

# Yugesh Ajit KOTHARI

Software Systems | Formal Methods & Verification | Programming Languages

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## EDUCATION

- 2017-2021\* Bachelor of Technology - Computer Science and Engineering - **Indian Institute of Technology Kapnur**  
Cummulative Grade Point/CGPA : **9.61/10.0**
- 2017 High-School ISC Diploma - Hill Top School, Jamshedpur, **97.0% score**

## ★ HONOURS & AWARDS

- 2018, 2019 **Academic Excellence Award** - for outstanding academic achievement in respective year
- 2017-21 **Aditya Birla Scholarship** - Among 15 candidates across all IITs
- 2017 **Kishore Vaigyanik Protsahan Yojana Scholarship**
- 2017 **All India Rank 193** Joint Entrance Examination Mains, **1.5 million candidates**
- 2017 **All India Rank 120** Joint Entrance Examination Advanced, **200,000 candidates**
- 2017 **Gold Medal** Indian National Physics Olympiad
- 2016 **All India Rank 30** National Science Talent Search Examination
- 2016 **National Standard Examination** Physics | Chemistry | Astronomy **Top 6 in state**

## WORK EXPERIENCE

- Present**  
**Jan 2020** | **Research Assistant, MAX PLANCK INSTITUTE FOR SOFTWARE SYSTEMS, Kaiserslautern, Germany**  
Practical Formal Methods, **Dr. Maria Christakis**
- > Formalized and designed a new Abstract Interpretation based approach to verify hybrid software.
  - > Implemented a symbiotic framework by extending an Abstract Interpretation engine **crab** and used it to formally verify a software with a Neural Network for safety properties.
  - > Currently working on a hybrid technique of combining Abstraction Interpretation and Bounded Model Checking.
- Seahorn** **Crab** **Clam** **C++** **Abstract Interpretation** **Program verification**
- Sept 2020**  
**Jun 2020** | **Research Intern, ECOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE, Lausanne, Switzerland (remote)**  
Network Architecture Lab, **Prof. Katerina Argyraki**
- > Extended Bolt to give run time performance guarantees for Software Network Functions by analysing them at LLVM-IR level allowing performance predictions to be more portable (predicting performance agnostic of underlying hardware).
  - > Used KLEE for exhaustive symbolic execution and computed software level metrics in LLVM to compare relative predictions with x86. Implemented proof-of-concept for the Bridge and NAT Network Functions.
  - > A report of the work can be found [here](#).
- KLEE** **BOLT** **LLVM** **eBPF** **Software Performance**
- Jun 2020**  
**May 2020** | **Software Development Intern, MASTERCARD, Pune, India (remote)**  
 [github.com/mc-internship/covid19visualizer](https://github.com/mc-internship/covid19visualizer)
- > Built a dashboard to track updates and developments of rising COVID-19 cases in India.
  - > Implemented strong, industry standard devops principles to create production ready code with support for Continuous Integration and Continuous Deployment.
  - > A blueprint of the CI/CD pipeline can be seen [here](#). Project can be see [here](#) (no longer actively maintained).
- COVID-19** **Web Development** **DevOps**
- July 2019**  
**May 2019** | **Research Intern, PURDUE UNIVERSITY, West Lafayette, Indiana, USA**  
Purdue Formal Methods Reseach Lab, **Prof. Roopsha Samanta**
- > Developed infrastructure to transpile a parsed C program to a Static-Single-Assignment form Boolean Program; with intent to reason about program behaviour using an SMT-solver like **Z3**.
  - > Worked on formalizing a novel framework for statement-level multi-line automated program repair using **CPAChecker** that leverages lazy predicate abstraction for automated reasoning about incorrect program behaviour and a code synthesizer to suggest repairs based on satisfying models from a pMaxSAT query.
- Java** **Ant** **Antler** **CPAChecker** **Z3** **Program Repair**

July 2018 **Member of Technical Staff, NUTANIX, Bangalore, India**  
 May 2018

- > Worked on CALM, Nutanix's application-orchestration tool that allows clients to manage state and replicas of their applications and VMs at all stages in the deployment cycle.
- > Implemented from scratch tasks for their suite that allow users to configure and authenticate to third-party rEST servers to fetch any information and set as properties on machine as per the deployment requirement.
- > Work included adding a web-UI component (ReactJs), embedded document models at the backend (Python) and a GoLang based task executor instance on their proprietary execution framework.
- > **Received returning offer for internships in later breaks.**

Python Javascript ReactJs GoLang micro-service architecture

## </> PROJETS

### UNDERGRADUATE RESEARCH PROJECT

NOV 2020 - PRESENT

Explored the smack tool-chain, and fixed the Angelic Verifier within corral for current version of smack. Identified benchmarks for buffer-overflow bugs, and currently working on developing an AV Property Language to detect buffer-overflows for static driver verification.

Smack Corral Boogie Angelic Verification

### PROGRAM ANALYSIS AND VERIFICATION - CS639

SEP-NOV 2020

[github.com/yugeshk/CS639](https://github.com/yugeshk/CS639) [github.com/yugeshk/CS639-Assignments](https://github.com/yugeshk/CS639-Assignments)

Used Angelic Verification to analyze WebAssembly programs for memory safety bugs.

Implemented multiple control-flow and dataflow analysis techniques for a subset of the python grammar.

Faint Variable Analysis CFG construction AST parsing

### OZ INTEPRETER - COURSE PROJECT FOR CS350

OCT-NOV 2018

[github.com/yugeshk/CS350](https://github.com/yugeshk/CS350)

A minimal interpreter for Oz as part of my coursework for CS350 (Principles of Programming Languages). A declarative-concurrent interpreter based on the Kernel language (management of the SAS, Multi-stack, execution environment, etc).

Oz programming-languages functional-programming

### MICROSOFT CODE.FUN.DO - NATIONAL WINNER

MAY 2018

[WorldNewSense](https://worldnewsense.com)

Machine learning hackathon project that used the NLTK library for Natural Language Processing and Sentiment Analysis to summarize, filter and present news articles on World Politics filtered by topics and countries; scraped and analyzed over a year's news data to predict relations between countries.

Django NLP Heroku jQuery D3.js

### LIFE@IITK - PROGRAMMING CLUB, IIT KANPUR - PROJECT TEAM LEAD

MAY 2019- APR 2020

[github.com/life-iitk](https://github.com/life-iitk)

Unified web-app for all activities, updates and personal schedule (including individual academic and non-academic student-body updates) at IIT Kanpur. End-to-end implementation of prototype developed as *Personalized Notification Portal*. Managing depolyment as micro-services on college VMs.

ReactJs Django CentOS Nginx Dockers Software-development project-management

### SOFTWARE DEVELOPMENT LAB PROJECT

AUG 2019

[github.com/yugeshk/hotel-management](https://github.com/yugeshk/hotel-management)

Developed a hotel management portal using LAMP technologies that allows different end-users (i.e., manager, employees and customers) to perform different actions like complaint management, room booking and servive, salary management etc.

Linux Apache2 MySQL php docker-compose web-hosting

### SAT SOLVER - COMPLIMENTARY SUDOKU GENERATOR-SOLVER FOR VALIDITY

OCT 2018

[github.com/yugeshk/CS202](https://github.com/yugeshk/CS202)

SAT solvers, one implemented using custom heuristics using the semantic-tableaux approach another using randomized techniques. A logic based sudoku solver and generator that encodes a sudoku in DIMACS format to check for validity of the solver. Bench-marked various types of encodings against miniSAT.

Python SAT-solvers Formal-Methods Computer-logic

## TECHNICAL SKILLS

**Programming** C++, Python, Java, GoLang, Bash and Shell Scripting, Haskell, OCaml  
**Software** KLEE, Seahorn, Smack, Corral, Emscripten  
**Web** JavaScript, NodeJs, MongoDB, ReactJs, Django, PostgreSQL, GraphQL  
**Misc.** Git, Travis CI, Jira, Jenkins, Puppet, Dockers, Nginx, L<sup>A</sup>T<sub>E</sub>X, Heroku

## ✓ RELEVANT COURSEWORK

### Program Verification & Testing

Fundamentals of Computing\*  
Advanced Algorithms  
Software Development Lab  
Convex Optimization  
Introduction to Real Analysis  
Computer Networks#

Operating Systems  
Theory of Computation  
Introduction to Machine Learning  
Systems Programming Lab  
Probability and Statistics  
Partial Differential Equations  
Compiler Construction#

Principles of Programming Languages  
Data Structures and Algorithms  
**Parallel & High Performance Computing**  
Mathematics for Computer Science  
Logic In Computer Science  
Linear Algebra and ODE  
**Analysis of Concurrent Programs#**

\* ≡ Outstanding # ≡ Upcoming **bold** ≡ Graduate course

## 📌 POSITIONS OF RESPONSIBILITY

Present Jan 2021	<b>Teaching Assistant, SOFTWARE DEVELOPMENT AND OPERATIONS, IIT Kanpur</b>   📄 CS253 <ul style="list-style-type: none"><li>&gt; Involved in design of assignments and curriculum.</li><li>&gt; Helping students with queries and code.</li></ul>
July 2019 May 2019	<b>Overall Coordinator, SUMMER OF CODE, IIT Kanpur</b>   📄 IITK-SoC <ul style="list-style-type: none"><li>&gt; Organized and coordinated an industry funded Summer of Code program at IIT Kanpur that trained 100 students in Full Stack Development, with end projects aimed at creating positive societal impact.</li><li>&gt; <b>Structured program curriculum, lectures and timeline. Served as mentor to students during the coding phase.</b></li></ul>
Apr 2020 Apr 2019	<b>Coordinator, PROGRAMMING CLUB, IIT Kanpur</b> <ul style="list-style-type: none"><li>&gt; Coordinator for all student-organized programming activities at IIT Kanpur - organized workshops, gave lectures, and mentored projects.</li><li>&gt; Started a now popular 8 languages in 8 weeks summer project at IIT Kanpur - covering all major paradigms : procedural, object-oriented, functional and logic programming.</li></ul>
Apr 2019 Aug 2018	<b>Academic Mentor, COUNSELLING SERVICES, IIT Kanpur</b> <ul style="list-style-type: none"><li>&gt; Student volunteer for <b>teaching</b> and helping freshers with the course Fundamentals of Computing.</li></ul>
Present Jan 2019	<b>Systems Administrator, STUDENT SERVERS, IIT Kanpur</b> <ul style="list-style-type: none"><li>&gt; Manage a couple CentOS VMs, that run multiple campus software, nginx reverse proxies, dockerized micro-services and database clusters.</li></ul>
Apr 2019 Jul 2018	<b>Software Manager, TECHKRITI - TECHNICAL FESTIVAL, IIT Kanpur</b> <ul style="list-style-type: none"><li>&gt; Overall manager of all programming and software related events for Techkriti '19. Designed problem statements and conducted 4 programming events, that saw a participation of over 2000 students.</li></ul>
Present Aug 2018	<b>Student Member, DEPARTMENTAL UNDERGRADUATE COMMITTEE, CSE, IIT Kanpur</b> <ul style="list-style-type: none"><li>&gt; Student member nominated to departmental committee that handles all undergraduate academic policies.</li></ul>