# S Deepak Narayanan

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## Education

**Indian Institute of Technology (IIT) Gandhinagar** July 2016 - July 2020
Bachelor of Technology with Honours in Computer Science and Engineering GPA: 9.15/10

## Research Interest

Developing well-principled and provably efficient algorithms for large-scale machine learning problems.

## Work Experience

**Microsoft Research India** August 2020 - Present
Research Fellow, Machine Learning & AI Group

**California Institute of Technology** May 2019 - July 2019
Summer Undergraduate Research Fellow

## Publications

1. **Active Learning for Air Quality Station Deployment**
   **S. Deepak Narayanan**, Apoorv Agnihotri, Nipun Batra
   *Workshop on Real World Experiment Design and Active Learning*
   *International Conference on Machine Learning (ICML), 2020*

2. **Poster Abstract - A toolkit for spatial interpolation and sensor placement**
   **S. Deepak Narayanan***, Zeel Patel*, Apoorv Agnihotri, Nipun Batra
   *The 18th ACM Conference on Embedded Networked Sensor Systems (SenSys 2020)*

3. **[Re] One ticket to win them all: generalizing lottery ticket initializations across datasets and optimizers**
   Varun Gohil*, **S. Deepak Narayanan***, Atishay Jain*
   *ReScience C, Volume 6, May 2020*, NeurIPS Reproducibility Challenge, 2019

## Research Projects

1. **Fine-grained estimation of air quality using multi-modal data**
   Advisor: Prof. Nipun Batra August 2018 - April 2020

   Air quality is affected by dynamic spatiotemporal factors like weather, wind speed, humidity, temperature, points of interest, traffic etc. To model air quality effectively by incorporating these factors, we proposed using Gaussian Processes, because of their ability to encode domain knowledge by supporting custom kernels. We empirically demonstrate via extensive experimentation on a real world dataset that the proposed approach outperforms several state-of-the-art approaches.

2. **Active learning for air quality station deployment**
   Advisor: Prof. Nipun Batra August 2018 - April 2020

   Air quality monitoring is extremely sparse in many developing countries due to the expensive nature of sensing equipment. This often leading to poor estimates of air quality at unmonitored locations. To alleviate this monitoring problem, we propose an active learning scheme to choose informative locations for station deployment. We empirically demonstrate that the air quality estimates obtained after using the proposed scheme are comparable to several baseline algorithms.

* denotes equal contribution

3. **Deterministic coresets for $k$-means clustering**
   Advisor: Prof. Anirban Dasgupta August 2019 - January 2020

   Coresets are summaries of datasets such that algorithms computed on coresets are competitive to algorithms computed on the entire dataset. Coreset constructions are usually randomized, with theoretical guarantees holding true in expectation. Our aim in this project was to construct deterministic coresets for the $k$-means clustering problem. We propose deterministic sampling algorithms using variants of algorithms such as priority sampling, leverage score sampling and importance score sampling. We empirically demonstrate that the proposed algorithms are competitive to the randomized counterparts.

4. **Analyzing streams of data: Applications in Acoustics**
   Advisor: Prof. K. Mani Chandy May 2019 - July 2019

   Data streams are ubiquitous today. One major challenge in processing streams is that most software libraries operate on fixed data whereas streams continue forever. IoTPy is a software, developed at Caltech, that enables use of software designed for fixed data for endless streams. Our aim in this project was to build acoustic applications using IoTPy. We created novel acoustic effects produced by expensive copyrighted guitar pedals, along with building several other applications. The applications that we developed run on inexpensive Raspberry Pi's as opposed to expensive guitar pedals with no qualitative loss in the acoustic effect. Our work opens several possibilities for basic programmers to build sophisticated applications on streaming data.

## Software

1. **Polire: A toolkit for spatial interpolation and sensor placement**
   Advisor: Prof. Nipun Batra

   Despite recent advancements, fine-grained spatial sensing remains a challenge, owing to cost, maintenance, among other factors. Thus, estimating the sensed phenomenon at unmonitored locations and strategically installing sensors is of prime importance. Polire is a toolkit that help reduce the barrier for sensor deployments by providing a suite of algorithms for spatial interpolation and sensor placement. I am a core contributor to Polire, and implemented several spatial interpolation algorithms such as Inverse Distance Weighting, Natural Neighbors, Kriging, along with state-of-the-art sensor placement algorithms.

2. **IoTPy: A Python Package that helps build applications that operate on streams of data**
   Advisor: Prof. K. Mani Chandy January 2020 - August 2020

   IoTPy is a software built at Caltech to build modular applications that process streams of data. My contributions involved refactoring the repository, packaging the software, writing tests and creating example notebooks for the latest release. The latest release of IoTPy was presented at EuroPython 2020. I was a co-author in this presentation.

## Achievements and Honours

1. Recipient of the **Award for the best performance in core courses of Physics, Chemistry and Life Sciences** at the $9^{th}$ Convocation of IIT Gandhinagar. This award is given to only **one** student in the entire graduating batch of undergraduate students.

2. Secured an **A+** grade in the course **Linear Algebra and Differential Equations** at IIT Gandhinagar. This grade is awarded as a mark of excellence.

3. Featured in Dean's List for semesters 1,2,3,4,5 and 6 for **exceptional academic performance** at IIT Gandhinagar.

4. Awarded the prestigious **Summer Undergraduate Research Fellowship (SURF)**by **Caltech** to conduct research at Caltech during Summer 2019.

5. Awarded the prestigious **Summer Research Fellowship** by **the Indian Academy of Sciences** to conduct research at IIT Ropar during Summer 2018.

6. Recipient of the prestigious **National Talent Search Examination Scholarship**, awarded by the Government of India from 2014 till 2020. This scholarship is given to only 1000 students from across the country from over 1,000,000 candidates.

7. Selected for the prestigious **KVPY Fellowship**, awarded by the Department of Science and Technology, Government of India in 2016. This Fellowship is awarded to only 1000 students from 100,000 students from across the country.

8. Invited to attend **Microsoft's AI for Earth Summit** at Microsoft Redmond in May 2019.

9. Awarded **Microsoft AI for Earth Azure Grant** worth $30,000 (across 2 years) in 2018. I assisted Prof. Nipun Batra in writing the grant.