

# Ilya Razenshteyn

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## Research interests

Similarity search, sketching, metric embeddings, high-dimensional geometry, streaming algorithms, compressed sensing, combinatorial optimization.

## Education

2012–2017 **Massachusetts Institute of Technology**

Ph. D. in Computer Science

Advisor: *Piotr Indyk*

S. M. thesis: *Beyond Locality-Sensitive Hashing*

Ph. D. thesis: *High-Dimensional Similarity Search and Sketching: Algorithms and Hardness*

2007–2012 **Lomonosov Moscow State University**

M. Sc. in Mathematics

Advisors: *Maxim Babenko* and *Alexander Shen*

Thesis: *Covering Shortest Paths in Undirected Graphs*

## Awards and honors

- Simons Foundation Junior Fellowship, 2017
- Paper [5] invited to the Highlights of Algorithms conference, Berlin, 2017
- Paper [3] invited to the special issue of ACM Transactions on Algorithms, 2017
- Papers [10] and [11] invited to the Highlights of Algorithms conference, Paris, 2016
- Paper [10] invited to the special issue of SIAM Journal on Computing, 2015
- Akamai Presidential Fellowship, 2012
- Kolmogorov Fellowship, 2009–2012
- Gold medal at ACM International Collegiate Programming Contest, 2010
- Gold medals at International Olympiads in Informatics, 2006, 2007

## Program committees

- 13th International Computer Science Symposium in Russia (CSR 2018)
- 15th International Symposium on Experimental Algorithms (SEA 2016)

## Publications

*Selected work:* see [3], [8], [10] and [11] below.

1. A. Andoni, H. L. Nguyen, A. Nikolov, I. Razenshteyn and E. Waingarten, **Approximate Near Neighbors for General Symmetric Norms**, proceedings of *49th ACM Symposium on Theory of Computing (STOC)*, 2017.
2. A. Andoni, I. Razenshteyn and N. Shekel Nosatzki, **LSH Forest: Practical Algorithms Made Theoretical**, proceedings of *28th ACM-SIAM Symposium on Discrete Algorithms (SODA)*, 2017.
3. A. Andoni, T. Laarhoven, I. Razenshteyn and E. Waingarten, **Optimal Hashing-based Time-Space Trade-offs for Approximate Near Neighbors**, proceedings of *28th ACM-SIAM Symposium on Discrete Algorithms (SODA)*, 2017. **Invited to the special issue of ACM Transaction on Algorithms.**

4. T. D. Ahle, R. Pagh, I. Razenshteyn, F. Silvestri, **On the Complexity of Inner Product Similarity Join**, proceedings of *35th Symposium on Principles of Database Systems (PODS)*, 2016.
5. A. Andoni and I. Razenshteyn, **Tight Lower Bounds for Data-Dependent Locality-Sensitive Hashing**, proceedings of *32nd International Symposium on Computational Geometry (SoCG)*, 2016.
6. I. Razenshteyn, Z. Song and D. Woodruff, **Weighted Low Rank Approximations with Provable Guarantees**, proceedings of *48th ACM Symposium on Theory of Computing (STOC)*, 2016.
7. A. Backurs, P. Indyk, I. Razenshteyn and D. Woodruff, **Nearly-optimal bounds for sparse recovery in generic norms, with applications to  $k$ -median sketching**, proceedings of *27th ACM-SIAM Symposium on Discrete Algorithms (SODA)*, 2016.
8. A. Andoni, P. Indyk, T. Laarhoven, I. Razenshteyn and L. Schmidt, **Practical and Optimal LSH for Angular Distance**, proceedings of *29th Annual Conference on Neural Information Processing Systems (NIPS)*, 2015, code available at <http://falconn-lib.org/>.
9. Z. Allen-Zhu, R. Gelashvili and I. Razenshteyn, **Restricted Isometry Property for General  $p$ -Norms**, proceedings of *31st International Symposium on Computational Geometry (SoCG)*, 2015, accepted to *IEEE Transactions on Information Theory*.
10. A. Andoni, R. Krauthgamer and I. Razenshteyn, **Sketching and Embedding are Equivalent for Norms**, proceedings of *47th ACM Symposium on Theory of Computing (STOC)*, 2015. Invited to the special issue of *SIAM Journal on Computing*.
11. A. Andoni and I. Razenshteyn, **Optimal Data-Dependent Hashing for Approximate Near Neighbors**, proceedings of *47th ACM Symposium on Theory of Computing (STOC)*, 2015.
12. D. Dellinger, D. Fleischman, A. Goldberg, I. Razenshteyn and R. F. Werneck, **An Exact Combinatorial Algorithm for Minimum Graph Bisection**, *Mathematical Programming Series A*, 2015.
13. S. Lattanzi, S. Leonardi, V. Mirrokni and I. Razenshteyn, **Robust Hierarchical  $k$ -Center Clustering**, proceedings of *6th Conference on Innovations in Theoretical Computer Science (ITCS)*, 2015.
14. A. Andoni, P. Indyk, H. L. Nguyen and I. Razenshteyn, **Beyond Locality-Sensitive Hashing**, proceedings of *25th ACM-SIAM Symposium on Discrete Algorithms (SODA)*, 2014.
15. P. Indyk and I. Razenshteyn, **On Model-Based RIP-1 Matrices**, proceedings of *40th International Colloquium on Automata, Languages and Programming (ICALP)*, 2013.
16. A. Goldberg, I. Razenshteyn and R. Savchenko, **Separating Hierarchical and General Hub Labelings**, proceedings of *38th International Symposium on Mathematical Foundations of Computer Science (MFCS)*, 2013.
17. D. Dellinger, A. Goldberg, I. Razenshteyn and R. F. Werneck, **Graph Partitioning with Natural Cuts**, proceedings of *25th IEEE International Parallel & Distributed Processing Symposium (IPDPS)*, 2011.
18. M. Andreev, I. Razenshteyn and A. Shen, **Not Every Domain of a Plain Decompressor Contains the Domain of a Prefix-Free One**, *Theoretical Computer Science*, 2011.
19. M. Babenko, A. Gusakov and I. Razenshteyn, **Triangle-Free 2-Matchings Revisited**, *Discrete Mathematics, Algorithms and Applications*, 2010.
20. M. Babenko, I. Kolesnichenko and I. Razenshteyn, **A Linear Time Algorithm for Finding Three Edge-Disjoint Paths in Eulerian Networks**, proceedings of *36th International Conference on Current Trends in Theory and Practice of Computer Science (SOFSEM)*, 2010.

## Research internships

- 2016 **Microsoft Research Redmond**  
Mentor: *Konstantin Makarychev*  
Nonlinear dimension reduction via bi-Lipschitz extensions
- 2015 **IBM Research Almaden**  
Mentor: *David Woodruff*

- Weighted low rank approximations with provable guarantees [5]
- 2014 **Microsoft Research Silicon Valley**  
Mentor: *Alexandr Andoni*  
Equivalence between sketches and embeddings for general norms [9]  
Optimal data-dependent hashing for the high-dimensional nearest neighbor search [10]
- 2013 **Google New York**  
Mentors: *Silvio Lattanzi* and *Vahab Mirrokni*  
Universal outliers for  $k$ -center clustering [12]
- 2011 **Microsoft Research Silicon Valley**  
Mentors: *Andrew Goldberg* and *Renato Werneck*  
Fast exact algorithm for the minimum bisection problem [11]
- 2010 **Microsoft Research Silicon Valley**  
Mentors: *Andrew Goldberg* and *Renato Werneck*  
Efficient heuristic for partitioning road networks [16]

## References

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| Piotr Indyk           | professor, MIT                               |
| Alexandr Andoni       | associate professor, Columbia University     |
| Robert Krauthgamer    | professor, Weizmann Institute of Science     |
| Konstantin Makarychev | associate professor, Northwestern University |