Siva Kesava Reddy KAKARLA

Computer Science (PhD), UCLA

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I am a fifth-year Ph.D. candidate with a background in networks, formal methods, and programming languages. I am interested in researching all aspects of the design and implementation of high-performance network automation tools with potential future applications to distributed systems. My approach combines insights from verification, testing, anomaly detection, algorithms, and automata theory.

Education

2017 – Present **M.S. and Ph.D. in Computer Science.**
University of California, Los Angeles (UCLA), CA, USA.
CGPA: 4.0 / 4.0.
Advisors: Prof. Todd Millstein and Prof. George Varghese

2013 – 2017 **B. Tech. in Computer Science and Engineering (*Honors*).**
Indian Institute of Technology, Kharagpur, India.
CGPA: 9.67 / 10.0.

Awards and Honors

2021–2022 Dissertation Year Fellowship (DYF) from UCLA

2021 Finalist (top 3.5%) for the Facebook PhD Fellowship Program

2020 "Best Student Paper" award at the ACM SIGCOMM 2020 conference

2018–2019 UCLA Dean's Graduate Student Research (GSR) Fellowship

2017 UCLA Graduate Dean's Scholar Award (GDSA) given to department's top incoming PhD student

2013 – 2017 JBNSTS Scholarship

2013 All India Rank-330 in IIT-JEE Advance

2011 – 2013 KVPY Fellowship from Dept. of Science and Technology, India

Publications

NSDI '22 **SCALE: Automatically Finding RFC Compliance Bugs in DNS Nameservers**
Invited for an article in ⟨USENIX ;login: Magazine⟩
Siva Kesava Reddy Kakarla, Ryan Beckett, Todd Millstein, George Varghese.
Artifact https://github.com/dns-groot/Ferret

HotNets '21 **How Complex is DNS?**
Siva Kesava Reddy Kakarla, Ryan Beckett, Todd Millstein, George Varghese.
Proceedings of the 20th ACM Workshop on Hot Topics in Networks, HotNets 2021, pages 116-122.

SIGCOMM '21 **CAMPION: Debugging Router Configuration Differences**
Alan Tang, Siva Kesava Reddy Kakarla, Ryan Beckett, Ennan Zhai, Matt Brown, Todd Millstein, Yuval Tamir, George Varghese.
Proceedings of the 2021 ACM SIGCOMM 2021 Conference, pages 748–761.
Artifact https://github.com/atang42/batfish/tree/rm-localize

SIGCOMM '20 **GROOT: Proactive Verification of DNS Configurations.** ⟨Best Student Paper Award⟩
Siva Kesava Reddy Kakarla, Ryan Beckett, Behnaz Arzani, Todd Millstein, George Varghese.
Proceedings of the Conference of the ACM Special Interest Group on Data Communication, SIGCOMM 2020, pages 310–328.
Artifact https://github.com/dns-groot/2020_SIGCOMM_Artifact_157

NSDI '20 **Finding Network Misconfigurations by Automatic Template Inference (SELFSTARTER).**
Siva Kesava Reddy Kakarla, Alan Tang, Ryan Beckett, Karthick Jayaraman, Todd Millstein, Yuval Tamir, George Varghese.
Proceedings of the 17th USENIX Symposium on Networked Systems Design and Implementation, NSDI 2020, pages 999–1013.
Artifact https://github.com/SivaKesava1/SelfStarter

arXiv '19 **Expect More from the Network: DDoS Mitigation by FITT in Named Data Networking.**
Zhiyi Zhang, Vishrant Vasavada, Siva Kesava Reddy Kakarla, Eric Osterweil, and Lixia Zhang.
CoRR, abs-1902-09033.

GLOBECOM '17 **IEEE 802.11ac DBCA: A Tug of War between Channel Utilization and Fairness.**
Mahankali Saketh, Siva Kesava Reddy Kakarla, Raja Karmakar, Samiran Chattopadhyay, Sandip Chakraborty.
Proceedings of the IEEE Global Communications Conference, 2017, pages 1–6.

Research Tools Impact

FERRET
- Performs automated testing of DNS nameserver implementations by using symbolic execution of the DNS formal model
- Scales better than symbolic testing and finds deeper (RFC violation) bugs than fuzz testing
- Found **30** bugs across 8 different open-sourced DNS implementations, including popular implementations such as Bind, PowerDNS, Knot, and Nsd, of which **20** are fixed
- Found a critical vulnerability where an attacker with little effort could **crash** Bind nameservers and resolvers remotely (High-severity rated CVE-2021-25215)
- Found **4** bugs in Amazon Route 53 DNS implementation (tests now part of CI/CD pipeline)

GROOT
- Verifies efficiently that a property of interest holds for all possible DNS queries by reducing the extremely large space of possible queries to a smaller set of *query equivalence classes*
- Found multiple issues of delegation inconsistencies, cyclic zone dependencies, and rewrite blackholing in minutes in the Microsoft zone files with over 500k records
- Revealed **109** new bugs in 10 seconds in a large campus network with over a hundred thousand records
- Found around **160k** issues of blackholing in 3 minutes, which initiated a cleanup of the zone files of a large CDN with over 3.5 million records

SELFSTARTER
- Automatically finds configuration errors without a specification via a form of outlier detection on inferred templates
- Found **33** route policies with previously unknown bugs in the Microsoft wide area network
- Inferred templates provide *actionable* feedback to the operators to remediate the errors

Professional Experience

Amazon (Intern) — **Finding DNS RFC Compliance Errors in Amazon Route 53 DNS**
with *John Backes, and Gavin McCullagh*, Automated Reasoning Group and Route 53. *Fall '21*

SIGCOMM '21 — **Artifact Evaluation Committee Member** *2021*

Google (Intern) — **Finding Topology Errors by Graph Templating of Google Metro Networks**
with *Jayaram Mudigonda, and Anees Shaikh*, NetInfra Group. *Summer '20*

Microsoft (Intern, Contractor) — **GROOT: Proactive Verification of DNS Configurations**
with *Ryan Beckett, and Behnaz Arzani*, MNR Group. *Summer '19 – Winter '20*

UCLA (Undergraduate TA) — **CS 118 – Computer Network Fundamentals**
with *Prof. George Varghese.* *Fall '19*

UCLA (Graduate RA) — **Misconfigurations by Template Inference and Formal Methods for a Robust DNS**
with *Prof. Todd Millstein, and Prof. George Varghese*, NetVerify Group. *Fall '17 – current*

IIT Kharagpur (Undergraduate RA)
Does QUIC Kill Your Data Plan? A View Using YouTube Adaptive Streaming Clients
with *Prof. Sandip Chakraborty*, Complex Network Research Group (CNeRG). *Fall '16 – Spring '17*

LinkedIn (Intern)
Enhancement of LinkedIn spam detection tool with Mockito unit tests
with *Prashanth Nimmagadda*, Content Filtering & Spam Detection Team. *Summer '16*

IISc Bangalore (Intern)
Experimenting with Akka Package
with *Prof. Komondoor V. Raghavan*, Compilers, PL and SE Group. *Summer '15*

Talks and Presentations

Feb '22	Find Bugs in your DNS Zone files Before Deployment with GRoot – DNS-OARC 37	*Virtual*
Jan '22	Formal Methods for a Robust DNS – UCLA CS 201 Seminar	*Virtual*
Nov '21	How Complex is DNS? – The 2021 ACM HotNets Workshop	*Virtual*
Nov '21	Exploiting Formal Methods To make The Domain Name System More Robust – NetVerify 2021 (Network Verification Workshop in conjunction with the 29th IEEE ICNP 2021)	*Virtual*
May '21	"So you think your Nameservers are Correct?": Finding Errors Automatically in Nameserver Implementations – DNS-OARC 35	*Virtual*
Aug '20	GRoot – The 2020 ACM SIGCOMM Conference	*Virtual*
Jul '20	GRoot – Intentionet (invited by Ratul Mahajan)	*Virtual*
Feb '20	SelfStarter – The 2020 NSDI Conference	*Santa Clara, CA*
Aug '19	SelfStarter – Intentionet and Microsoft Research	*Seattle/Redmond, WA*

References

- **Todd Millstein**
  Professor of Computer Science
  University of California, Los Angeles
  ✉: todd@cs.ucla.edu

- **George Varghese**
  Professor of Computer Science
  University of California, Los Angeles
  ✉: varghese@cs.ucla.edu

- **Ryan Beckett**
  Senior Researcher
  Microsoft
  ✉: ryan.beckett@microsoft.com

- **John Backes**
  Senior Applied Scientist
  Amazon Web Services (AWS)
  ✉: jbackes@amazon.com