

BUDVIN EDIPPULIARACHCHI

PhD Candidate in Computer Science, Tufts University

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RESEARCH INTERESTS

I develop and optimize numerical methods and solvers that harness the performance of modern hardware and software. My work spans extreme-scale mesh and domain decomposition in distributed memory, faster sparse computations for PDE solvers through compression, finite element solvers built on modern compiler infrastructure (MLIR), and formalizations for verified finite element solvers.

EDUCATION

Tufts University 2023 – present
Ph.D. in Computer Science (Candidate) Medford, MA

- Advisor: Prof. Hari Sundar. GPA: 3.96/4.00.
- M.S. in Computer Science, earned en route (2026).

University of Moratuwa 2018 – 2022
B.Sc. Eng. (Hons), specialized in Computer Science & Engineering Sri Lanka

- CGPA: 4.12/4.20 (3.97/4.00 equivalent); ranked 1st of 128 students; Dean's List in all eight semesters.
- Gold Medal for the best overall GPA in the Computer Science & Engineering specialization.

Cornell, Maryland, Max Planck Pre-doctoral Research School (CMMRS) Aug 2022
Max Planck Institute for Software Systems Saarbrücken, Germany

- One of 80 participants selected from 400+ applicants for a week of lectures and panels with researchers and faculty.

PUBLICATIONS

Peer-Reviewed Conference Papers

[C2] **Budvin Edippuliarachchi**, David Van Komen, and Hari Sundar. AMRaCut: Scalable Partitioning for Adaptive Mesh Refinement. In *Proc. International Conference for High Performance Computing, Networking, Storage and Analysis (SC '25)*, 2025. doi:10.1145/3712285.3759863
🐙 github.com/paralab/AMRaCut

[C1] **Budvin Edippuliarachchi**, Damika Gamlath, Ruchin Amaratunga, Gunavaran Brihadiswaran, and Sanath Jayasena. Quill: A Memory Efficient k -mer Counting and k -mer Querying Tool for Commodity Clusters. In *Proc. 14th International Conference on Bioinformatics and Biomedical Technology (ICBBT '22)*, 2022. doi:10.1145/3543377.3543389

Posters and Student Research Competitions

[P1] **Budvin Edippuliarachchi**, Ponnuswamy Sadayappan, and Hari Sundar. Index Compression for Finite Element Sparse Matrix-Vector Multiplication. *To appear in ACM Student Research Competition at SC '26*, 2026.

TALKS AND PRESENTATIONS

Highly Scalable Methods for Adaptive Mesh Refinement of Complex Domains Mar 2025
SIAM Conference on Computational Science and Engineering (CSE25) Fort Worth, TX

AMRaCut: Scalable Partitioning for Adaptive Mesh Refinement Nov 2025
SC '25, paper presentation St. Louis, MO

RESEARCH EXPERIENCE

Graduate Research Assistant

Tufts University, advised by Prof. Hari Sundar

2023 – present

Medford, MA

Automated Code Generation for Multiphysics FEM with Modern Compiler Infrastructure

ongoing

- Generating MLIR directly from user-specified PDE problems solved by the finite element method, inheriting the optimizations of MLIR compilers such as IREE.
- Retains performance across NVIDIA GPUs, AMD GPUs, x86 CPUs, and ARM CPUs; designed for multivariable, multiphysics models so domain experts can rapidly test new physics.

Index Compression for Finite Element SpMV

[P1]

- Provable index compression for sparse matrices produced by FEM assembly: the SpMV operator is decomposed into cluster-local operators whose indices fit in narrower integers.
- Proved the compression is net-positive for low polynomial-order FEM; up to $1.7\times$ speedup over state-of-the-art SpMV kernels on NVIDIA GPUs and up to $2\times$ over Intel MKL on x86 CPUs.

Formal Verification for Finite Element Solvers

ongoing

- Collaboration with the Tufts Programming Languages group (TuPL) on a verified code-generation framework for FEM, implemented in the Lean theorem prover.
- Formalizes the translation of FEM weak forms into quadrature-based element-wise integration code with semantic preservation, as a machine-checkable specification for practical FEM frameworks.

AMRaCut: Scalable Partitioning for Adaptive Mesh Refinement

[C2]

- Bridges the scalability gap between space-filling-curve partitioners and multilevel graph partitioners for distributed mesh partitioning.
- $5\text{--}10\times$ faster than ParMETIS and PT-Scotch on 20,000+ cores while keeping maximum partition load within $1.5\text{--}2\times$ of optimal, sufficient for scalability of downstream solvers.

Student Researcher, ALICE O2 Software Profiling

2022

CERN, in collaboration with the University of Moratuwa

- Supervisors: Dr. Latchezar Betev (CERN), Prof. Indika Perera, Dr. Gayashan Amarasinghe.
- Profiled and benchmarked sample workflows of ALICE O2, CERN's software suite for Run 3, with CPU and memory profilers (perf, Intel VTune) to identify bottlenecks and improvements for the ALICE grid.
- Assessed the feasibility of injecting profiling tools into isolated containers for real-time performance monitoring.

Undergraduate Researcher, Accelerating k -mer Counting on Commodity Clusters

2021 – 2022

University of Moratuwa

Sri Lanka

- Supervisors: Prof. Sanath Jayasena, Gunavaran Brihadiswaran.
- Designed Quill, an MPI-based k -mer counting framework for commodity clusters lacking high-performance networks or file systems: master-node input reading, worker-node counting, and a pipelined producer-consumer workflow with dynamic load balancing. [C1]

 github.com/CSE-Optimizers/k-mer_counter

TEACHING EXPERIENCE

Graduate Teaching Assistant

2025

Department of Computer Science, Tufts University

Medford, MA

- CS 40: Machine Structure & Assembly Language Programming.

Teaching Assistant

2021 – 2023

Department of Computer Science & Engineering, University of Moratuwa

Sri Lanka

- CS3062 Theory of Computing; CS2022 Data Structures and Algorithms; CS1033 Programming Fundamentals.
- Prepared assignments and weekly quizzes, assisted with practicals and tutorials, graded assignments and exams, and helped run semester examinations.

HONORS AND AWARDS

Gold Medal , best overall GPA in Computer Science & Engineering, University of Moratuwa	2022
Selected participant , Cornell, Maryland, Max Planck Pre-doctoral Research School (80 of 400+)	2022
Dean's List , University of Moratuwa, all eight semesters	2018 – 2022
IEEEExtreme global programming competition: 71st (2021) and 92nd (2020) worldwide	2020, 2021
Champions , Aces Coders v8.0, national programming competition (University of Peradeniya)	2020
Champions , UoJ Coders, 12-hour programming competition (University of Jaffna)	2019
1st Runners-Up , RealHack, hackathon and programming competition (University of Kelaniya)	2019
Finalist , Robofest micromouse competition (SLIIT)	2018, 2019
Finalist , Sri Lanka Robotics Competition (University of Moratuwa)	2018
Bronze Medal , Sri Lanka Mathematics Olympiad (Junior)	2008

INDUSTRY EXPERIENCE

Software Engineer <i>Expert Intelligence</i>	2023
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- Designed reusable, containerized backend modules for AI workflows on mass-spectrometry data, within an event-driven, batch-job architecture (AWS Lambda, Batch, S3, RDS).
- Automated cloud resource management with AWS CDK; sped up container builds with reusable layers and caching.

Founding Member and DevOps Consultant <i>IXD Labs</i>	2021 – 2023
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- Built deployment templates across tech stacks (Python, TypeScript, .NET) and cloud vendors, including on-premises deployments; set up production monitoring and advised on scalability for small-to-medium products.

Software Engineering Intern <i>Mitra Innovation</i>	2020 – 2021 Sri Lanka
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- Developed and tested modules of a high-volume, event-driven network-threat monitoring system (AWS Lambda, DynamoDB, Step Functions).
- Built a scalable logging pipeline (Kinesis Data Streams, Glue, S3, Athena) and scheduled batch jobs for aggregated reporting; implemented an SSO workflow.
- Resolved memory leaks in, and improved, the 3D visualizations of a dashboard using vector mathematics.

OUTREACH AND WORKSHOPS

Step Up — Introduction to Algorithms <i>Workshop speaker, IEEE Student Branch, University of Jaffna</i>	2022
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Prolog to XTREME 15.0 <i>Webinar speaker on algorithms and data structures for IEEEExtreme, IEEE Student Branch, University of Jaffna</i>	2021
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CodeSolveur <i>Session speaker on competitive programming, IEEE Student Branch, General Sir John Kotelawala Defence University</i>	2021
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SKILLS

Research Areas	HPC, distributed-memory and parallel algorithms, graph partitioning, sparse linear algebra, finite element methods, compilers (MLIR)
Programming	C, C++, Python, Julia, Java, SQL, JavaScript
HPC & Tools	MPI, GPU programming and profiling, MLIR/IRREE, perf, Intel VTune
Cloud	AWS (Lambda, Batch, Step Functions, Kinesis, CDK)
Languages	English (professional), Sinhala (native)