tech Lead, ML Research Team (Remote)** — ExentAI, UK JUNE 2024 - PRESENT

- Development of Multimodal LLM Applications:
  - **Real Estate Document Analysis Copilot:**  
Led the development of a copilot system utilizing LLMs to analyze and extract information from real estate documents, and answer user queries.
  - **Contract and Invoice Information System:**  
Designed and implemented an LLM-based system for processing contracts and invoices for reduced manual data entry time and improved information retrieval efficiency.

– **Agent-based Retrieval-Augmented Generation (RAG) System for Financial Firms:**

Developing a private Large Language Model (LLM) integrated with an agentic Retrieval-Augmented Generation (RAG) system, focusing on reducing response times, ensuring accurate value extraction, and improving trend visualization and forecasting capabilities.

Creating a document parser that effectively extracts structured and unstructured data from various documents and converts them into a format understandable by LLMs

Developing a fine-tuned model using proprietary financial datasets to replace the existing RAG-based QA system. Addressing privacy concerns by creating an agent-based solution to synthesize datasets using open-source models from **Meta** or **DeepSeek**, thereby avoiding the use of proprietary LLMs for generating high-quality synthetic data.

– **Leveraging Small Agent Swarms for Basic NLP Tasks:**

Developing a pipeline utilizing a multi-agent system composed of small open-source LLMs to perform basic Natural Language Processing (NLP) tasks, including sentiment analysis, keyword extraction, and named entity recognition.

• **Research and Development:**

Spearheaded the development of R&D components for various LLM-based tasks, focusing on integrating multimodal signals to enhance model performance.

Built Minimum Viable Products (MVPs) applications, facilitating rapid prototyping and iterative testing to meet client requirements.

**Senior ML Research Engineer (Remote)** — ExentAI, UK

JUNE 2020 - DEC 2023

• **Developed Domain-Specific Language Models:**

- Designed and implemented language models tailored for diverse text analytics tasks,
- Deployed language models as scalable API services, facilitating seamless integration with various client platforms.
- Implemented robust API endpoints using Flask and Docker, ensuring reliable and efficient model serving.

• **Built OCR Pipeline:**

- Developed an Optical Character Recognition (OCR) pipeline to extract data from scanned documents and implemented a comprehensive solution for digitizing and organizing archival documents [[Noolaham Foundation OCR Pipeline](#)].
- Leveraged Tesseract and Fast-SAM for image preprocessing and text extraction, ensuring high-quality data output.

**Research Intern** — [Computational and Integrative Pathology Group, Northwestern University](#) FEB 2021 - JUNE 2023

• **Breast Cancer Survival Analysis:**

Prepared and processed breast cancer datasets for survival analysis, ensuring high data quality and integrity. Developed multi-task learning models to predict patient survival outcomes and implemented domain-adversarial training techniques to enhance model generalization across diverse data distributions.

• **Hyperparameter Tuning and Model Optimization:**

Created a tailored hyperparameter tuning package using **Ray** for automating the optimization process and enhancing model reliability and accuracy in survival data analysis through systematic parameter adjustments and optimization strategies.

**Senior ML Research Engineer (Remote)** — Analog Inference, USA

MAR 2019 - NOV 2022

• **Developed Optimized Models for Deep Learning Accelerators:**

- Developed and implemented deep learning models for diverse computer vision tasks, enhancing system accuracy and robustness under varying analog hardware constraints.
- Developed specialized algorithms for optimizing models on deep learning accelerators, incorporating techniques like quantization, compression, pruning, and noise compensation.

• **Implementation of Integer-Only Models:**

- Implemented integer-only versions of models such as **ResNet**, **FCN**, **YOLOv5**, **MIPNet**, and **Person-ReID** to overcome hardware constraints and enable execution on analog accelerators.
- Developed algorithms for quantization and pruning tailored to specific hardware constraints.
- Created a model structure prediction tool that automates the implementation of corresponding hardware models.

**Undergraduate Research Intern (Remote)** — CooperLab

FEB 2018 - OCT 2019

• **Developed Region-Based Object Detector and Classifier:**

- Created and deployed a region-based object detector and classifier specifically designed for counting white blood cells in non-neoplastic samples [[1](#)].
- Utilized machine learning algorithms and computer vision techniques to accurately identify and count white blood cells, achieving a median AUC of 0.9591 and a median error rate of 6.04%.
- Seamlessly integrated the developed model with **HistomicsTK**, enhancing the accuracy and efficiency of white blood

cell counts in histopathology workflows.

## PROJECTS

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**Graduate Research Assistant** — *Prompt-Guided Medical Image Segmentation* MAY 2024 - OCTOBER 2024

- Adapted the Segment Anything Model (SAM) for medical image segmentation using model reprogramming techniques. Achieved competitive performance compared to [MedSAM](#), trailing by 0.15 points in multi-organ segmentation and, outperforming MedSAM by 7.57 points in the binary class segmentation task.

**Graduate Research Assistant** — *Mixture of Experts for Editing Foundational Model Continually* JULY 2024 - PRESENT

- Developed a LoRA-based Mixture of Experts (MoE) algorithm for the **CLIP** model to continually modify its behaviour while retaining zero-shot capabilities for remaining concepts. By optimizing with only the selected concepts, our baseline algorithm removes 95% of concept knowledge while retaining the knowledge of remaining concepts with a loss of 10% across three steps of continual editing. We aim to improve the baseline to assist the unlearning in multimodal models such as LLaVA where CLIP/SigLIP-based encoders are utilized.

## SKILLS AND INTERESTS

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**Machine Learning & AI:** Finetuning Large Vision-and-Language Models, Multimodal Large Language Models (MLLMs), Visual Programming, Computer Vision, Model Adaptation, Parameter-Efficient Fine-Tuning (PEFT), Mixture of Experts (MoE), Retrieval-Augmented Generation (RAG), In-Context Learning

**Programming Languages:** Python, MATLAB, C++

**Frameworks & Libraries:** PyTorch, TensorFlow, Keras, OpenCV, MLflow, LLaMaIndex, LangChain, LangGraph, Qdrant

**Tools & Technologies:** CUDA, Flask, Docker, Git, L<sup>A</sup>T<sub>E</sub>X, HTML, Bootstrap, Inkscape

## GRANTS AND AWARDS

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Jan 2023 Monash International Research Student Graduate Scholarship

Nov 2023 - Jun 2024 Research grant by Monash eResearch: “*Personalizing Foundational Models via Multimodality*”, Computing units worth A\$33K

Feb 2024 Student Scholar Program grant by AAAI: “*LaViP: Language Grounded Visual Prompts*”

July 2024 - Present Research grant by Monash eResearch: “*Personalizing Foundational Models via Multimodality*”, Computing units worth A\$47K

## SELECTED PUBLICATIONS

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- [1] Ramraj Chandradevan, Ahmed A. Aljudi, Bradley R. Drumheller, Nilakshan Kunananthaseelan, Mohamed Amgad, David A. Gutman, Lee A.D. Cooper, and David L. Jaye. Machine-based detection and classification for bone marrow aspirate differential counts: initial development focusing on nonneoplastic cells. *Laboratory Investigation*, 100(1):98–109, 2020.
- [2] Nilakshan Kunananthaseelan, Jing Zhang, and Mehrtash Harandi. Lavip: Language-grounded visual prompting. In *Proceedings of the AAAI Conference on Artificial Intelligence*, volume 38, pages 2840–2848, 2024.