

Jacob Fox

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Research Interests

Extremal combinatorics, algebraic and probabilistic methods in combinatorics, Ramsey theory, graph theory, combinatorial geometry, and applications of combinatorics to computer science.

Affiliation

Assistant Professor, Department of Mathematics, MIT, 2010–Present
Ph.D. in Mathematics, Princeton University, Advisor: Benny Sudakov, 2006–2010
B.S. in Theoretical Mathematics, MIT, 2002–2006

Grants and Fellowships

Packard Fellowship 2013-2018
Alfred P. Sloan Research Fellowship 2013-2015
NEC Corporation Award, MIT – 2012-2014
NSF grant DMS 1069197 – 2011–2014
Co-PI, NSF grant for MIT PRIMES program – 2012–2015
MIT Simons Fellowship – 2010–2013
Princeton Centennial Fellowship – 2006–2009
NSF Graduate Research Fellowship – 2006–2009

Selected Awards

Invited speaker, Combinatorics Section, International Congress of Mathematicians, Seoul – 2014
Edmund F. Kelly Research Award, MIT – 2012
SIAM Discrete Mathematics Dénes König Prize – 2010
AMS-MAA-SIAM Morgan Prize for Undergraduate Mathematics Research – 2006
MIT Jon A. Bucsela Prize in Mathematics – 2006
Barry Goldwater Scholar – 2005
Intel Science Talent Search – 2nd place – 2002
International Science and Engineering Fair – 1st place in Mathematics – 2002
Siemens Westinghouse Science & Technology Competition – 4th place – 2001

Recent Professional Experience

Co-organizer for the MIT Combinatorics Seminar (Fall 2010–Present)
Managing editor of the Journal of Graph Theory (Fall 2010–Present)
MIT math faculty advisor for the Research Science Institute (2013–Present)
Co-Director of the MIT Math Summer Program for Undergraduate Research (2013–Present)
Program Committee for EUROCOMB 2013
Organizer for the MIT Math Graduate Research Lunch Seminar (Spring 2013)
Co-organizer for the SIAM Minisymposium on Probabilistic Combinatorics, Boston (2012)
Long-term participant at the IPAM special semester in combinatorics (Fall 2009)
Co-organizer for the Princeton Discrete Mathematics Seminar (Fall 2008–Spring 2009)

Teaching

18.316 Seminar in Combinatorics at MIT (Fall 2013)
18.318 Geometric Graph Theory at MIT (Spring 2013)
18.315 Extremal Combinatorics at MIT (Fall 2011)
18.997 Probabilistic Methods in Combinatorics at MIT (Spring 2011)
MAT 307 Combinatorics at Princeton (Spring 2009)
18.821 (TA) Project Mathematics Laboratory at MIT (Spring 2006)

Current Ph.D. Students

Andrey Grinshpun, László M. Lovász, Yufei Zhao

Current Postdoctoral Researchers

Peter Csikvari, Choongbum Lee, Andrew Suk

Referee

Grant Reviews: NSF panel in Combinatorics, NSA, Simons Foundation collaboration review.
Journals: *Inventiones Mathematicae*, *Duke Mathematics Journal*, *Advances in Mathematics*, *Selecta Mathematica*, *Journal of Combinatorial Theory Series A*, *Journal of Combinatorial Theory Series B*, *Combinatorica*, *Random Structures and Algorithms*, *SIAM Journal of Discrete Mathematics*, *Journal of Combinatorics*, *Journal of Graph Theory*, *Electronic Journal of Combinatorics*, *Discrete Mathematics*, *Graphs & Combinatorics*, and several conference proceedings.

Publications

Submitted

1. J. Fox, Stanley-Wilf limits are typically exponential.
2. D. Conlon, J. Fox, and B. Sudakov, Cycle packing.
3. J. Fox and L. M. Lovász, A tight lower bound on Szemerédi's regularity lemma.
4. J. Fox and Y. Zhao, A short proof of the multidimensional Szemerédi theorem in the primes.
5. D. Conlon, J. Fox, and Y. Zhao, A relative Szemerédi theorem.
6. J. Fox, A. Grinshpun, and J. Pach, The Erdős-Hajnal conjecture for rainbow triangles.
7. D. Conlon, J. Fox, C. Lee, and B. Sudakov, Ramsey numbers of cubes versus cliques.
8. N. Alon and J. Fox, Testing perfectness is hard.

To appear

9. D. Conlon, J. Fox, and Y. Zhao, Extremal results in sparse pseudorandom graphs, *Advances in Mathematics*.
10. D. Conlon, J. Fox, J. Pach, B. Sudakov, and A. Suk, Ramsey-type results for semi-algebraic relations, *Transactions of the American Mathematical Society*.
11. J. Fox, P. Loh, and Y. Zhao, The critical window for the classical Ramsey-Turán problem, *Combinatorica*.
12. M. DeVos, Z. Dvorak, J. Fox, J. McDonald, B. Mohar, and D. Scheide, Minimum degree condition forcing complete graph immersion, *Combinatorica*.
13. J. Fox, Constructing dense graphs with sublinear Hadwiger number, *J. Combinatorial Theory Ser. B*.
14. D. Conlon, J. Fox, and B. Sudakov, Short proofs of some extremal results, *Combinatorics, Probability, and Computing*.
15. J. Fox and J. Pach, Applications of a new separator theorem for string graphs, *Combinatorics, Probability, and Computing*.

2013

16. D. Conlon, J. Fox, and B. Sudakov, Two extensions of Ramsey's theorem, *Duke Mathematical Journal* **162** (2013).

17. J. Fox, C. Lee, and B. Sudakov, Chromatic number, clique subdivisions, and the conjectures of Hajós and Erdős-Fajtlowicz, *Combinatorica* **33** (2013), 181–197.
18. E. Berger, K. Choromanski, M. Chudnovsky, J. Fox, M. Loebl, A. Scott, P. Seymour, and S. Thomasse, Tournaments and colouring, *J. Combinatorial Theory Series B* **103** (2013), 1–20.
19. D. Conlon and J. Fox, Graph removal lemmas, *Surveys in Combinatorics*, Cambridge University Press, 2013, 1–50.
20. J. Fox, J. Pach, and A. Suk, The number of edges in k -quasi-planar graphs, *SIAM Journal of Discrete Mathematics* **27** (2013), 550–561.
21. D. Conlon, J. Fox, and B. Sudakov, An improved bound for the stepping-up lemma, *Discrete Applied Mathematics*, **161** (2013), 1191–1196.
22. E. Ackerman, J. Fox, R. Pinchasi, A note on light geometric graphs, *Discrete Mathematics* **313** (2013), 1281–1283.

2012

23. D. Conlon and J. Fox, Bounds for graph regularity and removal lemmas, *Geometric and Functional Analysis* **22** (2012), 1191–1256.
24. J. Fox, C. Lee, and B. Sudakov, Maximum union-free subfamilies, *Israel Journal of Mathematics* **191** (2012), 959–971.
25. J. Fox and J. Pach, String graphs and incomparability graphs, *Advances in Mathematics* **230** (2012), 1381–1401.
26. J. Fox, M. Gromov, V. Lafforgue, A. Naor, and J. Pach, Overlap properties of geometric expanders, *Journal für die reine und angewandte Mathematik* **671** (2012), 49–83. A preliminary version appeared in SODA 2011, 1188–1197.
27. J. Fox, J. Pach, B. Sudakov, and A. Suk, Erdős-Szekeres-type theorems for monotone paths and convex bodies, *Proceedings of the London Mathematical Society* **105** (2012), 953–982.
28. J. Fox and P. Loh, On a problem of Erdős and Rothschild on edges in triangles, *Combinatorica* **32** (2012), 619–628.
29. D. Conlon, J. Fox, and B. Sudakov, On two problems in graph Ramsey theory, *Combinatorica* **32** (2012), 513–535.
30. D. Conlon, J. Fox and B. Sudakov, Erdős-Hajnal-type theorems in hypergraphs, *J. Combinatorial Theory Series B* **102** (2012), 1142–1154.
31. J. Fox and J. Pach, Coloring K_k -free intersection graphs of geometric objects in the plane, *European Journal of Combinatorics* **33** (2012), 853–866. A preliminary version appeared in Proc. 24th ACM Sympos. on Computational Geometry (2008), 346–354.

2011

32. J. Fox, A new proof of the graph removal lemma, *Annals of Mathematics* **174** (2011), 561–579.
33. D. Conlon, J. Fox, and B. Sudakov, Large almost monochromatic subsets in hypergraphs, *Israel J. Math.* **181** (2011), 423–432.
34. J. Fox and B. Sudakov, Dependent random choice, *Random Structures and Algorithms* **38** (2011), 68–99.
35. J. Fox, J. Pach, and Cs. D. Tóth, Intersection patterns of curves, *J. London Mathematical Society* **83** (2011), 389–406.
36. J. Fox and J. Pach, Computing the independence number of intersection graphs, SODA 2011, 1161–1165.

2010

37. D. Conlon, J. Fox, and B. Sudakov, Hypergraph Ramsey numbers, *J. Amer. Math. Soc.* **23** (2010), 247–266.
38. D. Conlon, J. Fox, and B. Sudakov, An approximate version of Sidorenko’s conjecture, *Geometric and Functional Analysis* **20** (2010), 1354–1366.
39. J. Fox, J. Pach, and Cs. D. Tóth, Turán-type results for partial orders and intersection graphs of convex sets, *Israel J. Math.* **178** (2010), 29–50.
40. J. Fox, J. Pach, and Cs. D. Tóth, A bipartite strengthening of the Crossing Lemma, *J. Combinatorial Theory Ser. B*, **100** (2010), 23–35. A preliminary version appeared in Proc. 15th Sympos. on Graph Drawing (Sydney, 2007), vol. 4875 of LNCS, Springer, 2008, 13–24.
41. J. Fox, Complete minors and independence number, *SIAM J. Discrete Math.* **24** (2010), 1313–1321.
42. J. Fox and B. Sudakov, Decompositions into subgraphs of small diameter, *Combinatorics, Probability, and Computing* **19** (2010), 753–774.
43. J. Fox and J. Pach, A separator theorem for string graphs and its applications, *Combinatorics, Probability and Computing* **19** (2010), 371–390.
44. J. Fox, P. Keevash, and B. Sudakov, Directed graphs without short cycles, *Combinatorics, Probability, and Computing* **19** (2010), 285–301.
45. J. Fox, F. Frati, R. Pinchasi, and J. Pach, Crossings between curves with many tangencies, in Proc. WALCOM: Workshop on Algorithms and Computation, Lecture Notes in Computer Science 5942, Springer-Verlag (2010), 1–8.

2009

46. J. Fox and B. Sudakov, Density theorems for bipartite graphs and related Ramsey-type results, *Combinatorica* **29** (2009), 153–196.
47. D. Conlon, J. Fox, and B. Sudakov, Ramsey numbers of sparse hypergraphs, *Random Structures and Algorithms* **35** (2009), 1–14.
48. J. Fox, P. Loh, and B. Sudakov, Large induced trees in K_r -free graphs, *J. Combinatorial Theory Ser. B* **99** (2009), 494–501.
49. J. Fox and B. Sudakov, Two remarks on the Burr-Erdős conjecture, *European J. Combinatorics* **30** (2009), 1630–1645.
50. J. Fox and B. Sudakov, Paths and stability number in digraphs, *Electronic J. Combinatorics* **16** (2009), N23.
51. M. O. Albertson, D. W. Cranston, and J. Fox, Crossings, colorings, and cliques, *Electronic J. Combinatorics* **16** (2009), R45.
52. E. Ackerman, J. Fox, J. Pach, and A. Suk, On grids in topological graphs, Proc. 25th ACM Sympos. on Computational Geometry (2009), 403–412.

2008

53. J. Fox and B. Sudakov, Induced Ramsey-type theorems, *Advances in Mathematics* **219** (2008), 1771–1800.
54. J. Fox and J. Pach, Separator theorems and Turán-type results for planar intersection graphs, *Advances in Mathematics* **219** (2008), 1070–1080.
55. J. Fox and B. Sudakov, On a problem of Duke, Erdős, and Rödl on cycle-connected subgraphs, *J. Combinatorial Theory Ser. B* **98** (2008), 1056–1062.
56. J. Fox and B. Sudakov, Ramsey-type problem for an almost monochromatic K_4 , *SIAM J. Discrete Math.* **23** (2008), 155–162.
57. J. Fox and J. Pach, Erdős-Hajnal-type results on intersection patterns of geometric objects, Horizon of Combinatorics (G.O.H. Katona et al., eds.), Bolyai Society Studies in Mathematics, Springer (2008), 79–103.
58. J. Fox and B. Sudakov, Unavoidable patterns, *J. Combinatorial Theory Ser. A* **115** (2008), 1561–1569.

Undergraduate research

59. J. Fox and J. Pach, A Bipartite Analogue of Dilworth's Theorem for Multiple Partial Orders, *European J. Combinatorics* **30** (2009), 1846–1853.
60. J. Fox and Cs. D. Tóth, On the decay of crossing numbers, *J. Combinatorial Theory Ser. B* **98** (2008), 33–42. Also in Proc. 14th Sympos. on Graph Drawing (Karlsruhe, 2006), vol. 4372 of LNCS, Springer-Verlag, 174–183.
61. J. Fox, There Exist Graphs with Super-Exponential Ramsey Multiplicity Constant, *J. Graph Theory* **57** (2008), 89–98.
62. J. Fox, M. Mahdian, and R. Radoičić, Rainbow Solutions to the Sidon Equation, *Discrete Mathematics* **308** (2008), 4773–4778.
63. J. Fox, An infinite color analogue of Rado's theorem, *J. Combinatorial Theory Ser. A* **114** (2007), 1456–1469.
64. B. Alexeev, J. Fox, and R. Graham, Minimal colorings without monochromatic solutions to a linear equation, *Integers* **7(2)** (2007), A1.
65. J. Fox, V. Jungić, and R. Radoičić, Sub-Ramsey numbers for arithmetic progressions and the Sidon equation, *Integers* **7(2)** (2007), A12.
66. J. Fox and K. Lin, The Minimum Degree of Ramsey Minimal Graphs, *J. Graph Theory* **54** (2007), 167–177.
67. J. Fox, A Bipartite Analogue of Dilworth's Theorem, *Order* **23** (2006), 197–209.
68. J. Fox and D. J. Kleitman, On Rado's Boundedness Conjecture, *J. Combinatorial Theory Ser. A* **113** (2006), 84–100.
69. J. Fox and R. Radoičić, On the Degree of Regularity of Generalized van der Waerden Triples, *Integers* **5** (2005), A32.
70. V. Jungić, J. Licht (Fox), M. Mahdian, J. Nešetřil, and R. Radoičić, Rainbow Arithmetic Progressions and Anti-Ramsey Results, *Combinatorics, Probability, and Computing* **12** (2003), 599–620.

Selected Invited Talks

2014 (upcoming)

International Congress of Mathematicians, combinatorics section, Seoul, Korea

SIAM Conference on Discrete Mathematics, plenary talk, Minneapolis, Minnesota

2013

24th British Combinatorial Conference, plenary talk, London, UK
Erdős Centennial Conference, Budapest, Hungary
Graph Theory Workshop, Oberwolfach, Germany
Combinatorics and Probability Seminar, Yale University
Computer Science/Discrete Math Seminar, Institute for Advanced Study
Combinatorics Seminar, MIT
16th Conference on Random Structures and Algorithms, Poznan, Poland
Workshop on Probabilistic and Extremal Combinatorics, UCLA
Algorithms, Combinatorics and Optimization Seminar, Carnegie Mellon University
Geometric and Topological Graph Theory Workshop, Banff, Canada

2012

Abel Prize Conference to honor Endre Szemerédi, plenary talk, Minneapolis, Minnesota
Atlanta Lecture Series in Combinatorics and Graph Theory V, featured speaker, Atlanta, Georgia
CRM Conference on Perspectives in Discrete Mathematics, plenary talk, Barcelona, Spain
Colloquium, Freie University, Berlin, Germany
Colloquium on Discrete Mathematics and Computer Science, École Polytechnique, Paris, France
Conference on Graphs and Analysis, Institute for Advanced Study
One-Day Meeting in Combinatorics, Oxford University, Oxford, UK
Combinatorics Seminar, Cambridge University, Cambridge, UK
Additive Combinatorics in Paris 2012, Paris, France
Robin Thomas 50th birthday conference, Atlanta, Georgia
New Trends and Directions in Combinatorics, Banff, Canada
SIAM Minisymposium on Probabilistic Combinatorics, Boston, MA
Erdős Memorial Lecture, Memphis, Tennessee
Combinatorics Seminar, MIT
Algorithms, Combinatorics and Optimization Seminar, Carnegie Mellon University
Discrete Mathematics Seminar, London School of Economics and Political Science, London, UK
Workshop on χ -bounded graph classes, ENS Lyon, Lyon, France

2011

15th Conference on Random Structures and Algorithms, plenary talk, Atlanta, Georgia
EuroComb'11, plenary talk, Budapest, Hungary
3rd Canadian Discrete and Algorithmic Math. Conference, plenary talk, Victoria, BC, Canada
Discrete Mathematics Seminar, Princeton University
Combinatorics Workshop, Oberwolfach, Germany
Hypergraph Turán Problems Workshop, American Institute of Mathematics
Combinatorics Seminar, UCLA

2010

SIAM Discrete Mathematics Dénes König Prize Plenary Lecture
New Trends on Structural Graph Theory, plenary talk, Banff, Canada
Colloquium, UIC
Combinatorics Seminar, MIT
Applied Mathematics Seminar, MIT
Probability Seminar, MIT
Computer Science/Discrete Math Seminar, Institute for Advanced Study
Discrete Mathematics Seminar, Princeton University
Theory of Computing Seminar, NYU
Geometric Graph Theory Workshop, Lausanne, Switzerland
Combinatorics Seminar, Georgia Tech
Algorithms, Combinatorics, and Optimization Seminar, Georgia Tech
Combinatorics Seminar, UCLA
Graph Theory Workshop, Oberwolfach, Germany

2009

Colloquium, UCLA
Computer Science/Discrete Math Seminar, Institute for Advanced Study
Combinatorics and Probability Workshop, Oberwolfach, Germany
Combinatorial Geometry Workshop, Institute for Pure and Applied Mathematics
Combinatorics Tutorials, Institute for Pure and Applied Mathematics
Workshop on Probabilistic and Extremal Combinatorics, Banff, Canada
DIMACS Workshop on Graph Colouring and Structure, Princeton University
Discrete Mathematics Seminar, Rutgers University
DIMACS Workshop on Ramsey Theory, Rutgers University

2008

Geometry Seminar, NYU
Princeton-Oxford Workshop, Oxford University, Oxford, England
Computer Science/Discrete Math Seminar, Institute for Advanced Study
Discrete Mathematics Seminar, Columbia University
Discrete Mathematics Seminar, Princeton University
Combinatorics Seminar, UCLA
Discrete and Convex Geometry Workshop, Renyi Institute, Budapest, Hungary

2007

Graph Theory Workshop, Oberwolfach, Germany
Workshop on Extremal Graphs and Hypergraphs, Carnegie Mellon University
Combinatorics Seminar, Ohio State University
Combinatorial and Additive Number Theory Conference, CUNY

Combinatorics Seminar, CUNY

2006

Combinatorics Seminar, MIT

Discrete Mathematics Seminar, Princeton University

Workshop on Topological Graph Theory and Crossing Numbers, Banff, Canada

Geometry Seminar, NYU

Discrete Mathematics Seminar, Simon Fraser University, Burnaby, Canada

AMS-SIAM Conference on Discrete and Computational Geometry, Snowbird, UT

New York Number Theory Seminar, CUNY

Colloquium, Vassar College

CRM-Clay Workshop on Additive Combinatorics, Université de Montréal, Montreal, Canada

Discrete Math and Theory of Computation Seminar, Rutgers University

2005

Logic Seminar, MIT

Combinatorics Reading Seminar, UCSD

Combinatorics Seminar, CUNY

2004

Colloquium, Rutgers University

Logic Seminar, MIT

Combinatorics Seminar, MIT