

# Nishant Kumar

Research Fellow

Microsoft Research India

Advisors: *Dr.Nishanth Chandran, Dr.Divya Gupta, Dr.Aseem Rastogi & Dr.Rahul Sharma*

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## RESEARCH INTERESTS

Theoretical and Applied aspects of Cryptography and Security

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## EDUCATION

**Indian Institute of Technology Delhi**

Bachelor of Technology, Computer Science and Engineering

GPA: 9.15/10 (Overall)

India  
July '12 - July '16

**Delhi Public School**

All India Senior School Certificate Examination, CBSE, Delhi

Overall: 96.8%

India  
May '12

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## PUBLICATIONS AND MANUSCRIPTS

**CrypTFlow: Secure TensorFlow Inference**

Nishant Kumar, Mayank Rathee, Nishanth Chandran, Divya Gupta, Aseem Rastogi, Rahul Sharma

In proceedings of *IEEE Symposium on Security and Privacy (S&P)*, 2020 (To Appear) [GitHub] [PrePrint]

**A Practical Model for Collaborative Databases: Securely Mixing, Searching and Computing**

Shweta Agrawal, Rachit Garg, Nishant Kumar, Manoj Prabhakaran

In Submission to *ACM Conference on Computer and Communications Security (CCS)*, 2020 [PrePrint]

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## WORK EXPERIENCE

**Microsoft Research Lab**

Research Fellow, Cryptography group

Bengaluru, India  
July '18 - Present

Working on the *EzPC (Easy Secure Multi-Party Computation)* project, to construct efficient protocols, and develop tools/techniques, to increase the adoption of Secure Multi-Party Computation (MPC) as a tool, in various privacy-preserving tasks.

**Microsoft Corp.**

Software Engineer, *Azure Backup*

Hyderabad, India  
July '16 - June '18

Built an *Azure IaaS VM extension* to deliver on cloud-native, zero-infrastructure backup solution for workloads hosted in Azure (like SQL Server, SAP Hana etc.). Designed and built key infrastructural components of the extension to support various operations like backup and recovery on any given workload. This service was made generally available to all customers in Azure in April 2019 [Blog Post].

**Microsoft Corp.**

Software Engineering Intern, *Data Protection Manager*, Azure Backup

Hyderabad, India  
May '15 - July '15

Worked on secondary backup to Azure in Microsoft Data Protection Manager (DPM) using *Point-in-time copy semantics*. Designed and developed an OS-level component for change tracking on a volume in the DPM server using bitmaps. An end-to-end working prototype of improved secondary backup to Azure.

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## SELECTED RESEARCH PROJECTS

**CrypTFlow: Secure TensorFlow Inference**

Supervisors: *Dr.Nishanth Chandran, Dr.Divya Gupta, Dr.Aseem Rastogi & Dr.Rahul Sharma*, MSR India [PrePrint]

July '18 - Present

- CrypTFlow is an end-to-end system for converting TensorFlow inference code to secure MPC protocols. It is the first system to run very large neural networks, like RESNET-200 securely.
- Three constituent components: **Athos**, an end-to-end compiler from TensorFlow inference code to semi-honest MPC protocols; **Porthos**, a semi-honest 3-party computation protocol optimized for ML-like applications; and **Aramis**, a novel technique to compile semi-honest protocols to malicious protocols using hardware with integrity guarantees.
- Designed and developed Athos and Porthos; responsible for important compute-related optimizations in Porthos.
- Code available as open-source at [GitHub](#); working with several product groups for integration in Azure.

**Functionally Encrypted Datastores**

Supervisors: *Dr.Shweta Agrawal, IIT Madras & Dr.Manoj Prabhakaran, IIT Bombay*

July '15 - July '16, April '18 - Present

[PrePrint]

- Motivation to increase the efficiency of *Functional Encryption* (for specific classes of functions) at the cost of allowing the adversary to learn well-defined *leakage*, with similar tradeoffs between efficiency and security as in *Searchable Symmetric Encryption (SSE)*.
- Model partly motivated by the [rising security concerns](#) around *Aadhaar*, a central repository of national identities, including demographic and biometric data, being built by the Government of India.
- Model allows *multiple data-owners* to *anonymously* outsource data to *honest-but-curious non-colluding* servers and later allows *malicious clients* to make *search-and-compute* queries on the collected data.
- Designed and implemented crypto protocols for specific functions in *Genome-Wide Association Studies (GWAS)*.

#### Efficient MPC protocols for secure Machine Learning

June '19 - Present

Supervisors: [Dr.Nishanth Chandran](#) & [Dr.Divya Gupta](#), Microsoft Research India

- Working on constructing efficient (semi-honest and malicious) multi-party computation protocols, for secure inference of ML algorithms in a 2-party setting.

### SELECTED OTHER PROJECTS

#### Cryptography in 2-server setting

Jan '15 - May '15

Supervisors: [Dr.Shueta Agrawal](#), IIT Madras & [Dr.Ragesh Jaiswal](#), IIT Delhi

[\[Report\]](#)

- Model whereby a data-owner is interacting with *two non-colluding malicious servers*. Developed a *keyless* protocol for supporting *Proofs of Retrievability* in this setting, and explored how to do function computation efficiently.

#### Scheduling policies for Baadal - the IITD academic cloud

Jan '14 - July '14

Supervisor: [Dr.Amit Kumar](#), IIT Delhi

[\[Report\]](#)

- Proposed ways to improve VM scheduling policies used by [Baadal](#), orchestration software for IITD academic cloud.

### AWARDS AND ACHIEVEMENTS

- **ACM ICPC**: My team ([hyperbolicTan](#)) secured rank 18 in ICPC Kharagpur Regionals, 2014.
- **JOINT ENTRANCE EXAMINATION**: Secured all India rank of 755 in IIT-JEE 2012 among around half a million candidates.
- **KISHORE VAIGYANIK PROTSAHAN YOJANA**: Awarded the prestigious KVPY Fellowship Award, 2011, by Govt. of India.
- **CBSE MERIT**: Received CBSE Merit Certificate for being among the top 0.1% students in Economics in India.
- **REGIONAL MATHEMATICS OLYMPIAD**: Amongst the top 30 to qualify for RMO-2009, the first stage on the path of becoming part of India's contingent for International Mathematics Olympiad (IMO).
- **OLYMPIADS**: Secured all India ranks of 5 and 30 in National Science Olympiad, organized by [Science Olympiad Foundation](#) in 2007 and 2008 respectively.

### PROFESSIONAL SERVICE AND RESPONSIBILITIES

- Sub-Reviewer for ASIACRYPT 2019, INDOCRYPT 2019.
- Student volunteer at TCC 2018.
- Organizer, Joint crypto reading group between Microsoft Research India and IISc, Jan - April 2019.
- **DRI, [Stanford Scholar Initiative](#)**
  - Involved in the creation of short research talks on important papers in different areas of Computer Science, summarizing the novelty of the work, in an effort to disseminate the knowledge to a broader audience.
  - As a DRI (Directly Responsible Individual), successfully coordinated and led a team of 3-8 people to create a good research talk. Relevant talks: [talk #86](#), [talk #334](#), [talk #223](#).
- Mentor, [Avanti Fellows](#): As part of Avanti Fellows, an NGO that provides students from economically weak sections of India access to mentorship and training to get into good colleges, I mentored two students through their 11th and 12th standards in their preparation for IIT-JEE 2015.

### OPEN-SOURCE CONTRIBUTIONS

#### CrypTFlow: Secure TensorFlow inference

Microsoft Research India  $\approx$  10,000 LOC

[\[GitHub\]](#)

- Designed and developed Athos, a compiler (written in Python) from TensorFlow inference code to secure MPC protocols. Athos compiles TensorFlow using 2 Intermediate Languages (IL) - a High-Level Intermediate Language (HLIL) and a Low-Level Intermediate Language (LLIL). Implemented several standard and non-standard optimizations on each IL during compilation. Also, designed and incorporated several optimizations in Porthos (written in C++), a 3-party computation protocol geared for ML-like applications.