

Aravindan Vijayaraghavan

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Education

Princeton University

Ph.D. Computer Science.

Sep 2009 - (expected) July 2012

M.A. Computer Science.

Sep 2007 - Sep 2009

Advisor: Prof. Moses Charikar.

Indian Institute of Technology (IIT) Madras

B.Tech. Computer Science and Engineering. Minor: Physics

Aug 2003 - Jul 2007

Research Interests

Algorithms for combinatorial optimization problems.

Understanding the approximability of NP-hard optimization problems.

Average-case analysis, and designing algorithms for average-case instances.

Work Experience

- Toyota Technological Institute Chicago, Research Internship Summer 2010
- Princeton University, Teaching Assistant, COS 226 - Data Structures and Algorithms Spring 2009
- Princeton University, Teaching Assistant, COS 340 - Reasoning about Computation Fall 2008
- IIT Madras, Teaching Assistant, CS 110 - Introduction to Computing Fall 2006
- Northeastern University, Boston, Research Internship Summer 2006

Publications

- **Detecting High Log-Densities – an $O(n^{1/4})$ Approximation for Densest k -Subgraph.**
With Aditya Bhaskara, Moses Charikar, Eden Chlamtac and Uriel Feige.
In Symposium on the Theory of Computing (STOC) 2010.
- **Approximating the matrix p -norm.**
With Aditya Bhaskara.
In Symposium on Discrete Algorithms (SODA) 2011.
- **Polynomial Integrality gaps for Strong SDP relaxations of Densest k -subgraph.**
With Aditya Bhaskara, Moses Charikar, Venkatesan Guruswami and Yuan Zhou.
In Symposium on Discrete Algorithms (SODA) 2012.
- **Approximation algorithms and Hardness for the k -route cut problem.**
With Julia Chuzhoy, Yury Makarychev and Yuan Zhou.
In Symposium on Discrete Algorithms (SODA) 2012.
- **Approximation algorithms for Semi-random Partitioning problems.**
With Konstantin Makarychev and Yury Makarychev.
To appear in Symposium on the Theory of Computing (STOC) 2012.

Manuscripts and Ongoing projects

- **On Quadratic Programming with a Ratio objective.** 2011
With Aditya Bhaskara and Rajsekar Manokaran and Moses Charikar.
Submitted 2011 (arXiv:1101.1710).
- **Non-cooperative Bundling games.** 2007
With Ravishankar Krishnaswamy, Pandu Rangan Chandrasekaran and Ravi Sundaram.

Scholastic Achievements and Honors

- **Department Rank 1** in all 4 years of my undergraduate program. 2003 - 2007
- Won the prestigious **Institute Blues, IIT Madras** 2007
for excellence in academic, co-curricular and extra-curricular activities.
- Awarded the Stanford Graduate Fellowship, 2007
Graduate fellowship at Princeton.
- Recipient of the **Prof.R.Narasimhan Fellowship** 2005
- Secured a **Gold Medal** in the **International Chemistry Olympiad(IChO)** 2003 at Athens. 2003
- Secured an **All India Rank 28** in the IIT JEE Main Examination (99.99 percentile). 2003
- Secured an **All India Rank 2** in the CBSE Board Exams(AISSE) scoring 485/500. 2003

Selected Projects

- **Algorithms for Densest k -subgraph:** In joint work, we study the fundamental problem of finding small dense subgraphs (with at most k vertices). We give an $O(n^{1/4+\epsilon})$ approximation in $n^{O(1/\epsilon)}$ time, improving upon the previous best $n^{1/3}$ factor approximation algorithm after a long period of dormancy. Our algorithm is inspired from algorithms designed for a planted version of the problem (average-case). We identify the notion of log-density, which seems to capture the limits of current techniques.
- **Semi-random Partitioning problems:** Along with K.Makarychev and Y.Makarychev, we study a semi-random model for fundamental graph partitioning problems, which generalizes all previous models, and captures real-life instances much better. We present new algorithms which achieve $O(1)$ -factor approximations for classic problems like Sparsest cut, Balanced separator, Multicut in this model.
- **Strong Integrality gaps for Densest k -subgraph:** We show that Densest k -subgraph (used often as a hardness assumption) can not be approximated to even polynomial factors, using strong SDP hierarchies (in particular, the Lasserre and Sherali-Adams hierarchies). Though Densest k -subgraph and its variants are often used as good average-case hardness assumptions, only a PTAS has been ruled out. In the absence of good inapproximability results, this arguably gives the strongest evidence for these assumptions, and suggest that beating the current algorithms is beyond current techniques.
- **Approximating k -route cuts:** During my summer internship at TTI Chicago, we worked on the problem of approximating minimum k -route cuts (which are a generalization of multicuts). We obtained an $O(k \log^{1.5} n)$ factor approximation algorithm for k -route cuts in unweighted graphs and obtained polylogarithmic bicriteria approximations for general graphs. We also show the first non-trivial inapproximability results, for larger values of k . Previously, poly-logarithmic guarantees were known only for $k \leq 3$.
- **Approximating Matrix p -norms:** We study the problem of computing matrix $q \mapsto p$ norms ($\|A\|_{q \rightarrow p} = \max_{\|x\|_q=1} \|Ax\|_p$), which captures a rich variety of problems (generalizes maximum singular values). For $q \geq p$, we give an FPTAS to compute them for non-negative matrices — this seems like a useful primitive, like in constructing good oblivious routing schemes. We also exhibit almost-polynomial hardness for general matrices in a wide range of parameters.

Invited Talks

- Seminar, IBM T.J. Watson Research Center Aug 2011
Algorithms and Hardness for Approximating k -route cuts.
- Workshop on Approximability of CSPs, Fields Institute, Toronto. Aug 2011
The Densest k -subgraph problem.
- Seminar, IBM T.J. Watson Research Center. Jun 2011
Quadratic Programming with a Ratio objective.
- Colloquium, Toyota Technological Institute, Chicago. Mar 2011
The Densest k -subgraph problem.
- Seminar, IBM T.J. Watson Research Center. Apr 2010
Algorithms for Densest k -subgraph problem.

Extra-curricular Activities

- Won the *Institute Blues*, IIT Madras 2007
for excellence in co-curricular, extra-curricular and academic activities.
- Vice-President for AID (Association for India's Development), Princeton Chapter. 2008 - 2009
- Table Tennis Zonal (Pondicherry) Champion, 2000 and Zonal Runners up, 1999. 1999 - 2000

References

Moses Charikar, Professor, Princeton University.
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Other references will be provided upon request.