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Research Interests

I am a systems researcher working at the intersection of distributed systems, networking systems and program analysis. My PhD thesis focuses on improving information exchange on the web. The web currently suffers from high ephemerality and poor performance. To combat these issues, I have built systems which leverage fine-grained analysis of web computations in order to enable faster web page loads, improved web archiving and faster web crawling. My research work has been published at major systems' venues like OSDI, NSDI, FSE, CoNEXT and HotNets.

Areas: Networking systems, program analysis, distributed systems

Education

- 2023 (expected) **PhD in Computer Science**, University of Michigan, Systems Lab
Ann Arbor, Michigan, USA
Thesis: "Fine-grained analysis of web computations to enable improved access to web pages"
Advisors: [Harsha V. Madhyastha](#), [Ravi Netravali](#)
- 2019 **MSc in Computer Science**, University of Michigan, Systems Lab
Ann Arbor, Michigan, USA
Advisor: [Harsha V. Madhyastha](#)
- 2016 **B.Tech in Computer Science**
Indraprastha Institute of Information Technology
New Delhi, India
Thesis: "Safely upgrade application binaries using dynamic analysis"
Advisor: [Rahul Purandare](#)

Work Experience

- 2017 – Present **University of Michigan, Ann Arbor**, Research Assistant
Advisors: [Harsha V. Madhyastha](#), [Ravi Netravali](#)
- Designed web systems to reduce web pages' loading latency and enable efficient archiving by leveraging data-flow and control-flow analysis to extract runtime properties of web computations.
 - Worked on designs for cross data-center storage systems and wide area networks to offer predictable performance and low cost.
- 2016 – 2017 **IBM Research Lab, Delhi**, Research Engineer
High Performance Computing (HPC)
Supervisor: [Yogish Sabharwal](#)
- Optimized performance of Cuda libraries tailored towards IBM cloud's Watson Machine Learning offerings
 - Worked on scalable lifecycle management (deployment, scheduling, resiliency, fault tolerance) of deep learning jobs in IBM Watson Deep Learning as a Service product.
- Summer 2016 **IBM Research Lab, Delhi**, Research Intern
Cloud Computing
Supervisor: [Mohan Dhawan](#)
- Designed a diagnostic tool to perform root cause analysis of performance and operational faults in OpenStack, a cloud management stack.

- Summer 2016 **Google Summer of Code**, Code developer
GNU GCC
- 2015 – 2015 **Amazon**, Software Engineering Intern
Fullfillment By Amazon (FBA)
- Designed web widgets for Webstore by Amazon (WBA) service used by 100,000+ providers.

Awards and Honors



- 2023 IIPC'23 Student Travel Grant
- 2022 HotNets'22 Student Travel Grant
- 2022 OSDI'22 Student Travel Grant
- 2021 Highest Score for Graduate Student Instructor
- 2016 FSE'16 Student Travel Grant
- 2016 Academic Excellence Award, IIIT Delhi
- 2015 Awesome Amazonian Intern Award
- 2012 CBSE 12th Grade Math Award (Given to 0.1% of students)

Research Publications

Manuscripts

- NSDI'24 **Ayush Goel**, Jingyuan Zhu, Ravi Netravali, Harsha V. Madhyastha. *"Sprinter: Speeding Up High-Fidelity Crawling of the Modern Web"* 
- Preprint'22 Muhammed Uluyol, **Ayush Goel**, Harsha V. Madhyastha, Ben Zhang, Jonathan Zolla, Chi-Yao Hong, Sankalp Singh, Kirill Mendelev, Dina Papagiannaki, Amin Vahdat. *"Highly Available Bandwidth Guarantees on Highly Utilized Cloud WANs," Preprint 2022.* 
- HotNets'22 **Ayush Goel**, Jingyuan Zhu, Harsha V. Madhyastha. *"Making links on your web pages last longer than you," ACM HotNets 2022.* 
- OSDI'22 **Ayush Goel**, Jingyuan Zhu, Ravi Netravali, Harsha V. Madhyastha. *"Jawa: Web Archival in the Era of JavaScript," USENIX OSDI 2022.* 
- OSDI'21 Shaghayegh Mardani, **Ayush Goel**, Ronny Ko, Harsha V. Madhyastha, Ravi Netravali *"Horcrux: Automatic JavaScript Parallelism for Resource-Efficient Web Computation," USENIX OSDI 2021.* 
- HotMobile'21 **Ayush Goel**, Vaspol Ruamviboonsuk, Ravi Netravali, Harsha V. Madhyastha *"Rethinking Client-Side Caching for the Mobile Web," ACM HotMobile 2021.* 
- NSDI'20 Muhammed Uluyol, Anthony Huang, **Ayush Goel**, Mosharaf Chowdhury, Harsha V. Madhyastha *"Near-Optimal Latency Versus Cost Tradeoffs in Geo-Distributed Storage," USENIX NSDI 2020.* 
- CoNEXT'16 **Ayush Goel**, Sukrit Kalra, Mohan Dhawan *"GRETEL: Lightweight Fault Localization for OpenStack," ACM CoNEXT 2016.* 
- FSE'16 **Ayush Goel***, Sukrit Kalra*, Dhriti Khanna, Mohan Dhawan, Subodh Sharma, Rahul Purandare *"POLLUX: safely upgrading dependent application libraries," ACM FSE 2016.* 

Posters

- OSDI'22 **Ayush Goel**, Jingyuan Zhu, Ravi Netravali, Harsha V. Madhyastha. *"Jawa: Web Archival in the Era of JavaScript," USENIX OSDI 2022.* 
- NSDI'20 Muhammed Uluyol, Anthony Huang, **Ayush Goel**, Mosharaf Chowdhury, Harsha V. Madhyastha *"Near-Optimal Latency Versus Cost Tradeoffs in Geo-Distributed Storage," USENIX NSDI 2020.* 

Open-source Artifacts

- 2023 **Sprinter**
A high performance perfect fidelity web crawler that leverages compute memoization techniques to significantly improve crawling throughput by eliminating the need of a browser.
<https://github.com/goelayu/Sprinter>
- 2022 **Jawa**
A web archival crawler that significantly reduces storage overhead of archiving web pages while improving fidelity of archived pages.
<https://github.com/goelayu/Jawa>
- 2022 **Oblique**
Modified the original concolic execution engine for JavaScript execution to support multi threading
<https://github.com/goelayu/oblique>
- 2020 **Mahimahi**
Fixed various recording issues with the open-sourced record-replay toolkit from MIT.
<https://github.com/goelayu/mahimahi>

Teaching Experience

- Winter 2022 **University of Michigan, EECS 491**
Introduction to Distributed Systems
Graduate Student Instructor (TA) with Prof. Harsha V. Madhyastha
100+ students
- Fall 2019 **University of Michigan, EECS 491**
Introduction to Distributed Systems
Graduate Student Instructor (TA) with Prof. Harsha V. Madhyastha
100+ students
- Fall 2015 **IIT Delhi, CSE 231**
Operating Systems
Head Teaching Assistant with Prof. Pushpendra Singh
150+ students

Invited Talks

- May 2023 **IIPC Web Archival Conference**
Jawa: Web archival in the era of JavaScript
- Nov 2022 **ACM HotNets Workshop**
Making links on your Web Pages last longer than you
- July 2022 **USENIX OSDI**
Jawa: Web archival in the era of JavaScript
- May 2022 **IIPC Web Archiving Conference**
Improve the fidelity of web archives
- May 2021 **IIPC Web Archiving Conference**
Lightning talk: Web archives and storage overheads
- March 2021 **ACM HotMobile**
Rethinking client-side caching for the mobile web
- June 2020 **Google Web Performance Workshop**
Reusing JavaScript execution to improve mobile web performance

Selected Professional Service

2022	Artifact Evaluation Committee for SIGCOMM
2022	Artifact Evaluation Committee for OSDI
2022	Artifact Evaluation Committee for ATC
2022	Artifact Evaluation Committee for Eurosys
2021	Artifact Evaluation Committee for OSDI

Outreach Activities

2018 – Present	Graduate Rackham International, Board Member Student organization advocating for rights of international students <i>Chair of Diversity, equity, inclusion</i> <i>Co-Chair of Outreach</i>
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References

Harsha V. Madhyastha
Associate Professor, University of Southern
California
Adjunct Associate Professor, University of Michigan
harshavm@umich.edu

Ravi Netravali
Assistant Professor, Princeton University
rnetravali@cs.princeton.edu

Ben Greenstein
Software Engineer, Google
bengr@google.com