Shubham **Tiwari**

PhD student, University of Washington

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Research Interests

Broadly interested in the intersection of distributed systems and machine learning. Recently, I have been working on improving the efficiency of serving models. Previously, I have worked on a broad spectrum of problems, for example: memory management optimizations in hypervisors, network measurement, and congestion control (LEOScope, iBox).

Education

University of Washington, *Seattle* Sept 2023 - Present
Ph.D. in Computer Science (*ongoing*)
Advisors: Simon Peter, Ratul Mahajan

Birla Institute of Technology and Science (BITS), Pilani Aug 2016 - July 2021
B.E. Computer Science and M.Sc. Mathematics, CGPA: 8.52
Thesis: *Data-Driven Network Simulation with iBox*

Experience

Microsoft Research, *Redmond* June 2024 - Sept 2024
Research Intern with *Ishai Menache*
Project: Improvements to Azure Compute's VM allocation service.

Microsoft Research, *Bangalore* Aug 2021 - Aug 2023
Research Fellow with *Debopam Bhattacherjee*, *Venkat Padmanabhan*
Projects: LEO Satellite Networks (LEOScope)

Microsoft Research, *Bangalore* Jan 2021 - July 2021
Research Intern with *Venkat Padmanabhan*, *Nagarajan Natarajan*
Project: Data-Driven Network Simulation (iBox)

VMware, *Bangalore* Aug 2020 - Dec 2020
Intern, xLabs with *Jayneel Gandhi*
Project: Page-table Replication (Mitosis)

Samsung Research, *Bangalore* May 2020 - July 2020
Research Intern
Project: Cellular Network Planning

Software-Defined Networking Lab, *BITS Pilani* Jan 2019 - Dec 2019
Research Assistant with *K. Hari Babu*
Project: Passive Estimation of Link Latency (qMon)

Publications

C=Conference, J=Journal, P=Preprint, A=Article

A.1 **LEOScope: Building a Global Testbed for Low-Earth Orbit Satellite Networks** [link]
Saeed Fadaei, Shubham Tiwari, Aryan Taneja, Saksham Bhushan, Mohamed Kassem, Aravindh Raman, Debopam Bhattacherjee, Lili Qiu, Alan Woodward, Nishanth Sastry
SIGCOMM Computer Communication Review **SIGCOMM CCR'25**

C.1 **Boosting Application Performance using Heterogeneous Virtual Channels: Challenges and Opportunities** [link]
Talal Touseef, William Sentosa, Milind Kumar Vaddiraju, Debopam Bhattacherjee, Balakrishnan Chandrasekaran, Brighten Godfrey, Shubham Tiwari
22^{nd} *ACM Workshop on Hot Topics in Networks* **HotNets'23**

P.1 **T3P: Demystifying Low-Earth Orbit Satellite Broadband** [link]
Shubham Tiwari, Saksham Bhushan, Aryan Taneja, Mohamed Kassem, Cheng Luo, Cong Zhou, Zhiyuan He, Aravindh Raman, Nishanth Sastry, Lili Qiu, Debopam Bhattacherjee
Preprint

C.2 **Simulating Network Paths with Recurrent Buffering Units** [link]
Divyam Anshumaan, Sriram Balasubramanian, Shubham Tiwari, Nagarajan Natarajan, Sundararajan Sellamanickam, and Venkata N. Padmanabhan
37^{th} *AAAI Conference on Artificial Intelligence* **AAAI'23**

C.3 **Data-Driven Network Path Simulation with iBox** [link]
Sachin Ashok, Shubham Tiwari, Nagarajan Natarajan, Venkata N. Padmanabhan, and Sundararajan Sellamanickam
ACM SIGMETRICS / IFIP PERFORMANCE 2022 **SIGMETRICS'22**

J.1 **qMon: A method to monitor queueing delay in OpenFlow networks** [link]
Sandhya Rathee, Shubham Tiwari, K Haribabu, and Ashutosh Bhatia
Journal of Communications and Networks **JCN'22**

Projects

ElasticSwap: Memory-Management Strategies for Efficient Serving of LLMs April 2024 - Present
Advisors: Simon Peter, Ratul Mahajan

- Evaluated various memory-management techniques to improve the performance of long-context requests in Compound AI Systems.
- Developed a prototype of an LLM inference scheduler on top of vLLM to evaluate the performance of workloads under various request types and traffic patterns.

Optimizations to Azure Compute's VM Allocation Service June 2024 - Sept 2024
Advisors: Ishai Menache

- Evaluated the impact of enabling fine-grained VM placement strategies at scale.
- Proposed changes to resource allocation service with the potential of saving ($>$ \$1M) in operational costs.

LEOScope: Enabling Experimentation Across Low-Earth Orbit (LEO) Satellite Networks July 2022 - Present
Advisors: Debopam Bhattacherjee, Venkat Padmanabhan [code]

- Lead an effort with **Azure Space**, **MSRA**, and academic collaborators to build a platform of a global scale for experimentation across Low-Earth Orbit Satellite networks.
- Drove the effort through engineering challenges such as platform architecture, implementation of experiment scheduler, executor, and the central orchestrator.
- Initiated large-scale measurements based on ping and iperf to characterize satellite network paths.

iBox: Internet in a Box Jan 2021 - June 2022
Advisors: Venkat Padmanabhan, Nagarajan Natarajan [website]

- Built a data-driven network simulator that uses data to recreate end-to-end behavior of a network path.
- Leveraged a combination of internet measurement data and ML models to capture the impact of complex network phenomena such as cross-traffic and packet reordering.
- Integrated iBox with ns-2, ns-3, netem and **Microsoft Teams's** in-house network simulator.
- Resulting papers published at SIGMETRICS'22 and AAAI'23.

qMon: Passive Delay Monitoring in SDNs Jan 2019 - Dec 2019

Advisor: K. Hari Babu [paper] [code]

- Devised **qMon**, a scalable latency monitoring technique with zero data plane footprint.
- Developed an Open vSwitch based prototype to fetch queue length information using OpenFlow and passively estimate link latency.
- Evaluated qMon on a physical testbed under various traffic scenarios.
- Resulting paper published at JCN 2022.

Mitosis: Enabling Page-Table Replication in ESXi Aug 2020 - Dec 2020

Advisor: Jayneel Gandhi

- Implemented page-table replication (Mitosis) in VMware's core virtualization product – ESX.
- Developed prototypes to disambiguate the design and code needed to support page table replication in the ESX kernel.
- Conducted workload profiling to estimate the performance benefits of page-table replication; realized gains of upto 17% in workload execution time.

Miscellaneous

- Awarded a grant of 50,000 INR by AUGSD, BITS Pilani for developing a miniature autonomous driving vehicle.
- Demonstrated iBox at TAB – MSR India's annual technical event.
- Presented iBox at SIGMETRICS'22. [video]