Aman Goel

Ph.D. Candidate, Computer Science & Engineering, University of Michigan

Basic Information

5^{th} Year Ph.D. Candidate (adviser: Prof. Karem Sakallah)
Formal Methods & Automated Reasoning Group, CSE
University of Michigan, Ann Arbor, USA

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Research Interests

My research interests include exploring reliability & security of complex systems, and developing automated reasoning algorithms for ensuring system correctness. I also have a developing interest in data structures & algorithms, programming languages, machine learning and web systems. My current work focuses on automatic verification of complex systems.

Education

University of Michigan, Ann Arbor, USA — *Aug 2016 - Present*
Ph.D. student, Computer Science & Engineering
Grade Point Average: **3.96/4**

IIT Madras, India — *July 2011 - May 2016*
Bachelor of Technology, Electrical Engineering — *Silver Medalist*
Master of Technology, Microelectronics & VLSI

- Grade Point Average: **9.23/10**
- Minor: Industrial Engineering (GPA: 9.33/10)

Recent Research Experience

Developer of *AVR* — *Sep 2016 - Present*
AVR is a tool for automatic verification of state-transition systems
– Successfully applied on hardware and software systems
– Uses SMT solvers to perform word-level formal verification
– Uses data abstraction for scaling unbounded property verification
– Won 1^{st} place in the prestigious Hardware Model Checking Competition (HWMCC) 2020

Developer of *I4* — *Aug 2018 - Present*
I4 is a tool for automatic, push-button verification of distributed systems
– Performs automated correctness checking and bug-hunting for distributed systems
– Uses formal methods and symmetry to simplify and automate verification tasks

Contributor to Open-source Tools — *Summer 2020 @ Menlo Park, CA*
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– A state-of-the-art SMT solver from SRI
– Worked with the CSL team and developed techniques for quantified SMT solving

Contributor to Commercial Tools — *Summer 2019 @ Haifa, Israel*
JasperGold
– A state-of-the-art formal verification platform from Cadence
– Developed word-level verification engines for JasperGold
– Worked with Cadence SVG (systems verification group) and developed algorithms for automatically solving hard verification tasks

Recent Service

Artifact evaluation committees (AEC) — *2019 - Present*
VMCAI'21: Conference on Verification, Model Checking, and Abstract Interpretation
OOPSLA'20: Conference on Object-Oriented Programming Systems, Languages, and Apps
CAV'20: Conference on Computer-Aided Verification

Skills

Good knowledge of *C++, C, Python, Verilog, Shell scripting*
Working knowledge of *MATLAB, Java, HTML, LLVM*
Good understanding of *SAT / SMT solvers*

Selected Publications

AVR: Abstractly Verifying Reachability
Aman Goel, and Karem Sakallah. In International Conference on Tools and Algorithms for the Construction and Analysis of Systems (*TACAS*), 2020 (to appear).

I4: Incremental Inference of Inductive Invariants for Verification of Distributed Protocols
Ma, Haojun, **Aman Goel**, Jean-Baptiste Jeannin, Manos Kapritsos, Baris Kasikci, and Karem A. Sakallah. In Proceedings of the 27th Symposium on Operating Systems Principles (*SOSP*), ACM, 2019.

Towards Automatic Inference of Inductive Invariants
Ma, Haojun, **Aman Goel**, Jean-Baptiste Jeannin, Manos Kapritsos, Baris Kasikci, and Karem A. Sakallah. In Proceedings of the Workshop on Hot Topics in Operating Systems (*HotOS*), pp. 30-36. ACM, 2019.

Model checking of Verilog RTL using IC3 with syntax-guided abstraction
Aman Goel, and Karem Sakallah. In NASA Formal Methods Symposium (*NFM*), pp. 166-185. Springer, Cham, 2019.

Empirical evaluation of IC3-based model checking techniques on Verilog RTL designs
Aman Goel, and Karem Sakallah. In 2019 Design, Automation & Test in Europe Conference & Exhibition (*DATE*), pp. 618-621. IEEE, 2019.

iitRACE: A memory efficient engine for fast incremental timing analysis and clock pessimism removal
Peddawad, Chaitanya, **Aman Goel**, B. Dheeraj, and Nitin Chandrachoodan. In 2015 IEEE/ACM International Conference on Computer-Aided Design (*ICCAD*), pp. 903-909. IEEE, 2015.

Honors & Awards

- Recipient of **Rackham Predoctoral Fellowship** 2020-21 for outstanding PhD research
- Runner-up finalist of the **CSE Graduate Student Honors Competition** 2019 for outstanding PhD research for *Push-button Verification using Abstraction and Induction*
- Recipient of Dwight F. Benton fellowship at University of Michigan for 2016-17
- Recipient of research travel grant and Israel travel award for 2019
- Branch position 2 in Electrical Engineering at IIT Madras (*Silver medalist*)
- Won international 3^{rd} place in TAU Contest at ICCAD 2015 for Incremental Timing Analysis
- Recipient of *best undergraduate research project* at Pan IIT Research Expo 2014
- Recipient of *Electronics for You* prize for best academic performance at graduate level
- Won *National Award* for the Empowerment of Persons with Disabilities 2013 for Solar Charger for Hearing Aid Devices

Selected Courses

University of Michigan

- *Advanced Algorithms*
- *Advanced Compilers*
- *Formal Verification*
- *AI Foundations*
- *Web Systems*

IIT Madras

Computer Science:

- *Data Structures & Algorithms*
- *Computational Engineering*
- *Design Verification*
- *Digital Systems Testing*

Mathematics & Operations Research:

- *Combinatorial Optimization*
- *Fundamentals of Operational Research*
- *Probability Foundations*
- *Decision Modelling*

Teaching Experience

University of Michigan:

EECS 281 Data Structures & Algorithms	*Aug - Dec 2017 & 2018*
EECS 478 Logic Synthesis & Optimization	*Jan - Apr 2018*
EECS 579 Digital System Testing	*Aug - Dec 2019*
EECS 492 Introduction to Artificial Intelligence	*Jan - Apr 2020*

IIT Madras:

EE 5311 Digital IC Design	*Aug - Nov 2015*
EE 5332 Mapping Signal Processing Algorithms to DSP Architectures	*Jan - May 2016*

Former Activities

– *Summer School on Formal Techniques* *Summer 2018 @ Menlo Park, CA*
Invited participant at Summer School on Formal Techniques 2018 hosted by SRI

– *MPUC: Compiler for Memristor Arrays* *Jan - Apr 2017*
Developed a compiler for coarse-grained architecture of memristor arrays

– *Radiation Pattern Measurement System for Automotive Radar* *May - July 2014*
Wireless Connectivity Solutions, Texas Instruments, India
Developed an automatic radar positioning system for radar modules testing

– *Voice to Text Converter* *Mar 2013*
Developed software that converts voice input in a language to text field in other chosen language using available softwares of Google Voice Recognition and Google Translate

Others

– *U-M Mentorship program* *2016 - Present*
Encourage and guide undergraduate students towards CS major, programming and graduate studies

– Voluntary blood donor

Hobbies

Swimming, Water Polo, Skating (ice & roller), Soccer