

# PRAFULLKUMAR TALE

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Department of Mathematics,  
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## Fields of Interests

- Parameterized Complexity
- Graph Theory
- Algorithmic Engineering
- Conditional Lower Bounds
- Graph Algorithms

## Work Experiences

### Indian Institute of Science Education and Research Pune, India

*Position:* INSPIRE Faculty Fellow

September 2022 – Present

### CISPA Helmholtz Center for Information Security, Saarbrücken, Germany

*Position:* Post-Doctoral Researcher

July 2020 – August 2022

### Max-Planck Institute for Informatics ( MPII ), Saarbrücken, Germany

*Position:* Post-Doctoral Researcher

March 2020 – June 2020

### University Of Bergen, Bergen, Norway

*Position:* Researcher (An internship during Ph.D.)

Jan 2019 – June 2019

### Ebay/PayPal Pvt Ltd

*Position:* Software Engineer

June 2012 – July 2013

## Education

### The Institute of Mathematical Sciences ( IMSc ), HBNI, Chennai

Ph.D. in Theoretical Computer Sciences

Aug 2015 – Feb 2020

### The Institute of Mathematical Sciences ( IMSc ), HBNI, Chennai

Master of Science in Theoretical Computer Sciences

Aug 2013 – Aug 2015

### Indian Institute of Technology ( IIT ), Roorkee

Master of Science in Applied Mathematics

July 2007 – May 2012  
(Five-year Integrated Degree Program)

## Teaching Experience

### 2. Mathematics of Network Algorithms @ IISER-Pune

Aug 2023 – Dec 2023

Course-coordinator of course jointly offered by Department of Mathematics and Department of Data Science at IISER-Pune. The course focuses on the mathematical side of artificial neural networks closely following the Deep Learning book by Courville, Goodfellow, and Bengio. The class consisted of 31 students from undergraduate, graduate and PhD program. (Course webpage)

### 1. Algorithms @ IISER-Pune

Jan 2023 – May 2023

Course-coordinator of course offered by Department of Mathematics at IISER-Pune. We covered basics of algorithms closely following the Algorithm Design book by Kleinberg and Tardos. The class consisted of 54 students from undergraduate, graduate and PhD program.

## Mentoring Experience

- **Mr Pritam Acharya**, a student of BS-MS program at IISER-Pune Aug 2023 – Dec 2023.
- **Mr Jetharam Bhambhu**, a student of BS-MS program at IISER-Pune Aug 2023 – Dec 2023.
- **Mr Rajat Adak**, a student of MSc in Math & Computing at IIT Hyderabad May 2023 – July 2023
- **Ms Rucha Siddam**, a student of MSc in Mathematics at IIT Gandhinagar May 2023 – July 2023
- **Ms Saraswati Nanoti**, a PhD student at IIT Gandhinagar May 2023 – July 2023
- **T I Darsan**, a student of BS-MS program at IISER-Pune Jan 2023 – May 2023.

## Manuscripts

3. **Tight (Double) Exponential Bounds for NP-Complete Problems: Treewidth and Vertex Cover Parameterizations**  
with Florent Foucaud, Esther Galby, Liana Khazaliya, Shaohua Li, Fionn Mc Inerney, Roohani Sharma
2. **Revisiting Fair Allocation of Indivisible Items with Conflict Graphs**  
with Susobhan Bandopadhyay, Aritra Banik, Abhishek Sahu
1.  **$\alpha$ -approximate Reductions: a Novel Source of Heuristics for Better Approximation Algorithms**  
with Fredrik Manne, Geevarghese Philip, Saket Saurabh

## Publications<sup>1</sup>

23. **Parameterized Complexity of Biclique Contraction and Balanced Biclique Contraction**  
with R. Krithika, Kutty Malu V K, Roohani Sharma  
[C-22] (To appear) Foundations of Software Technology and Theoretical Computer Science (FSTTCS), 2023
22. **Romeo and Juliet Meeting in Forest Like Regions**  
with Neeldhara Misra, Manas Mulpuri, Gaurav Viramgami  
[C-21] Foundations of Software Technology and Theoretical Computer Science (FSTTCS), 2022
21. **Domination and Cut Problems on Chordal Graphs with Bounded Leafage**  
with Esther Galby, Daniel Marx, Philipp Schepper, Roohani Sharma  
[C-20] International Symposium on Parameterized and Exact Computation (IPEC), 2022
20. **Metric Dimension Parameterized by Feedback Vertex Set and Other Structural Parameters**  
with Esther Galby, Liana Khazaliya, Fionn Mc Inerney, Roohani Sharma  
[C-19] Mathematical Foundations of Computer Science (MFCS), 2022  
[J-15] (To appear) SIAM Journal on Discrete Mathematics (SIDMA) (2023)
19. **Reducing the Vertex Cover Number via Edge Contractions**  
with Paloma T. Lima, Vinicius F. dos Santos, Ignasi Sau, Uéverton S. Souza  
[C-18] Mathematical Foundations of Computer Science (MFCS), 2022  
[J-14] Journal of Computer and System Sciences (JCSS), Volume 129: 22-38 (2022).

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<sup>1</sup>The norm in the theoretical computer science community is to publish a preliminary version of results in conferences (which often have page limits) and a full version in journals. Also, the authors' name appear in alphabetical order of their last names, and hence there is no notion of the first author. I attest that I have made significant contributions to all the articles.

18. **The Complexity of Contracting Bipartite Graphs into Small Cycles**  
*with R. Krithika, Roohani Sharma*  
[\[C-17\] Graph-Theoretic Concepts in Computer Science \(WG\), 2022](#)
17. **Parameterized Complexity of Weighted Multicut in Trees**  
*with Esther Galby, Dániel Marx, Philipp Schepper, Roohani Sharma*  
[\[C-16\] Graph-Theoretic Concepts in Computer Science \(WG\), 2022](#)
16. **A Framework for Parameterized Subexponential Algorithms for Generalized Cycle Hitting Problems on Planar Graphs**  
*with Dániel Marx, Pranabendu Misra, Daniel Neuen*  
[\[C-15\] ACM-SIAM Symposium on Discrete Algorithms \(SODA\), 2022](#)
15. **Sparsification Lower Bound for Linear Spanners in Directed Graphs**  
*(This is a single author paper without a conference version.)*  
[\[J-13\] Theoretical Computer Science \(TCS\), Volume 898: 69-74 \(2022\)](#)
14. **On the Parameterized Approximability of Contraction to Classes of Chordal Graphs**  
*with Spoorthy Gunda, Pallavi Jain, Daniel Lokshantov, Saket Saurabh*  
[\[C-14\] Approximation, Randomization, and Combinatorial Optimization APPROX/RANDOM, 2020](#)  
[\[J-12\] ACM Transactions on Computation Theory \(ToCT\), Volume 13\(4\): 27:1-27:40 \(2021\)](#)
13. **Parameterized Complexity of Maximum Edge-Colorable Subgraph**  
*with Akanksha Agrawal, Madhumita Kundu, Abhishek Sahu, Saket Saurabh*  
[\[C-13\] Annual International Computing and Combinatorics Conference \(COCOON\), 2020](#)  
[\[J-11\] Algorithmica, Volume 84 \(10\): 3075 – 3100 \(2022\)](#)
12. **On the Parameterized Complexity of Maximum Degree Contraction**  
*with Saket Saurabh*  
[\[C-12\] International Symposium on Parameterized And Exact Computation \(IPEC\), 2020](#)  
[\[J-10\] Algorithmica, Volume 84: 405 – 435 \(2022\)](#)
11. **On the Parameterized Complexity of Grid Contraction**  
*with Saket Saurabh, Ueverton Dos Santos Souza*  
[\[C-11\] Scandinavian Symposium and Workshops on Algorithm Theory \(SWAT\), 2020](#)  
[\[J-09\] Journal of Computer and System Sciences \(JCSS\), Volume 129: 22-38 \(2022\)](#)
10. **Subset Feedback Vertex Set in Chordal and Split Graphs**  
*with Geevarghese Philip, Varun Rajan, Saket Saurabh*  
[\[C-10\] International Conference on Algorithms and Complexity \(CIAC\), 2019](#)  
[\[J-08\] Algorithmica, Volume 81 \(9\): 3586-3629 \(2019\)](#)
9. **Path Contraction Faster than  $2^n$**   
*with Akanksha Agrawal, Fedor Fomin, Daniel Lokshantov, Saket Saurabh*  
[\[C-09\] International Colloquium on Automata, Languages and Programming \(ICALP\), 2019](#)  
[\[J-07\] SIAM Journal on Discrete Mathematics \(SIDMA\), 34\(2\): 1302-1325 \(2020\)](#)
8. **An FPT Algorithm for Contraction to Cactus**  
*with R. Krithika, Pranabendu Misra*  
[\[C-08\] Annual International Computing and Combinatorics Conference \(COCOON\), 2018](#)  
[\[J-06\] Theoretical Computer Science \(TCS\), Volume 954: 113803 \(2023\).](#)

7. **Exact and Parameterized Algorithms for  $(k, i)$ -Coloring**  
with Diptapriyo Majumdar, Rian Neogi, Venkatesh Raman  
[C-07] Algorithms and Discrete Applied Mathematics, (CALDAM), 2017
6. **Paths to Trees and Cacti**  
with Akanksha Agrawal, Lawqueen Kanesh, Saket Saurabh  
[C-06] International Conference on Algorithms and Complexity (CIAC), 2017  
[J-05] Theoretical Computer Science (TCS), Volume 860: 98-116 (2021)
5. **On the Parameterized Complexity of Contraction to Generalization of Trees**  
with Akanksha Agarwal, Saket Saurabh  
[C-05] International Symposium on Parameterized and Exact Computation (IPEC), 2017  
[J-04] Theory of Computing Systems (ToCS) Volume 63 (3): 587-614 (2019)
4. **Parameterized and Exact Algorithms for Class Domination Coloring**  
with R. Krithika, Ashutosh Rai, Saket Saurabh  
[C-04] SOFSEM 2017: Theory and Practice of Computer Science  
[J-03] Discrete Applied Mathematics (DAM), Volume 291: 286-299 (2021)
3. **Lossy Kernels for Graph Contraction Problems**  
with R. Krithika, Pranabendu Misra, Ashutosh Rai  
[C-03] Foundations of Software Technology and Theoretical Computer Science (FSTTCS), 2016
2. **Dynamic Parameterized Problems**  
with R. Krithika, Abhishek Sahu  
[C-02] International Symposium on Parameterized and Exact Computation IPEC, 2016  
[J-02] Algorithmica, Volume 80(9): 2637-2655 (2018)
1. **Harmonious Coloring: Parameterized Algorithms and Upper Bounds**  
with Sudeshna Kolay, Ragukumar Pandurangan, Fahad Panolan, Venkatesh Raman  
[C-01] Graph-Theoretic Concepts in Computer Science (WG), 2016  
[J-01] Theoretical Computer Science (TCS), Volume 772: 132-142 (2019)

## Reviewer for

### Journals:

- SIAM Journal on Discrete Mathematics (SIDMA) (2022)
- Algorithmica (2023), (2022), (2018)
- Journal of Computer and System Sciences (JCSS) (2021), (2021), (2020), (2020)
- Theoretical Computer Science (TCS) (2023)×2, (2022), (2021), (2019), (2019)
- Discrete Mathematics & Theoretical Computer Science (DMTCS) (2021)
- Discrete Applied Mathematics (DAM) (2021)

### Conferences:

- ACM-SIAM Symposium on Discrete Algorithms (SODA) (2023)
- International Colloquium on Automata, Languages, and Programming (ICALP) (2023), (2020)
- European Symposium on Algorithms (ESA) (2023), (2022)×2, (2020) (2019)
- Symposium on Theoretical Aspects of Computer Science (STACS) (2023), (2020)
- Algorithms and Data Structures Symposium (WADS) (2023)

- International Workshop on Graph-Theoretic Concepts in Computer Science (**WG**) (2023), (2022)×2, (2021), (2017)
- Mathematical Foundations of Computer Science (**MFCS**) (2023)
- International Symposium on Algorithms and Computation (**ISAAC**) (2022), (2021), (2020)
- International Symposium on Parameterized and Exact Computation (**IPEC**) (2003)×2, (2018), (2017), (2016)
- Foundations of Software Technology and Theoretical Computer Science (**FSTTCS**) (2023)
- International Computing and Combinatorics Conference (**COCOON**) (2020), (2018)
- International Symposium on Fundamentals of Computation Theory (**FCT**) (2023)×2

## Research Visits

Universite Clermont Auvergne, Clermont-Ferrand, France	Sept 2023
Indian Institute of Science (IISc), Bangalore, India.	July 2023
National Institute of Science Education and Research (NISER), Bhubaneswar, India.	July 2023
Indraprastha Institute of Information Technology Delhi (IIIT-Delhi), India	June 2023
University of Bergen, Bergen, Norway	May 2017 – July 2017
University of Bergen, Bergen, Norway	Sep 2016 – Nov 2016
Max-Planck Institute for Informatics ( MPII ), Saarbrücken, Germany	June 2015 – July 2015

## Invited Talks

### Regarding Research

- (T3) **Parameterized Approximation Algorithms Workshop (PAAW) 2022:**  
*Title* : Parameterized Approximability of Contraction to Classes of Chordal Graphs  
*Date* : 4<sup>th</sup> July 2022
- (T2) **Parameterized Complexity 301:**  
*Title* : Graph Contraction: Old and New Developments  
*Date* : 31<sup>st</sup> December 2020
- (T1) **Parameterized Complexity Seminar:**  
*Title* : Parameterized Approximability of Contraction to Classes of Chordal Graphs  
*Date* : 24<sup>th</sup> November 2020

### Regarding Teaching

- (T1) Invited to deliver a 90-minutes long talk at Maharashtra State Development of Educators and Enhancement in Delivery (MS-DEED) Programme. The programme aims to engage in developing the professional capacity of teachers who teach B.Sc. and M.Sc.-level students.  
*Date*: 22<sup>nd</sup> May 2023.

## Programming Experience

### ◦ **Lossy Kernelization in Practice**

Jan 2019 – June 2019

We posit that a carefully crafted lossy reduction rule can yield improved approximation solution in practice. I have implemented (in C++ and CPLEX) different algorithms to solve DOMINATING SET on sparse graphs for various benchmark instances to support our hypothesis.

### ◦ **The Parameterized Algorithms and Computational Experiments Challenge ( PACE )**

Implemented various algorithms to solve the following problems on large graphs: VERTEX COVER using C++ (in 2019), STEINER TREE using C++ (in 2018), and MINIMUM FILL-IN using Python (in 2017).

### ◦ **SymPy – Open Source Project**

March 2011 – May 2012

One of the authors of SymPy, an open-source Python library for symbolic mathematics. I have contributed to its development by submitting functions, reviewing pull requests, fixing patches.

## Conferences and Workshops Attended

### ◦ **ICGT 2022**

July 4 – 8, 2022

Attended 11<sup>th</sup> workshop on International Colloquium on Graph Theory and Combinatorics at Montpellier, France.

### ◦ **WG 2022**

June 22 – 24, 2022

Attended 48<sup>th</sup> edition of the International Workshop on Graph-Theoretic Concepts in Computer Science at Tübingen, Germany, and presented our work.

### ◦ **IPEC 2020**

December 14 – 18, 2020

(Virtually) Attended 15<sup>th</sup> International Symposium on Parameterized and Exact Computation, and presented our work.

### ◦ **SWAT 2020**

June 22 – 24, 2020

(Virtually) Attended 17<sup>th</sup> Scandinavian Symposium and Workshops on Algorithm Theory and presented our work.

### ◦ **Algorithmic Tractability via Sparsifiers**

August 9 – 12, 2019

Attended workshop on tools used to sparsify the instances of hard problems that arise algorithmically. This workshop was organized in Lehigh, India, and supported by the ERC Grant LOPRE and the Institute of Mathematical Sciences.

### ◦ **WorKer 2019**

June 3 – 7, 2019

Attended a workshop on Kernelization organized by the University of Bergen (UiB) at UiB, Norway.

### ◦ **CIAC 2017**

May 24 – 26, 2017

Attended Algorithms and Complexity - 10<sup>th</sup> International Conference, CIAC 2017 in Athens, Greece and presented our work.

### ◦ **Rangoli Of Algorithms ( RoA ) and FSTTCS 2016**

December 11 – 12, 2016

Attended RoA as a part of the IARCS Annual Conference on Foundations of Software Technology and Theoretical Computer Science organized at Chennai Mathematical Institute, India.

### ◦ **CTD 2016**

April 28 – 29, 2016

Attended Chennai Theory Day organized by Chennai Mathematical Institute and presented research work on various graph coloring.

### ◦ **WorKer 2015**

June 1 – 4, 2015

Attended workshop on Kernelization organized by the University of Bergen at Sophus Lie Conference Center, Norway.



- **FSTTCS 2014** December 15 – 17, 2014  
Attended IARCS Annual Conference on Foundations of Software Technology and Theoretical Computer Science organized at India International Centre, New Delhi.
- **Advanced School on Parameterized Algorithms & Kernelization ( ASPAK )** Mar 3 – 8, 2014  
This school was focused on several recent advances in parameterized algorithms and kernelization. It covered many fundamental as well as few advanced techniques.

## Academic Achievements and Scholarships

- **INSPIRE Faculty Fellowship** 2022  
Awarded INSPIRE Faculty Fellowship by the Department of Science and Technology, Govt. of India to carry out independent research.
- **CV Raman Post-Doctoral Fellowship** 2022 (*Declined*)  
Awarded the CV Raman Post-Doctoral Fellowship by Indian Institute of Sciences, Bangalore.
- **Best Student Paper Award at IPEC** 2016  
Awarded Best Student Paper Award for our paper titled 'Dynamic Parameterized Problems' at International Symposium on Parameterized and Exact Computation, IPEC 2016.
- **National Board for Higher Mathematics ( NBHM )** 2010 (*Declined*)  
Selected for M.A./M.Sc. Scholarship conducted by NBHM and funded by Department of Atomic Energy, Govt of India. Only twenty-two students throughout the nation were selected in that year.
- **Innovation in Science Pursuit for Inspired Research ( INSPIRE )** 2008 (*Declined*)  
Awarded Innovation in Science Pursuit for Inspired Research (INSPIRE) scholarship by the Department of Science and Technology, Govt of India, for perusing basic science at Indian Institute of Technology.
- **Kishore Vaigyanik Protsahan Yojana ( KVPY )** 2008 to 2012  
Recipient of Kishore Vaigyanik Protsahan Yojana scholarship awarded by Department of Science and Technology, Govt of India in 2007. It is the highest-paid scholarship at the graduate level.
- **Merit-cum-means Scholarships ( MCM )** 2007 to 2008  
Awarded merit-cum-means scholarships by Indian Institute of Technology for being second in the Mathematics department in the academic year 2007.
- **IIT Joint Entrance Examination – 2007**  
Secured All India Rank 3289 in IIT-JEE and 3524 in AIEEE. (Among the top 1 % of students in the nation.)
- **National Talent Search Examination ( NTSE )** 2005 to 2007  
Awarded with National Talent Search Examination in the year 2005. This scholarship is given to the top 750 students in India.
- **Physics Olympiad – 2006**  
In the top 1 % (out of 42000 students) at the National level in the Physics Olympiad conducted by the Indian Association of Physics Teachers (IAPT).

## References

- **Prof. Saket Saurabh**  
The Institute of Mathematical Sciences, HBNI, Chennai, India  
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- **Prof. Dániel Marx**

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- **Prof. Geevarghese Philip**

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