Enamundram Naga Karthik

PhD Candidate, NeuroPoly & Mila - Québec AI Institute August 30, 2025

emvnagakarthik naga-karthik.github.io enamundram-naga-karthik naga-karthik scholar

Research Interests

Computer Vision, Medical Image Analysis, Lifelong Learning, Generative Models, Multimodal Learning, Genomic Language Models

Research Objective

Graduating PhD candidate with experience in processing large-scale medical datasets, developing deep learning techniques for medical image analysis, and contributing to open-source software. Interested in collaborating with teams developing predictive multimodal models for precision medicine.

Education

- **Polytechnique Montréal / Mila - Québec AI Institute** *09/2021 - Present*
  Ph.D. in Biomedical Engineering **Montréal, Canada**
  - Thesis: Towards automatic spinal cord MRI analysis for improved estimation of imaging biomarkers [submitted]
  - Supervisor and Co-Supervisor: Prof. Julien Cohen-Adad and Prof. Sarath Chandar
  - GPA: 4.0/4.0
- **École de Technologie Supérieure** *09/2019 - 07/2021*
  Master of Applied Sciences (M.A.Sc) in Electrical Engineering **Montréal, Canada**
  - Thesis: Unsupervised Three-dimensional Segmentation of Scoliotic Spines from MR Volumes with Uncertainty Estimation [thesis]
  - Supervisor and Co-Supervisor: Prof. Catherine Laporte and Prof. Farida Cheriet
  - Grade: 4.3/4.3
- **Shiv Nadar University** *07/2015 - 05/2019*
  Bachelor of Technology in Electronics and Communication Engineering with Minor in Mathematics **Greater Noida, India**
  - Thesis: Extraction and Visualization of the Features of Fingerprints using Conventional Methods and CNNs
  - Supervisor: Prof. Madan Gopal
  - GPA: 9.19/10

Publications

B=Book Chapter, C=Conference, J=Journal, P=Preprint

[C.5] **Dynamic Robot-Assisted Surgery with Hierarchical Class-Incremental Semantic Segmentation**
J. Hindel, E. Mekic, E. N. Karthik, R. Mohan, D. Cattaneo, M. Kalweit, A. Valada
MICCAI Workshop on Applications of Medical Artificial Intelligence [paper] [code] **[MICCAI AMAI '25]**

[P.2] **Monitoring morphometric drift in lifelong learning segmentation of the spinal cord**
E. N. Karthik, S. Bédard, J. Valošek, . . . , 50 more authors, . . . , S. Chandar, J. Cohen-Adad
ArXiv (Under Review in Imaging Neuroscience (formerly NeuroImage)) [paper] [code] **[arXiv '25]**
Accepted as a Poster at the Conference on Lifelong Learning Agents Workshop Track **[CoLLAs '25]**

[J.6] **Automatic segmentation of spinal cord lesions in MS: A robust tool for axial T2-weighted MRI scans**
E. N. Karthik*, J. McGinnis*, R. Wurm, S. Ruehling, R. Graf, J. Valosek, P.L. Benveniste, M. Lauerer, J. Talbott, R. Bakshi, S. Tauhid, T. Shepherd, A. Berthele, C. Zimmer, B. Hemmer, D. Rueckert, B. Wiestler, J. S. Kirschke, J. Cohen-Adad, Mark Muehlau
Imaging Neuroscience (formerly NeuroImage) [paper] [code] **[ImagNeuro '25]**

[J.5] **Towards Contrast-Agnostic Segmentation of the Spinal Cord**
S. Bédard*, E. N. Karthik*, C. Tsagkas, E. Pravatà, C. Granziera, A. C. Smith, K. A. Weber II, J. Cohen-Adad
Medical Image Analysis (Impact Factor: 11.8) [paper] [code] **[MedIA '25]**

[J.4] **SCIseg: Automatic Segmentation of Intramedullary Lesions in Spinal Cord Injury**
E. N. Karthik*, J. Valošek*, A. C. Smith, D. Pfyffer, S. Schading-Sassenhausen, L. Farner, K. A. Weber II, P. Freund, and J. Cohen-Adad
Radiology: Artificial Intelligence (Impact Factor: 13.2) [paper] [code] **[RadAI '24]**

[C.4] **SCIsegV2: A Universal Tool for Segmentation of Intramedullary Lesions in Spinal Cord Injury**
E. N. Karthik*, J. Valošek*, L. Farner, D. Pfyffer, S. Schading-Sassenhausen, A. Lebret, G. David, A. C. Smith, K. A. Weber II, M. Seif, P. Freund, J. Cohen-Adad
MICCAI Workshop on Applications of Medical Artificial Intelligence [paper] [code] **[MICCAI AMAI '24]**

[C.3] **Contrast-agnostic Spinal Cord Segmentation: A Comparative Study of ConvNets and Vision Transformers**
E. N. Karthik, S. Bédard, J. Valošek, S. Chandar, J. Cohen-Adad
Medical Imaging with Deep Learning: Short-paper Track [paper] [code] **[MIDL Short '24]**

[J.3] **Uncertainty Estimation in Unsupervised MR-CT Synthesis of Scoliotic Spines**
E. N. Karthik, F. Cheriet and C. Laporte
IEEE Open Journal of Engineering in Medicine and Biology (Impact Factor: 2.7) [paper] [code] **[IEEE OJEMB '23]**

[C.2] **Segmentation of Multiple Sclerosis Lesions across Hospitals: Learn Continually or Train from Scratch?**
E. N. Karthik, A. Kerbrat, P. Labauge, T. Granberg, J. Talbott, D. Reich, M. Filippi, R. Bakshi, V. Callot, S. Chandar, J. Cohen-Adad
Medical Imaging Meets NeurIPS Workshop [paper] [code] **[MedNeurIPS '22]**

[J.2] **Label fusion and training methods for reliable representation of inter-rater uncertainty**
A. Lemay, C. Gros, E.N. Karthik, J. Cohen-Adad
Machine Learning for Biomedical Imaging [paper] [code] **[MELBA '22]**

[P.1] **Team NeuroPoly: Pipelines for the MICCAI 2021 MS New Lesions Segmentation Challenge**
U. Macar, E. N. Karthik, C. Gros, A. Lemay, J. Cohen-Adad
MICCAI 2021 Challenge: Multiple Sclerosis New Lesions Segmentation [paper] [code] **[MICCAI '21]**

[C.1] **3D segmentation of the scoliotic spine from MRI using unsupervised volume-based MR-CT synthesis**
E. N. Karthik, F. Cheriet and C. Laporte
SPIE: Medical Imaging [paper] [code] **[SPIE '21]**

[B.1] **Extraction of the Features of Fingerprints Using Conventional Methods and CNNs**
E. N. Karthik, G. Madan
Machine Learning Algorithms and Applications [paper] **[Wiley '21]**

[J.1] **Automatic tongue surface extraction from three-dimensional ultrasound vocal tract images**
E. N. Karthik, E. Karimi, S. M. Lulich, C. Laporte
Journal of the Acoustical Society of America [paper] **[JASA '20]**

Honors and Awards

- **QBIN Travel for Training Awards | 3,000 CAD** *2024*
  Quebec Bio-Imaging Network / Réseau de Bio-Imagerie du Québec **[letter]**
  ◦ Recipient of the travel award for a research visit to Technische Universität München, Germany.
- **DAAD Short-Term Research Grants | 7,800 EUR** *2024*
  German Academic Exchange Service / Deutscher Akademischer Austauschdienst **[letter]**
  ◦ Recipient of the prestigious grant for a 6-month research visit to Technische Universität München, Germany.
- **UNIQUE Excellence Doctoral Scholarship | 15,000 CAD** *2022*
  Unifying Neuroscience and Artificial Intelligence - Québec / Union Neurosciences et Intelligence Artificielle - Québec **[letter]**
  ◦ Recipient of the doctoral scholarship from UNIQUE, an FRQNT-funded research center.
- **FRQNT Doctoral Research Scholarship | 84,000 CAD** *2021*
  Fonds de recherche du Québec Nature et technologies **[letter]**
  ◦ Secured funding for 4 years from the prestigious doctoral scholarship by ranking 1st out of 29 applicants.
- **Governor General of Canada's Academic Gold Medal** *2021*
  Government of Canada **[letter]**
  ◦ Awarded Canada's most prestigious academic medal for highest CGPA during my master's studies at ÉTS.
- **Best Master's Thesis Award | 1,000 CAD** *2021*
  École de Technologie Supérieure Montréal **[letter]**
  ◦ Recognized as the best Master thesis upon the recommendation of the jury for an "Excellent" thesis defense
- **Master's Tuition Fee Exemptions | 13,000 CAD** *2020*
  École de Technologie Supérieure Montréal
  ◦ Received tuition fee exemptions for 3 consecutive semesters – Winter, Summer, Fall 2020.
- **ÉTS Master's Internal Scholarship | 5,000 CAD** *2020*
  École de Technologie Supérieure Montréal
  ◦ Received the scholarship based on academic excellence and quality of the master's research project.
- **ÉTS Research Internship Travel and Subsistence Allowance | 4,200 CAD** *2018*
  École de Technologie Supérieure Montréal
  ◦ Received travel and subsistence allowance for my undergraduate research internship at LATIS Lab, ÉTS Montreal.

Research Experience

- **TUM-NIC and AIM Lab, Technical University of Munich [website]** *07/2024 - 11/2024*
  Visiting PhD Researcher **Munich, Germany**
  - Visited Prof. Daniel Rueckert's Lab for AI in Medicine and Prof. Mark Muehlau's Lab at TUM Neuroimaging Center on a 4-month DAAD-funded research stay.
  - Investigated the impact of preprocessing techniques, namely, *stitching* and *straightening* of individually-acquired chunks of the spinal cord towards multiple sclerosis lesion segmentation in spinal cord MRI.
- **NeuroPoly Lab, Polytechnique Montreal [website]** *06/2021 - 08/2021*
  Graduate Research Intern **Montreal, Canada**
  - **Automatic Segmentation of New Multiple Sclerosis Lesions**: Worked on developing a deep learning-based method for the soft segmentation of multiple sclerosis lesions as part of the MICCAI 2021 MS New Lesions Segmentation Challenge.
  - Our team secured 2nd position out of 23 teams on one of the challengers' evaluation metrics.
- **LATIS Lab, Ecole de Technologie Supérieure, Montreal [website]** *05/2018 - 08/2018*
  Undergraduate Research Intern **Montreal, Canada**
  - Applied the concepts of 3D phase symmetry and active surfaces to detect and extract the surface of the tongue from raw 3D ultrasound (US) images under the supervision of Prof. Laporte at LATIS.
  - Work done in collaboration with the Speech and Hearing Sciences Department, Indiana University, Bloomington.
- **Computer Science and Engineering Department, IIT Bombay** *05/2017 - 07/2017*
  Undergraduate Research Intern **Mumbai, India**
  - Adapted the concepts of filtered back projection (FBP), dictionary learning and conjugate gradient methods to reconstruct computed tomography (CT) images of a walnut.
  - Worked under the supervision of Prof. Ajit Rajwade at the Department of Computer Science.

Open-source Contributions

- **Spinal Cord Toolbox (SCT) | Command-line tools for the analysis of spinal cord MRI data** *09/2022 - 12/2022*
  Maintained by: NeuroPoly Lab **[github]**
  - Integrated into SCT the pathology-specific segmentation models I have developed for clinical collaborators.
  - Examples: Spinal cord injury lesions [paper][usage], contrast-agnostic segmentation [paper][usage], multiple sclerosis lesions [paper][usage]
- **MetricsReloaded | New Framework for Biomedical Image Analysis Validation** *09/2022 - 12/2022*
  Maintained by: Project MONAI **[github]**
  - Added relative volume error and lesion-wise metrics (sensitivity, F_1-score) for better segmentation evaluation.
- **ivadomed | Open-source package for Medical Image Analysis with Deep Learning** *09/2022 - 12/2022*
  Maintained by: NeuroPoly Lab **[github]**
  - Contributed by adding new features and models developed by the lab.

Reviewing

- **Journals:** Computers in Biology and Medicine, Neural Networks, Quantitative Imaging in Medicine and Surgery (Reviewer of the month award),
- **Conferences:** MICCAI 2025

Teaching Experience

- **INF8245E - Machine Learning | Course Instructor: Sarath Chandar** *09/2022 - 12/2022*
  Polytechnique Montréal | Teaching Assistant **[website]**
  - Responsible for designing a coding assignment on introductory ML concepts including k-Nearest Neighbours, Bayes Classifier and Logisitic Regression.
  - Holding weekly office hours and assisting the instructor in grading assignments.
- **IFT6135 - Learning Representations | Course Instructor: Aaron Courville** *01/2022 - 04/2022*
  Université de Montréal | Teaching Assistant **[website]**
  - Responsible for designing assignments on deep generative models and self-supervised learning.
  - Holding weekly office hours and assisting the instructor in grading assignments.
- **Deep Learning Summer School** *01/2022 - 04/2022*
  Neuromatch Academy | Teaching Assistant **[website]**
  - Responsible for teaching a 3-week course on deep learning to a group of 10 graduate students.
  - Topics ranged from basic (Multilayer Perceptrons, Optimization) to advanced (Reinforcement, Continual, and Self-supervised Learning). Complete syllabus can be found here.

MENTORSHIP

- **Graduate Mentor** *05/2024 - 12/2024*
  Mila - Québec AI Institute
  - Responsible for mentoring two graduate students, Jeremy Kaufman and Guilluame Charron, enrolled in Mila's Professional Master's program during their industrial internships at the National Film Board of Canada (NFB).
    - **Project**: Automatic indexing and retrieval of video data. Objectives of their internship were to: (i) create an indexing tool with automatic captioning, video tagging and synopsis generation on NFB's decades-long archived data, and (ii) using multi-modal (text, audio, video) models for automatic content retrieval based on user queries.
    - **Responsibilities**: My tasks involved assisting the students in their transition from academia to industry, ensuring progress in the company's projects through weekly meetings, providing technical guidance by discussing papers, solving bugs, etc.

VOLUNTEER EXPERIENCE

- **Supervision Requests Evaluator** *11/2024 - 12/2024*
  Mila - Québec AI Institute **[website]**
  - Evaluated 14 Masters and PhD graduate school applications to Mila
  - Responsibilities included evaluating the applicants' research potential and their fit within various research groups led by Mila professors through their grades, CVs, statements-of-purpose and recommendation letters.
- **Graduate School Application Assistance for Underrepresented Students in AI** *2023, 2024*
  Chandar Research Lab Initiative **[website]**
  - Assisted students from under-represented countries for their graduate school applications by providing them tips to improve their CV and statements-of-purpose.
- **Organizing Committee Member for the Conference on Lifelong Learning Agents (CoLLAs)** *08/2022*
  Polytechnique Montréal / Mila - Québec AI Institute **[website]**
  - Member of the organizing committee for the first international conference on lifelong learning agents.
  - Responsible for back-end development and maintenance, mainly in hosting the conference website on Amazon Web Services (AWS) and handling accounting/registrations via Stripe.
- **Student Reviewer at the Service d'Aide à la Rédaction d'Articles (SARA)** *10/2019 - 06/2021*
  École de Technologie Supérieure, Montréal **[website]**
  - SARA is a scientific community at ÉTS aiming to help graduate researchers better the art of academic writing.
  - Volunteered for two paper-review requests, which involved the tasks of critically analyzing the authors' papers and providing insightful comments on the clarity and expression of their work.

TECHNICAL SKILLS

- **Programming and Markup Languages:** Python, Bash, LaTeX, Markdown, HTML, Git, Slurm
- **Data Science & Machine Learning:** PyTorch, `scikit-learn`, `pandas`, `nibabel`, `matplotlib`
- **Cloud Services:** AWS S3, AWS CloudFront
- **Specialized Software:** 3DSlicer, FSLeyes, ITKSnap

ADDITIONAL INFORMATION

Languages: Hindi, Telugu (Native), English (Expert), French (Intermediate)

Sports: **Winner** of the Shiv Nadar University (SNU) Table Tennis Championship (2018, 2019). **Winner** of the **best player** award in SNU Table Tennis Championship for the academic year 2017-18.

Interests/Hobbies: Finisher of 5 Half Marathons (21.1 km). Best finish time 01:49:57.