

# MEET UDESHI

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**Research interests:** hardware security, reverse engineering, decompilation, trojan detection

## EDUCATION

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### PhD, Center for Cybersecurity, New York University

Sep'22 - Present

*Advisors: Prof. Farshad Khorrami and Prof. Ramesh Karri*

- Research focus on reverse engineering PLC binaries

### Dual Degree B.Tech + M.Tech, Electrical Engineering, IIT Bombay

Jul'14 - Jun'19

*Advisor: Prof. Virendra Singh*

- Masters thesis focused on hardware security
- Member of Computer Architecture and Dependable Systems Lab
- CGPA: 8.18 / 10

## PUBLICATIONS

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N. K. Boran, S. Rathore, **M. Udeshi** and V. Singh, "Fine-Grained Scheduling in Heterogeneous-ISA Architectures," in IEEE Computer Architecture Letters, vol. 20, no. 1, pp. 9-12, 1 Jan.-June 2021

**M. Udeshi**, H. Garg, V. Baddi, P. Dwarakanath and S. Ladwa, "Low Power Object Tracking on AI100 using Kernelized Correlation Filters," in Qualcomm QBuzz Conference 2021 (won **Best Paper Award**)

## ACHIEVEMENTS

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Awarded the **Recognition of Outstanding Contributions (RoCStar)** for the AI100 compiler and KCF projects

Received a **Gold Medal** in Indian National Physics Olympiad given to top 35 students across the country

Scored **Advanced Performer (AP)** grade in CS101, awarded to top 3 students in a batch of 200

Secured **All-India rank 275** in IIT JEE Advanced 2014 examination out of 1.3 million students

## WORK & RESEARCH EXPERIENCE

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### Senior Engineer - Qualcomm R&D

Jul'19 - Jul'22

*ML Compiler Team for Cloud AI100 Accelerator*

- Worked on key aspects of AI100 compiler like multi-core, multi-thread and SIMD parallelization, memory management, graph scheduling and operator fusion
- Innovated various **graph optimization techniques** applicable to 2D and 3D computer vision models, recommendation systems and autonomous driving tasks
- Developing an **automatic SIMD code generation** framework for ML operators using dataflow analysis
- Contributed to the open-source **Pytorch Glow** compiler framework
- Deployed power efficient object tracking pipeline using **Kernelized Correlation Filters (KCF)** on AI100

### Master's Thesis - Hardware Security

Aug'18 - Jun'19

*Guide: Prof. Virendra Singh, CADSL, IIT Bombay*

- Designed a **prefetcher disabling attack** to amplify cache side-channel leakage which achieves **99%** reduction in prefetches generated by **AES program**
- Implemented confidence measurement for stride and DCPT prefetcher in **GEM5** simulator
- Simulated a timing attack on the **re-order buffer** using **SNIPER** x86 simulator
- Implemented **microbenchmarking tools in x86 assembly** to reverse-engineer cache information of Intel cores

### R&D Project - HIDC: Heterogeneous-ISA Dynamic Core

Aug'17 - Jul'18

*Guide: Prof. Virendra Singh, CADSL, IIT Bombay*

- Implemented abstractions which help programs running on HIDE to migrate between two ISAs during execution
- Created a stack analysis and mapping framework for x86 to ARM migrations which analyses **LLVM-IR**
- Proposed a granular function level migration strategy to reduce cost of migration by **100x**
- Benchmarked the migration time between x86 and ARM for programs from **SPEC-2006** using **GEM5** simulator

## Google Summer of Code - Kivy

May'16 - Aug'16

*Python Native UI Framework Game Engine*

- Created a **Python+Cython** module for Tiled maps integration with the **KivEnt** Game Engine
- Implemented Cython optimized **Animation System** using entity-component architecture

## Software Development Intern - Amazon India

Jul'17 - Aug'17

*Transportation Financial Systems*

- Implemented processing and sorting of **1 million+ receipts** daily using **DynamoDB, SQS**
- Automated server setup containing 30+ AWS resources in **CloudFormation**

## OPEN SOURCE CONTRIBUTIONS

Created and maintained **Youtube Fast Playlist**, a webapp to rapidly form playlists from Youtube videos

Contributed the "merge albums" feature to the **beets** music library manager

Collected a bug bounty on bug fixes for the **Kivy Python NUI** framework

Worked on UI aspects of the **wptview** web application for **Mozilla**

Made minor contributions to the **Numpy** repository

## LEADERSHIP & TEACHING POSITIONS

**Mentor** for a hardware security project in the Qualcomm Innovation Fellowship from Aug'20 to May'21

**Teaching Assistant** for VLSI Design lab in Spring'19 under Prof. Sachin Patkar

**Teaching Assistant** for Microprocessors course in Fall'18 under Prof. Virendra Singh

**Manager** of Electronics Club, IIT Bombay for Fall'16 and Spring'17 semesters

**Teaching Assistant** for Computer Programming flipped classroom in Summer'16 under Prof. D.B.Phatak

**Reviewer** in the 46th International Physics Olympiad in Jun'15

## SKILLS

### Relevant Courses

Advanced Computer Architecture

VLSI CAD

Image Processing

Neuromorphic Engineering

### Programming

Embedded C/C++

Python

VHDL

★★★★★

★★★★★

★★★★☆

### Frameworks

Pytorch Glow Compiler

LLVM Compiler

OpenCV

★★★★★

★★★★★

★★★★☆

### Tools and Simulators

GEM5

SNIPER

Vivado HLS

★★★★★

★★★★☆

★★★★☆

## INDEPENDENT RESEARCH & ACADEMIC PROJECTS

### RFID-based Secure Point-of-Sale Payment System

Sep'20 - Dec'20

*Swadeshi Microprocessor Challenge*

- Designed a Point-Of-Sale system using the Shakti microprocessor with cryptography hardware extensions
- Developed a payment interface based on RFID cards using RFID security features
- Conceptualized a business strategy to deploy payment systems in public transport networks like Mumbai Metro

## Core Team Member, Kindred Networks

Jan'18 - Aug'18

*Communication Services startup for IoT*

- Developed an end-to-end **LoRaWAN** communication solution using **Raspberry Pi** and **STM32** platforms
- Designed custom Raspberry Pi shield with radio concentrator, GSM and GPS module
- Deployed proof-of-concept water metering project in Delhi in collaboration with Faclon Labs

## Zedroid: Android on Zedboard

Spring'18

*VLSI Design lab, Guide: Prof. Sachin Patkar*

- Rebuilt Android 5.0 OS on top of Linux Kernel v3.2 for Zynq platform
- Modified OS init procedure to enable on-board networking with **Android Debug Bridge**
- Interfaced with on-board FPGA for performance intensive applications like video-streaming

## Hexapod Navigation using Local Positioning

Spring'18

*Embedded Systems course, Guide: Prof. Kavi Arya*

- Achieved **10% location accuracy** in  $2.25m^2$  area with **RSSI trilateration** for local positioning using **ZigBee**
- Designed a Hexapod with 18 degrees of freedom and implemented path-following robot using local positioning

## PODEM implementation for Combinational ATPG

Spring'18

*VLSI Testing course, Guide: Prof. Virendra Singh*

- Implemented **Path-Oriented Decision Making** for test generation of combinational circuits
- Integrated algorithm with **Deductive Fault Propagation** to boost performance
- Built logic gate test simulation framework in C++

## Photoplethysmograph Sensor

Fall'17

*Sensors course, Guide: Prof. Siddharth Tallur*

- Designed analog filters for denoising and **200x amplification** of IR sensor output
- Implemented 16-value FFT processing on **Arduino** to extract heart-rate
- Tested with 3 skin tones and illumination ranging 5 – 15mA to quantify sensor effectiveness

## Visible Light Communication

Spring'17

*Electronics Design lab, Guide: Prof. Kumar Appaiah*

- Achieved target of **100+ KBits/s** with modem generating Manchester encoded data stream
- Interfaced PLL circuit at receiver end for frequency-locking and clock-retrieval at 100KHz
- Implemented USB-to-VLC conversion on **Tiva-C Launchpad** to connect 2 computers over VLC
- Achieve link distance of over 5 meters with laser and high-intensity photodiode

## Difference-Based Image Noise Modeling using Skellam Distribution

Spring'17

*Advanced Image Processing course, Guide: Prof. Ajit Rajwade*

- Extracted Skellam parameters from difference of images with Poisson noise
- Applied Skellam noise model to edge-detection and background-subtraction use cases

## Silicon-on-Insulator Self Heating analysis

Spring'17

*Physics of Transistors course, Guide: Prof. Udayan Ganguly*

- Formulated application of Non-Equilibrium Green's Function for self-heating analysis
- Simulated spatial distribution of Power Dissipation using average energy of current differential
- Presented theory and simulation results as a poster to 100+ crowd

## EXTRA CURRICULARS

Volunteered to teach Business Studies as part of Supplemental Learning Program of **Vidya NGO**

Won third place in Case-Study competition at **Inter-IIT Tech Meet 2018** held at IIT Madras

Awarded **Tech Special Mention** by hostel for year 2015–2016 among 500+ students

Mentored 5 participants in **Kharagpur Winter of Code** to contribute to Youtube Fast Playlist

Participated in Art and Craft sessions by Rang club like wall painting, road painting.