Bhavana Mehta

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Research Focus: My research focuses on building adaptive, high-performance and fault-tolerant distributed systems through dynamic resource optimization, workload-aware runtime switching, adaptive sharding, and reinforcement learning to enhance scalability and throughput in untrustworthy environments.

Education

University of Pennsylvania
Ph.D. & M.S. in Computer & Information Science | GPA: 3.95/4.0 *2019 – 2025 (Expected)*
Focus: Distributed Systems, ML Infrastructure, Fault Tolerance

Nirma Institute of Technology
B.Tech., Electronics & Communication Engineering *2014 – 2018*

Selected Publications

Adaptive Sharding in Untrusted Environments *(SIGMOD' 26)*
Bhavana Mehta, Nupur Baghel, Mohammad J Amiri, Ryan Marcus, Boon Thau Loo

Towards Full Stack Adaptivity in Permissioned Blockchains *(VLDB '24)*
Chenyuan Wu, Mohammad J Amiri, Haoyun Qin, **Bhavana Mehta**, Ryan Marcus, Boon Thau Loo

Towards Adaptive Fault-Tolerant Sharded Databases *(VLDB '23)*
Bhavana Mehta, Neelesh C A, Prashanth Iyer, Mohammad J Amiri, Boon Thau Loo, Ryan Marcus

AdaChain: A Learned Adaptive Blockchain *(VLDB '23)*
Chenyuan Wu, **Bhavana Mehta**, Mohammad J Amiri, Ryan Marcus, Boon Thau Loo

Experience

University of Pennsylvania
PhD Researcher, Distributed Systems Lab (Advisor: Prof. Boon Thau Loo) *2019 – Present*

- **Marlin**:
  - Architected and led the implementation of Marlin, the first **adaptive sharding system** for distributed systems in untrustworthy environments, to maintain **high performance** under **shifting and adversarial workloads.**
  - **Designed and benchmarked** two resharding architectures: a **centralized model** using hypergraph partitioning for near-optimal performance, and a novel **decentralized protocol** that operates without trusted components.
  - Mitigated performance degradation from adversarial skew by creating a dynamic data placement system that **improved throughput by over 40%** compared to static sharding.
  - Validated the system at scale on a **128-node cluster** and engineered core reliability features, including **rate-limited data migration** to prevent thrashing and a fault-injection harness to verify BFT correctness.
- **AdaChain**:
  - Developed a **reinforcement learning framework** that adaptively selects the **optimal transaction processing paradigm** (e.g., Order-Execute vs. Execute-Order-Validate) at runtime based on workload characteristics.
  - Modeled the selection process as a **contextual multi-armed bandit problem**, using Thompson sampling to improve committed throughput over the best fixed paradigms on skewed workloads.
  - Implemented the complete learning pipeline, including **state featurization** from the blockchain ledger (write ratio, hot key ratio), online model training, and a robust, decentralized architecture-switching protocol.
- **Kernel-Bypass TCP Migration**:
  - Collaborated with Microsoft Research and MIT for the Capybara project by building a **DPDK-based prototype** for live, microsecond-scale **TCP connection migration.**
  - Measured migration latency of active flows at **$\sim$4 μs** on commodity servers, demonstrating a **12x improvement** over kernel-based solutions and enabling dynamic load balancing for latency-critical services.

Bluespec Inc.
Design Engineer *2018–2019*

- Built a Jenkins and Docker-based **CI/CD pipeline** for configurable hardware builds, reducing the release cycle from two weeks to **three days.**

Skills

Languages: Python, C++/C, Rust, SQL, Bash
Systems & DevOps: Linux, Docker, Git, Jenkins, CI/CD, CloudLab
Distributed Systems: Raft/Paxos, PBFT/HotStuff, 2PC, Redis, KaHyPar, YCSB
ML for Systems: Reinforcement Learning, Contextual Bandits, Thompson Sampling
Networking: DPDK, Kernel Bypass, Low-Latency Networking
Hardware: Bluespec SystemVerilog, Vivado, Xilinx UltraScale