

SHIKHAR TULI

PhD Candidate
Electrical Engineering
Princeton University

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ACADEMIC DETAILS

Year	Degree	Institute	CGPA/Percentage
2020-Present	Ph.D. in Elec. and Comp. Eng.	Princeton University	3.887
2016-2020	B.Tech in Electrical Engineering	Indian Institute of Technology Delhi	9.486
2016	Class XII, CBSE	Amity International School	96.6%
2014	Class X, CBSE	Amity International School	10.00

AWARDS AND ACHIEVEMENTS

- Received **Pramod Subramanyan *17 Early Career Graduate Award** at Princeton University.
- Awarded **Ph.D. Fellowship** (USD95,000) for the first year of study.
- Received **Rajiv Bhambawale Award for Best B.Tech thesis** at the undergraduate level.
- Awarded **ThinkSwiss Research Scholarship** (CHF4800) for a summer internship at Embedded Systems Laboratory (ESL), EPFL under the E3 program.
- Received **Summer Undergraduate Research Award** for outstanding research at undergraduate level for the summer of 2018.
- Received **Design Innovation Summer Award** (DISA - 2017) and **DIT Seed Grant** for summer project.
- Placed among the **Top 7%** of IIT Delhi in the first, second, fifth and seventh semesters based on academic performance.
- Won **2nd Runners Up**, **Best Mechanical Design Award** and **Best Technical Report** Cash Prize for Bomb Disposal Robotics National Competition at IIT Kharagpur - December 2016
- Secured **All India Rank 1624** in Joint Entrance Exam Advanced - 2016 among 150,000 candidates.
- Awarded **Chairperson's Trophy** for being the **School Topper** with 96.60% in CBSE AISSCE XII standard.
- Awarded **All Rounder** for VIII and IX standard.
- Received **Best Alliance award** and **Rockwell Collin's Innovation award** for National Robotics Competition - First Tech Challenge in X standard. Competition [link](#).
- Awarded **Second Runners Up** position and **Award for Best Marketing** in F1 in schools national competition in which students design, manufacture and race with miniature Formula 1 cars. Team Facebook [page](#). Competition [link](#).

RESEARCH PROJECTS

Co-design of CNNs and Accelerators Research Project

Prof. Niraj K. Jha, Princeton University
Aug 2020 - Present

Designing and developing a novel framework that co-designs machine learning models (namely CNNs) along with the accelerator chip to which it would be mapped. Proposed novel neural architecture search techniques along with an expanded suit of CNN models and hardware accelerators.

Exploration of the Transformer design space Research Project

Prof. Niraj K. Jha, Princeton University
Dec 2020 - Present

Studying the effects of various architectural hyperparameters in the design of transformers along with various training recipes in order to find the best architecture for each common task in the natural language processing domain. Heterogeneous and flexible architectures have shown to outperform traditional homogeneous and rigid models that have the same set of hyperparameters across all layers in the network.

Inductive biases in CNNs and Transformers

Research Project

CoCoSci Lab, Princeton University

Jan - Jul 2021

Studied various human inductive biases on common computer-vision models including CNNs and transformers. Trained and evaluated models on the stylized Imagenet dataset to test shape/texture biases. Through a diverse set of experiments, it was found that transformers are superior models with improved inductive biases compared to CNNs. Github Repository [link](#).

Supervised and Unsupervised Spiking Neural Networks

Research Project

Prof. Debanjan Bhowmik, IIT Delhi

Aug - Nov 2019

Simulated Supervised and Unsupervised Spiking Neural Networks employing STDP Learning rule (thesis [link](#)). Implemented code-level and circuit-level simulations of a novel neuromorphic system capable of learning on common machine learning benchmarks.

Architectures of Emerging Non-Volatile Memories

Summer Research Project

Embedded Systems Lab, EPFL

May - Nov 2019

Developed novel architectures for Emerging Non-Volatile Memories (NVMs) like RRAMs, STT-MRAMs, SOT-MRAMs, PC-RAMs, etc. For this, a Variability-Aware Controller (VAC) was proposed to asynchronously write to the NVM. This resulted in performance and energy improvements in low-power Edge applications. Computing overheads and implementing an adaptive and dynamic version of the VAC for further optimizing design-space parameters.

Modeling of HCI Degradation in GAA NWFETs

Summer Research Project (SURA)

Prof. Abhisek Dixit, DWLCL, IIT Delhi

May 2018 - Nov 2019

Investigated and modeled Hot-Carrier Injection based degradation effects in gate-all-around nanoWire FETs. Various model dependencies of device reliability were proposed for HCD in NWFETs. These models were backed by experimental study (using SMUs and WGFMs) and physical justification. The project was under the Design and Wafer-Level Characterization Lab (DWLCL), IIT Delhi and in collaboration with IMEC Leuven, Belgium ([link](#)).

FogBus

Remote Summer Research Project

CLOUDS Lab, University of Melbourne

May - July 2018

Developed a blockchain-based lightweight framework, named FogBus for Edge and Fog Computing, for end-to-end integration of IoT-Edge-Cloud. FogBus offers a platform independent interface to IoT applications and computing instances for execution and interaction. A Sleep Apnea analysis application was deployed using this framework for real time notification and diagnosis by analyzing pulse oximeter data. Github Repository [link](#).

Low Cost Air Purifier with ENMS

Industrial Project

Prof. Sujeet K. Sinha and NanoClean India Pvt. Ltd.

May 2017 - July 2018

Designed and developed a commercial air purifier which uses air mask/respirator for filtration with other primary and secondary air filters. A new innovative design was implemented with FPGA-based ENMS (Enhanced Network Management System) control for real time feedback, online maintenance and integration of large number of them in geographically spread locations. It is affordable and user friendly. Patent pending.

Coral IP-phone

Industrial Project

Coral Telecom Pvt. Ltd.

Aug 2020 - Nov 2021

Developing a VoIP phone with the use of system-on-module (SOM), integrating RGB TTL LCD with a capacitive touch panel, MIPI-CSI camera, PoE functionality, L2 switch, keyboard, speaker and mic onto the SOM. The phone supports all video calling features.

Coral Cloud

Industrial Project

Coral Telecom Pvt. Ltd. and ST Microelectronics

Jan - Mar 2018

Designed and developed a high availability and load-balanced, Electronic Private Automatic Branch Exchange (EPABX) for SIP communication using Free-Switch open source software. The system features no-single-point-of-failure with hot-swappable power supply (SMPS).

TEACHING APPOINTMENTS

Department of Electrical and Computer Engineering, Princeton University:

- Machine Learning for Predictive Data Analytics. **Head T.A.** Sep - Dec 2021.

Department of Electrical Engineering, Indian Institute of Technology Delhi:

- Introduction to Electrical Engineering. **T.A.** *Jul - Nov 2019.*

RESEARCH APPOINTMENTS

- Research Associate. Computational Cognitive Science (CoCoSci) Laboratory ([link](#)), Princeton University. *Jan - Jul 2021.*
- Research Associate. Natural and Artificial Intelligence through Transistors and Spintronics (NAITS) group ([link](#)). *Jan - Jul 2020.*
- Research Associate. Embedded Systems Laboratory (ESL), EPFL, Switzerland ([link](#)). *May - Jul 2019.*
- Remote Research Assistant. Cloud Computing and Distributed Systems (CLOUDS) Laboratory, University of Melbourne, Australia ([link](#)). *May - Jul 2018.*
- Research Assistant. Design and Wafer Level Characterization Laboratory (DWLCL), IIT Delhi ([link](#)). *May - Jul 2018.*

WORK EXPERIENCE

- Founder and CEO. Qubit Inc. ([link](#)). *Jan 2020 - Present.*
- Research Consultant. Coral Telecom Ltd. ([link](#)). *Apr 2016 - Present.*

REVIEWING

Publons profile available at this [link](#).

- Wiley: Software Practices and Experience (SPE)
- IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems (TCAD)
- IEEE Transactions on Emerging Topics in Computing (TETC)
- IEEE Transactions on Industrial Informatics (TII)
- Conference on Information Sciences and Systems (CISS)
- Annual Meeting of the Cognitive Science Society (CogSci)
- International Conference on Machine Learning (ICML)

PUBLICATIONS

Updated list of publications with software repositories, datasets and preprint links can be found on my [website](#).

Refereed Conference and Workshop Publications

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|-----------------|--|
| C7. NEURIPS '21 | Shreshth Tuli, <u>Shikhar Tuli</u> , Giuliano Casale and Nicholas R. Jennings. <i>Generative Optimization Networks for Memory Efficient Data Generation</i> . NeurIPS 2021 - Workshop on ML for Systems. link . |
| C6. COGSCI '21 | <u>Shikhar Tuli</u> , Ishita Dasgupta, Erin Grant, and Thomas L Griffiths. <i>Are Convolutional Neural Networks or Transformers more like human vision?</i> Annual Meeting of the Cognitive Science Society, 2021. link . |
| C5. ICONS '20 | <u>Shikhar Tuli</u> and Debanjan Bhowmik. <i>Design of a Conventional-Transistor-Based Analog Integrated Circuit for On-Chip Learning in a Spiking Neural Network</i> . International Conference on Neuromorphic Systems, 2020. link . |
| C4. ISCAS '20 | <u>Shikhar Tuli</u> and Shreshth Tuli. <i>AVAC: A Machine Learning based Adaptive RRAM Variability-Aware Controller for Edge Devices</i> . IEEE International Symposium on Circuits and Systems, 2020. link . |

- C3. ASP-DAC '20 [Shikhar Tuli](#), Marco Antonio Rios, Alexandre Sébastien Julien Levisse, and David Atienza Alonso. *RRAM-VAC: A Variability-Aware Controller for RRAM-based Memory Architectures*. Asia and South Pacific Design Automation Conference, 2020. [link](#).
- C2. CLOUDCOM '19 Shreshth Tuli, [Shikhar Tuli](#), Udit Jain, and Rajkumar Buyya, *APEX: Adaptive Ext4 File System for Enhanced Data Recoverability in Edge Devices*. International Conference on Cloud Computing, 2019. [link](#).
- C1. DAC '19 Neetu Jindal, Sandeep Chandran, Preeti Ranjan Panda, Sanjiva Prasad, Abhay Mitra, Kunal Singhal, Shubham Gupta, and [Shikhar Tuli](#), *DHOOM: Reusing design-for-debug hardware for online monitoring*. Design and Automation Conference, 2019. [link](#).

Refereed Journal Publications

- J6. MEDRXIV '20 Shreshth Tuli, [Shikhar Tuli](#), Ruchi Verma, and Rakesh Tuli. *Modelling for prediction of the spread and severity of COVID-19 and its association with socioeconomic factors and virus types*. MedRxiv (2020). [link](#).
- J5. IoT '20 Shreshth Tuli, [Shikhar Tuli](#), Rakesh Tuli, and Sukhpal Singh Gill. *Predicting the Growth and Trend of COVID-19 Pandemic using Machine Learning and Cloud Computing*. Internet of Things (2020). [link](#).
- J4. ITL '20 Shreshth Tuli, [Shikhar Tuli](#), Gurleen Wander, Praneet Wander, Sukhpal Singh Gill, Schahram Dustdar, Rizos Sakellariou, Omer Rana, *Next Generation Technologies for Smart Healthcare: Challenges, Vision, Model, Trends and Future Directions*, Internet Technology Letters. [link](#).
- J3. IoT '20 Sukhpal Singh Gill, Shreshth Tuli, Minxian Xu, Inderpreet Singh, Karan Vijay Singh, Dominic Lindsay, [Shikhar Tuli](#), et al. *Transformative Effects of IoT, Blockchain and Artificial Intelligence on Cloud Computing: Evolution, Vision, Trends and Open Challenges*, Internet of Things, Volume 8. [link](#).
- J2. TED '20 Charu Gupta, Anshul Gupta, [Shikhar Tuli](#), Erik Bury, Bertrand Parvais, and Abhisek Dixit. *Characterization and modeling of Hot Carrier Degradation in N-Channel Gate-All-Around Nanowire FETs*. IEEE Transactions on Electron Devices, 2020. [link](#).
- J1. JSS '19 Shreshth Tuli, Redowan Mahmud, [Shikhar Tuli](#), and Rajkumar Buyya. *FogBus: A Blockchain-based Lightweight Framework for Edge and Fog Computing*. Journal of Systems and Software, Volume 154, 2019, Pages 22-36, [link](#). **Top ten downloaded article of 2019 award** [link](#).

Under review

- [Shikhar Tuli](#), Chia-Hao Li, Ritvik Sharma, Niraj K. Jha. *CODEBench: A Neural Architecture and Hardware Accelerator Co-Design Framework*. IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems (TCAD), 2022.
- [Shikhar Tuli](#), Bhishma Dedhia, Shreshth Tuli, Niraj K. Jha. *FlexiBERT: Are Current Transformer Architectures too Homogeneous and Rigid?*. Journal of Artificial Intelligence, 2022.

PATENTS

- *Low Cost Air Purification System*, [Shikhar Tuli](#), Shreshth Tuli, Sujeet K. Sinha, IIT Delhi. Filed at the Indian Patent Office. Date: 2nd August 2017, App. No.: 201711027523
- *Combination Lock with limited trial and resetting mechanism*, [Shikhar Tuli](#), Shreshth Tuli, Harshit Abrol, Shivang Dwivedi, Saujanya Chaudhary, Kargil Singh, Sivanandam Aravindan IIT Delhi. Filed at the Indian Patent Office. Date: 10th August 2017, App. no.: 201711028520

COURSES

- **Electrical Engineering:**
Computer Architecture, Digital Electronics, Machine Learning and Intelligence, Analog Electronics, Physical Electronics, Power Electronics, Communication Engineering, Control Engineering, Engineering Electromagnetics, Signals

and Systems, Electromechanics, Circuit Theory, IC Technology*, MOS VLSI Design*, Neuromorphic Engineering*, Mixed-Signal Circuit Design*, Compact modeling of Semiconductor Devices*, CMOS RF IC Design*, Digital Signal Processing[†], Embedded Computing[†].

- **Computer Science, Mathematics, Physics and Cognitive Science:** Data Structures and Algorithms, Probability and Stochastic Processes, Calculus, Linear Algebra, Principles of Semiconductors, Computer Vision[†], Machine Learning and Pattern Recognition[†], Natural Language Processing[†], Reinforcement Learning[†], Probabilistic Models of Cognition[†], Dynamics in Cognition[†].

*Graduate-level course at IIT Delhi, [†]Graduate-level course at Princeton University

TECHNICAL SKILLS

- **Programming Languages:** Python, MATLAB, Verilog-A, PEL, Java, C/C++, Verilog, RTL, x86 and ARM assembly, CUDA, OpenCL, HTML.
- **Frameworks:** Arduino, PADS - PCB, Altium Designer, Eagle, PSIM, AnSYS HFSS, Keysight EasyEXPERT, Keysight IC-CAP, Origin Pro, Adobe Photoshop, Adobe Illustrator, Solidworks, Cinema 4D.

POSITIONS OF RESPONSIBILITY

- **Technical Executive** - Makerspace (Design and Innovation Centre at IIT Delhi). *Aug 2018 - Aug 2020.*
- **Coordinator** - Sportech '17 (Sports fest at IIT Delhi).

OTHER INTERESTS

Lawn Tennis, Football, Jazz Dance, Graphics Designing, Poster Making, Video Editing, Poem writing.