Durga Keerthi Mandarapu

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Summary

I am broadly interested in parallel systems, high-performance computing, databases, and compilers. My current research involves accelerating irregular programs such as tree and graph traversals using GPU Ray Tracing hardware.

Education

Ph.D. in Computer Science — *W.Lafayette, U.S.A.*

Advisor: Prof. Milind Kulkarni,Purdue University **(GPA:3.95/4.00)** — *Aug. 2019 - Aug. 2025**

Bachelors(Honors) in Computer Science and Engineering with Minor in Economics — *Hyderabad, India*

Indian Institute of Technology, Hyderabad **(GPA:8.78/10.00)** — *Jul. 2015 - Apr. 2019*

Publications

- **Durga Mandarapu**, Vani Nagarajan, Artem Pelenitsyn, Milind Kulkarni. "Arkade: k-Nearest Neighbor Search With Non-Euclidean Distances using GPU Ray Tracing." In ACM International Conference on Supercomputing, ICS 2024. 🏆 **Best Paper Award** [PDF]
- Vani Nagarajan, **Durga Mandarapu**, Milind Kulkarni. "RT-kNNS Unbound: Using RT Cores to Accelerate Unrestricted Neighbor Search." In International Conference on Supercomputing, ICS '23. [PDF]
- **Durga Mandarapu.** "A survey of quantum compilers" (Poster). Introduction to Quantum Compilers, Indoquant 2019. [PDF]
- Radhiya Arsekar, **Durga Mandarapu**, M. V. Panduranga Rao. "EpiStrat: A Tool for Comparing Strategies for Tackling Urban Epidemic Outbreaks." In International Conference on Smart Health, ICSH 2017. [PDF]

Publications In Submission

- **Durga Mandarapu**, Isaac Fuksman, Artem Pelenitsyn, Gilbert Louis Bernstein, Milind Kulkarni. "Mochi: Collision Detection for Spherical Particles using GPU Ray Tracing." In review at SIGGRAPH 2025. [PDF]
- **Durga Mandarapu**, Anish Kambhampati, Milind Kulkarni. "S-ray: Accelerating spatial queries using GPU Ray Tracing."

Internships

Scalable Distributed Random Walks — *Seattle, U.S.A.*

Software Engineering Intern, Meta — *Summer 2024*

- Developed separate compute and storage services to make the distributed random walks more scalable on a billion-node user-ads graph.
- Profiled several performance, I/O, and network metrics and benchmarked the new service on a variety of hardware to demonstrate how it scales differently and efficiently handles the same workloads.

Distributed Random Walks — *Austin, U.S.A.*

Software Engineering Intern, Katana Graph — *Summer 2022*

- Developed a scalable random walks application to overlap communication and computation on distributed graphs using the Katana interface.
- Conducted performance profiling by varying the number of hosts, random walk algorithms, and datasets to analyze communication-computation costs.

Betweenness Centrality for Streaming Graphs — *Vancouver, Canada*

MITACS Internship under the guidance of Prof. Keval Vora, Simon Fraser University — *Summer 2019*

- Developed a parallel incremental algorithm that processes non-monotonous dynamic edge updates to compute a betweenness centrality measure of all the vertices in a streaming graph.

Strategy Selection in Epidemic Management using Agent-Based Modeling — *Hyderabad, India*

Guide: Prof. M. V. Panduranga Rao, IIT Hyderabad — *Fall 2016 - Spring 2017*

- Developed a tool that performs a scalable simulation of an epidemic that uses agent-based modeling of individuals to understand and predict how the disease could spread in an urban slum community.

Selected Research Projects

Spatial Database Queries using GPU Ray Tracing Cores (Under submission) — *W. Lafayette, U.S.A.*

Advisor: Prof. Milind Kulkarni, Purdue University. — *Fall 2023**

- Implemented an algorithm in CUDA to accelerate spatial queries such as spatial select, spatial join, and KNN join using GPU Ray Tracing Cores.

Collision Detection and DEM particle simulation with GPU Ray Tracing Cores (In review) *W. Lafayette, U.S.A.*

Advisor: Prof. Milind Kulkarni, Purdue University. *Summer 2023 - Fall 2024*

- For spherical particles, designed a faster and scalable discrete collision detection along with DEM simulation using GPU Ray Tracing and CUDA.
- For triangle meshes, devised triangle-triangle intersection test on Ray Tracing cores even though they are limited to ray-triangle intersection.

Neighbor Search using GPU Ray Tracing (ICS'24) *W. Lafayette, U.S.A.*

Advisor: Prof. Milind Kulkarni, Purdue University. *Fall 2022 - Spring 2024*

- Accelerated non-L^2 distances on ray tracing cores that order objects on L^2 distance, by formulating two generic distance computations.
- Working on extending the search to data points from higher dimensions, although ray tracing cores only expose 3 dimensions.

Concurrency Control with RDMA *W. Lafayette, U.S.A.*

Guide: Prof. Walid Aref, Prof. Jianguo Wang, Purdue University. *Fall 2020*

- Implemented 2-Phase-Locking (wait-die, no-wait), Optimistic Currency Control (Forward-OCC, Backward-OCC), and Multi-Version Concurrency Control (multi-version timestamp ordering) protocols using RDMA to process transactions on a 5-node cluster.

Algorithms for overlaying topologies in Data Center Networking *W. Lafayette, Indiana*

Research Assistant, Guide: Prof. Douglas Comer, Purdue University. *Summer 2020*

- Developed a heuristic that greedily selects a neighbor to map logical overlay topologies to physical underlay topologies. Runs in polynomial time which is otherwise an NP-problem.

Component Specific Passes on LLVM *Hyderabad, India*

Guide: Ramakrishna Upadrasta, IIT Hyderabad. *Spring 2019*

- Divided a program into basic components, and the clang compiler optimization passes into sub-sequences of transform and analysis passes to show that the performance achieved by applying all the passes can also be achieved by just a sub-sequence of them in a shorter time.

Parallel Sparse Matrix-Matrix Multiplication [Honors Project] *Hyderabad, India*

Guide: Prof. Sathya Peri, IIT Hyderabad. *Fall 2018 - Spring 2019*

- Developed a lock-free and wait-free algorithm that uses relaxed barrier constraints to mitigate the synchronization delays between threads for making applications like sparse matrix-matrix multiplication more scalable.

Optimistic Algorithms for Distributed Transactional Memory *Hyderabad, India*

Guide: Prof. Sathya Peri, IIT Hyderabad. *Fall 2018*

- Developed a library that uses a distributed basic timestamp ordering algorithm that can be plugged in to read and write shared objects in transactional memory. Optimized the number of messages exchanged to remove redundant notifications.

Grants & Awards

WHPC, *Women in High-Performance Computing, Travel grant to attend SC conference* *2024*

ICS, *ACM International Conference on Supercomputing, Best Paper Award and travel grant* *2024*

PLDI, *ACM SIGPLAN Conference on Programming Language Design and Implementation, Travel grant* *2023*

SOCC, *ACM Symposium on Cloud Computing, Travel grant* *2019*

MITACS, *scholarship for research internship in Canada* *2019*

JENESYS, *Indian cultural ambassador to Japan, funded by Embassy of Japan* *2018*

Service

Reviewer, *IEEE Transactions on Big Data* *2024*

Graduate Student Mentor, *Future Mentors Program, Purdue University* *Fall 2024 - Spring 2025**

- Anish Kambhampati, Computer Science Junior, Purdue University. Project: Accelerating spatial queries using GPU Ray-Tracing
- Isaac Fuksman, Computer Science Junior, Purdue University. Project: Accelerating collision detection using GPU Ray-Tracing

Mentor, *SIGPLAN long-term mentorship Program, PLDI* *Fall 2024 - Spring 2025**

- Haolin (Hailey) Li, Masters in Computer Science, UCSD

Lit-soc (Literary Society) Coordinator, National Service Scheme , *IIT Hyderabad chapter* *Fall 2017 - Spring 2018*

- Organized weekly sessions for students on Computers, English, Mathematics, and Science at local government schools.
- Developed a database of presentations on the topics from the high school textbooks, with the help of the IITH student community

Teaching

Graduate Teaching Assistant, *Data Structures, Purdue University* *Fall 2019 - Summer 2021*

Undergraduate Teaching Assistant, *IIT Hyderabad*

- Operating Systems (Fall 2018, Spring 2019), Database Systems (Spring 2019)
- Data Structures (Fall 2017), Introduction to Programming (Fall 2017)