Michael S. O. Molloy Department of Computer Science, University of Toronto molloy@cs.toronto.edu

Degrees: 1994 Ph.D. Algorithms, Combinatorics and Optimization, Department of Mathematics, Carnegie Mellon University Thesis: Random Graphs on a Fixed Degree Sequence 1992M.Math. Combinatorics and Optimization, Faculty of Mathematics, University of Waterloo Thesis: The Chromatic Number of Sparse Random Graphs B.Math. Mathematics (Honours Co-Op), University of Waterloo 1989**Employment:** July 2004 -Full Professor Department of Computer and Mathematical Sciences University of Toronto at Scarborough July 2018 - June 2023 Chair Department of Computer and Mathematical Sciences University of Toronto at Scarborough April 2017 - May 2017 Visiting Researcher Dept Informatique, Ecole Normale Superieure Paris July 2001 - June 2004 Associate Professor Department of Computer and Mathematical Sciences University of Toronto at Scarborough Jan 2003 - June 2003 Visiting Researcher Microsoft Research July 1996 - June 2001 Assistant Professor Department of Computer and Mathematical Sciences University of Toronto at Scarborough May 1996 - June 1996 **Research** Associate Department of Computer Science University of Toronto NSERC Postdoctoral Fellow May 1994 - May 1996 Department of Computer Science University of Toronto

Research Endeavours:

General research in graph theory and theoretical computer science, focussing most often on probabilistic aspects of these fields.

External Research Grants:		
2019 - 2025	NSERC Individual Research Grant	\$41,000 per annum
2014 - 2019	NSERC Individual Research Grant	\$62,000 per annum
2009 - 2014	NSERC Individual Research Grant	\$50,000 per annum
2009 - 2013	NSERC Research Accelerator Grant	\$120,000
2004 - 2009	NSERC Individual Research Grant	\$45,000 per annum
2001	Premier's Research Excellence Award	\$100,000
2000	Sloan Research Fellowship	US\$40,000
2000	NSERC Equipment Grant (held with 7 others).	\$68,729
2000 - 2004	NSERC Individual Research Grant	\$37,000 per annum
2000 - 2002	CITO Research Project Award (held with 12 others)	\$128,435
1999 - 2000	CITO Research Project Award (held with 12 others)	\$92,053
1996 - 2000	NSERC Individual Research Grant	\$27,000 per annum
1996	NATO Collaborative Research Grant (held with L. Devroye and B. Reed)	\$11,000
1995	NATO Collaborative Research Grant (held with L. Devroye and B. Reed)	\$9,000

Publications:

In all of my publications, the authors appear in alphabetical order, as is the tradition in my field.

Refereed Journals:

- 1. J. Aliaj, M. Molloy. Adaptable and conflict colouring multigraphs with no cycles of length three or four. Journal of Graph Theory **104**, 188 219 (2023).
- A. Logan, M. Molloy, P. Pralat. A variant of the Erdos-Renyi random graph process. Journal of Graph Theory 102, 322 - 345 (2023).
- M. Molloy and L. Postle. Asymptotically good edge correspondence colouring. Journal of Graph Theory 100, 559 - 577 (2022).
- J. Gimbel, A. Kundgen, M. Molloy. Fractional cocoloring of graphs. Graphs and Combinatorics 38, article 64 (2022).
- D. Mitsche, M. Molloy, P. Pralat. k-regular subgraphs near the k-core threshold of a random graph. J. Comb. Th. (B) 142, 106 - 143 (2020).
- M. Molloy. The list chromatic number of graphs with small clique number. J. Comb. Th. (B) 134, 264 - 284 (2019).
- M. Molloy. The freezing threshold for colourings of a random graph. J. ACM 65, Vol. 2, Art. 7 (2018).
- P. Gao and M. Molloy. The stripping process can be slow: part I. Rand. Str. & Alg. 53, 76 - 139 (2018).
- P. Gao and M. Molloy. Inside the clustering window for random linear equations. Rand. Str. & Alg. 52, 197 - 218 (2018).
- M. Molloy. The rainbow connection number for random 3-regular graphs. Elec. J. Comb. 24, P3.49 (2017).
- P. Bennett, I. Bonacina, N. Galesi, T. Huynh, M. Molloy and P. Wollan. Space proof complexity for random 3-CNFs. Inf. & Comp. 255, 165 - 176 (2017).
- M. Molloy. The adaptable chromatic number and the chromatic number. Journal of Graph Theory 84, 53 - 56 (2017).
- B. Farzad, A. Golestanian, M. Molloy. Backbone colourings of graphs. Discrete Math. 339, 2721 - 2722 (2016).
- D. Achlioptas and M. Molloy. The solution space geometry of random linear equations. Random Structures and Algorithms 46, 197 - 231 (2015).
- M. Molloy. Sets that are connected in two random graphs. Random Structures and Algorithms 45, 498 - 512 (2014).

- M. Molloy and B. Reed. Colouring graphs when the number of colours is almost the maximum degree. J. Comb. Th. (B) 109, 134 195 (2014).
- 17. M. Bradonjic, M. Molloy and G. Yan. Containing viral spread on sparse random graphs: bounds, algorithms, and experiments. Internet Mathematics 9, 406 433 (2013).
- 18. S. Chan and M. Molloy. A dichotomy theorem for the resolution complexity of random constraint satisfaction problems. SIAM J. on Computing 42, 27 - 60 (2013).
- 19. H. Connamacher and M. Molloy. The satisfiability threshold for a seemingly intractible random constraint satisfaction problem. SIAM J. on Discrete Math. 26, 145 168 (2012).
- S. Chan and M. Molloy. (k+1)-cores have k-factors. Comb. Prob. and Comp., 21, 882 896 (2012).
- 21. H. Hatami and M. Molloy. The scaling window for a random graph with a given degree sequence. Random Structures and Algorithms 41, 99 123 (2012).
- 22. M. Molloy and G. Thron. An asymptotically tight bound on the adaptable chromatic number. Journal of Graph Theory **71**, 331 - 351 (2012).
- B. Lucier and M. Molloy. The Glauber dynamics for colourings of bounded degree trees. SIAM J. Disc. Math. 25, 827 - 853 (2011)
- M. Molloy and G. Thron. The adaptable choosability number grows with the chromatic number. Disc. Math. 311, 2268 - 2271 (2011).
- M. Molloy and B. Reed. Asymptotically optimal frugal colourings. J. Comb. Th. (B) 100, 226 - 246 (2010).
- B. Farzad and M. Molloy. On the edge-density of 4-critical graphs. Combinatorica 29 665 -689 (2009).
- H. Hatami and M. Molloy. Sharp thresholds for constraint satisfaction problems and homomorphisms. Random Structures and Algorithms 33, 310 - 332 (2008).
- M. Molloy. When does the giant component bring unsatisfiability? Combinatorica 28, 693 -734 (2008).
- 29. M. Molloy and M. Salavatipour. The resolution complexity of random constraint satisfaction problems. SIAM J. Comp. 37, 895 922 (2007).
- D. Achlioptas, M. Molloy, C. Moore and F. Van Bussel. Rapid mixing for lattice colourings with fewer colours. J. Stat. Mech.: Th. & Practice. P10011 (2006).
- 31. A. Frieze and M. Molloy. The satisfiability threshold for randomly generated binary constraint satisfaction problems. Random Structures and Algorithms 28, 323 339 (2006).
- R. Greiner, R. Hayward, M. Jankowska and M. Molloy. *Finding Optimal Satisficing Solutions for And-Or Trees.* Artificial Intelligence 170, 19 58 (2006).

- M. Molloy. Cores in random hypergraphs and boolean formulas. Random Structures and Algorithms 27, 124 - 135 (2005).
- M. Molloy and M. Salavatipour. A bound on the chromatic number of the square of a planar graph. J. Comb. Th. (B) 94, 189 - 213 (2005).
- 35. B. Farzad, M. Molloy and B. Reed. (Δk) -critical graphs. J. Comb. Th. (B) **93**, 173 185 (2005).
- 36. M. Molloy. The Glauber dynamics on the colourings of a graph with large girth and maximum degree. SIAM J. Computing **33** 721 737 (2004).
- D. Achlioptas, P. Beame and M. Molloy, A sharp threshold in proof complexity. J. Computer and System Sciences 68, 238 - 268 (2004).
- M. Molloy Models and thresholds for random constraint satisfaction problems. SIAM J. Computing 32, 935 - 949 (2003).
- 39. M. Dyer, A. Frieze and M. Molloy. A probabilistic analysis of randomly generated binary constraint satisfaction problems. Theoretical Computer Science **290**, 1815-1828 (2003).
- 40. A. Goerdt and M. Molloy. Analysis of edge deletion processes on faulty random regular graphs. Theoretical Computer Science **297**, 241-260 (2003).
- M. Molloy and L. Sedgwick. Isomorphism certificates for undirected graphs. Discrete Math. 256, 349 - 359 (2002).
- N. Alon, P. Erdős, D. Gunderson and M. Molloy. A Ramsey-type problem and the Turán numbers. J. Graph Theory 40, 120 - 129 (2002).
- M. Dyer, C. Greenhill and M. Molloy. Very rapid mixing of the Glauber dynamics for proper colourings on bounded-degree graphs. Random Struc. & Alg. 20, 98 - 114 (2002).
- A. Kundgen and M. Molloy. Extremal Problems for Chromatic Degree Sets. J. Graph Theory 40, 68 - 74 (2002).
- D. Achlioptas, L. Kirousis, E. Kranakis, D. Krizanc, M. Molloy, and Y. Stamatiou. Random Constraint Satisfaction: A More Accurate Picture. Constraints 6, 329 - 324 (2001).
- M. Molloy. Very rapidly mixing Markov Chains for 2Δ-colourings and for independent sets in a 4-regular graph. Random Struc. & Alg. 18, 101 - 115 (2001).
- M. Molloy and B. Reed. Near-Optimal List Colourings. Rand. Struc. & Alg. 17, 376 402 (2000).
- 48. A. Frieze and M. Molloy. Splitting Expander Graphs. J. of Algorithms 33, 166 172 (1999).
- M. Molloy and B. Reed. Critical Subgraphs of a Random Graph. Elec. J. Comb. 6, R35 (1999).
- D. Achlioptas and M. Molloy. Almost All Graphs with 2.522n Edges are not 3-Colourable. Electronic J. Comb. 6, R29 (1999).

- 51. M. Molloy. Chromatic Neighbourhoods. Journal of Graph Theory 31, 303 311 (1999).
- M. Molloy and B. Reed. The Size of the Largest Component of a Random Graph on a Fixed Degree Sequence. Combinatorics, Probability and Computing 7, 295 - 306 (1998).
- M. Molloy and B. Reed. A Bound on the Total Chromatic Number. Combinatorica 18 241 - 280 (1998).
- D. Achlioptas, J. Brown, D. Corneil and M. Molloy. The Existence of Uniquely -G Colourable Graphs. Discrete Math 179 1 - 11 (1998).
- 55. H. Hind, M. Molloy and B. Reed. Total Colouring with $\Delta + poly(\log \Delta)$ Colours. SIAM Journal on Computing **28** 816 821 (1998).
- H. Hind, M. Molloy and B. Reed. Colouring a Graph Frugally. Combinatorica 17 469 482 (1997).
- M. Molloy and B. Reed. A Bound on the Strong Chromatic Index of a Graph. Journal of Combinatorial Theory (B) 69 103 - 109 (1997).
- M. Molloy, H. Robalewska, R. W. Robinson and N. C. Wormald. 1-Factorisations of Random Regular Graphs. Random Structures and Algorithms 10 305 - 321 (1997).
- N. Alon, C. McDiarmid and M. Molloy. *Edge-Disjoint Cycles in Regular Directed Graphs*. Journal of Graph Theory **22** 231 - 237 (1996).
- 60. C. Cooper, A. Frieze, M. Molloy, and B. Reed. *Perfect Matchings in Random r-Regular*, *s-Uniform Hypergraphs.* Combinatorics, Probability and Computing **5** 1 14 (1996).
- M. Molloy. A Gap Between the Appearance of a k-Core and a k-Chromatic Graph. Random Structures and Algorithms. 8 159 - 160 (1996).
- M. Molloy and B. Reed. A Critical Point for Random Graphs with a Given Degree Sequence. Random Structures and Algorithms 6 161 - 180 (1995).
- 63. M. Molloy and B. Reed. *The Dominating Number of a Random Cubic Graph*. Random Structures and Algorithms **7** 209 222 (1995).
- 64. C. Cooper, A. Frieze and M. Molloy. *Hamilton Cycles in Random Regular Digraphs*. Combinatorics, Probability and Computing **3** 39 50 (1994).
- A. Frieze and M. Molloy. Broadcasting in Random Graphs. Discrete Applied Math 54 77 79 (1994).

Refereed Conference Proceedings:

- 66. M. Molloy and R. Restrepo. Frozen variables in random constraint satisfaction problems. Proceedings of SODA 2013.
- 7b M. Molloy. *The freezing threshold for colourings of a random graph.* Proceedings of STOC 2012. (Conference version of [7].)

- 21b H. Hatami and M. Molloy. The scaling window for a random graph with a given degree sequence. Proceedings of SODA 2010. (Conference version of [21].)
- 23b B. Lucier, M. Molloy and Y. Peres. *The Glauber dynamics for colourings of bounded degree trees.* Proceedings of RANDOM 2009. (Conference version of [23].)
- 25b M. Molloy and B. Reed. Asymptotically optimal frugal colourings. Proceedings of SODA 2009. (Conference version of [25].)
- 18b S. Chan and M. Molloy. A dichotomy theorem for the resolution complexity of random constraint satisfaction problems. Proceedings of FOCS 2008. (Conference version of [18].)
- 67. L. Lau and M. Molloy. *Randomly colouring graphs with girth 5 and large maximum degree*. Proceedings of LATIN 2006.
- 19b H. Connamacher and M. Molloy. The exact satisfiability threshold for a potentially intractible random constraint satisfaction problem. Proceedings of FOCS 2004. (Conf. version of [19].)
- 30b D. Achlioptas, M. Molloy, C. Moore and F. Van Bussel. Sampling grid colourings with fewer colours. Proceedings of LATIN 2004. (Conference version of [30].)
- 68. D. Achlioptas, P. Beame and M. Molloy. *Exponential bounds for DPLL below the satisfiability* threshold. Proceedings of SODA 2004.
- 33b M. Molloy. *Cores in random hypergraphs and boolean formulas*. Proceedings of SODA 2004. (Conference version of [33].)
- 31b A. Frieze and M. Molloy. The satisfiability threshold for randomly generated binary constraint satisfaction problems. Proceedings of RANDOM 2003. (Conference version of [31].)
- 29b M. Molloy and M. Salavatipour. The resolution complexity of random constraint satisfaction problems. Proceedings of FOCS 2003. (Conference version of [29].)
- 32b R. Grenier, R. Hayward and M. Molloy. *Optimal depth-first strategies for and-or trees.* Proceedings of AAAI 2002, 725 730. (Conference version of [32].)
- 36b M. Molloy. The Glauber dynamics on the colourings of a graph with large girth and maximum degree. Proceedings of STOC 2002, 91 98. (Conference version of [36].)
- 38b M. Molloy. *Models and thresholds for random Constraint Satisfaction Problems*. Proceedings of STOC 2002, 201 217. (Conference version of [38].)
- 34b M. Molloy and M. Salavatipour. Frequency channel assignments on planar networks. Proceedings of ESA 2002, 736-747. (conference version of [34].)
- 37b D. Achlioptas, P. Beame and M. Molloy, A sharp threshold in proof complexity. Proceedings of STOC 2001, 337--336 (Conference version of [37].)
- 16b M. Molloy and B. Reed. Colouring graphs when the number of colours is almost the maximum degree. Proceedings of STOC 2001, 462-470. (Conference proceedings version of [16].)

- 40b A. Goerdt and M. Molloy. Analysis of edge deletion processes on faulty random regular graphs. Latin American Theoretical Informatics, 2000. (Conference proceedings version of [40].)
- M. Molloy and B. Reed. Further Algorithmic Aspects of the Lovasz Local Lemma. Proceedings of STOC 1998, 524 - 529.
- M. Molloy and B. Reed. Colouring Graphs whose Chromatic Number is Almost Their Maximum Degree. Latin American Theoretical Informatics, 1998.
- 45b D. Achlioptas, L. Kirousis, E. Kranakis, D. Krizanc, M. Molloy, and Y. Stamatiou. Random Constraint Satisfaction: A More Accurate Picture. Proceedings of CP 97, Lecture Notes in Computer Science 1330, 107 - 120. (Conference proceedings version of [45].)
- 71. D. Achlioptas and M. Molloy. Analysis of a List-colouring Algorithm on a Random Graph. Proceedings of FOCS 1997.
- M. Molloy, B. Reed and W. Steiger. On the Mixing Rate of the Triangulation walk. Proceedings of the 1997 DIMACS Workshop on Randomization Methods in Algorithm Design, 179 - 190.

Books and Book Chapters:

- 73. M. Molloy and B. Reed. *Graph Colouring and the Probabilistic Method.* Springer, Heidelberg 2001. 326 pages.
- M. Molloy. Thresholds for colourability and satisfiability for random graphs and boolean formulae. Book chapter in Surveys in Combinatorics, J. Hirschfield, ed., pp. 165 - 197, Cambridge University Press, 2001.
- M. Molloy. The Probabilistic Method. Book chapter in Probabilistic Methods for Algorithmic Discrete Mathematics, M. Habib, C. McDiarmid, J. Ramirez-Alfonsin and B. Reed, editors. pp. 1 - 35. Springer, 1998.
- 76. M. Molloy and B. Reed. Graph Colouring via the Probabilistic Method. Book chapter in Graph Theory and Computational Biology, A. Gyrafas and L. Lovasz editors. pp. 125 - 155. J. Bolyai Math. Soc. 1999.

Submitted:

- 77. M. Molloy, E. Surya and L. Warnke *The degree-restricted random process is far from uniform.* arXiv:2211.00835
- M. Molloy, P. Pralat and G. Sorkin Matchings and loose cycles in the semirandom hypergraph model. arXiv:2401.00559

Teaching:

Undergraduate Courses

CSC/MAT A67 Discrete Mathematics, Fall 2024.
MAT D44, Topics in Combinatorics: The Probabilistic Method, Winter 2022.
CSC C73, Algorithm Design and Analysis, Winter 2009, Fall 2004, 2006, 2011, 2012.
CSC C63, Computational Complexity and Computability, Winter 2004, 2006, 2008, 2011, 2012, 2014, 2015, 2016, 2018.
CSC C64, Computational Complexity and Computability, Winter 1998, 1999, 2001, 2002.
CSC B70, Fundamental Data Structures and Techniques, Fall 1999.
CSC B63, Design and Analysis of Data Structures, Winter 2006.
MAT C32, Graph Theory, Winter 1999.

Graduate Courses

CSC 2410, Introduction to Graph Theory, Winter 1998, 1999, 2002, 2009, 2012, 2013, 2014. Fall 2004, 2006, 2015, 2017. CSC 2427, The Probabilistic Method, Winter 2000, 2008.

CSC 2427, Graph Colouring, Winter 2001.

CSC 2427, Random Graphs, Winter 2004, 2011.

CSC 2427, Random Constraint Satisfaction Problems, Winter 2004, 2011. Fall 2014.

Graduate Student Supervision:

Ph.D.

Lora Hrisch, Sept 2022 - present

Darek Yung, DCS, UofT, Sept 2009 - April 2016. Ph.D. awarded April 2016. Thesis title: *Resolution complexity of random constraint satisfaction problems*.

Brendan Lucier, DCS, UofT. Sept 2007 - Aug 2011. Ph.D. awarded Aug 2011. Thesis title: *The Power of Uncertainty: Algorithmic Mechanism Design in Settings of Incomplete Information.* (co-supervised with A. Borodin.)

Giovanna Thron, DCS, UofT. Feb 2010 - Aug 2011 (did not complete)

Hamed Hatami, DCS, UofT, (co-supervised with Balazs Szegedy). Feb 2005 - Aug 2009. Ph.D. awarded Aug 2009. Thesis title: *Generalizations of the Gowers norms*.

Harold Connamacher, DCS, UofT. Sept 2000 - Apr 2008. Ph.D. awarded Apr 2008. Thesis title: *Threshold phenomena in random constraint satisfaction problems*.

Lap Chi Lau, DCS, UofT. Sept 2003 - Sept 2006. Ph.D. awarded Sept 2006. Thesis title: On approximate min-max theorems for graph connectivity problems.

Babak Farzad, DCS, UofT. Feb 2001 - Aug 2005. Ph.D. awarded Aug 2005. Thesis title: On Colourings of Graphs.

Frank Van Bussel, Dept of Computer Science, University of Toronto. Oct 2000 - Aug 2004. Did not complete.

Mohammad Salavatipour, DCS, UofT. April 2001 - Aug 2003. Ph.D. awarded Aug 2003. Thesis title: *Graph Colouring via the Discharging Method*.

Dimitris Achlioptas, DCS, UofT. (Start date ?) - Jan 1999. Ph.D. awarded Jan 1999. Thesis title: Threshold Phenomena in Random Graph Colouring and Satisfiability.

Tim Moorhouse, DCS, UofT. Feb 1996 - Sept 1999. Did not complete (co-supervised with Derek Corneil).

Paul Gries, DCS, UofT. Oct 1996 - Dec 1998. Did not complete.

Masters

Ziying Zhang, DCS, Dec 2022 - Jan 2024. Masters awarded Jan 2024. Research project: Frugal colouring triangle-free graphs.

Lora Hrisch, Math, UofT, Sept 2020-Aug 2022. Masters awarded Aug 2022. Research project: *Cores in random graphs.*

Jurgen Aliaj, DCS, UofT, Jan 2018 - Apr 2019. Masters awarded Apr 2019. Research paper title: Adaptable and conflict colouring multigraphs with no cycles of length three or four.

David Solymosi, DCS, UofT, Sept 2013 - Oct 2015. Masters awarded Sept 2015. Research paper title: On the spine of 3-XOR-SAT.

Arron Norwell, DCS, UofT. Sept 2010 - Jan 2012. Masters awarded Jan 2012. Research paper title: A threshold for clusters in real-world random networks.

Giovanna Thron, DCS, UofT. Sept 2008 - Jan 2010. Masters awarded Jan 2010. Research paper title: An asymptotically tight bound on the adaptable chromatic number.

Siu On Chan, DCS, UofT. Dec 2006 - Jan 2008. Masters awarded Jan 2008. Research paper title: The resolution complexity of general random constraint satisfaction problems.

Hamed Hatami, DCS, UofT. Sept 2003 - Jan 2005. Masters awarded Jan 2005. Thesis title: *Randomly colouring and colouring random graphs.*

Mohammad Mahdian, DCS, UofT. Sept 1998 - Jan 2000. Masters awarded Jan 2000. Thesis title: *The Strong Chromatic Index of Graphs.*

Laura Sedgwick, DCS, UofT. Sept 1996 - Jan 1998. Masters awarded Jan 1998. Thesis title: *Isomorphism Certificates for Undirected Graphs.*

Grace Won, Dept of Mathematics, UofT. Apr 1996 - Dec 1996. Masters awarded Dec 1996. Project title: *Graph Colouring*.

Frank Van Bussel, DCS, UofT. Sept 1998 - Sept 2000. Masters awarded Sept 2000. Thesis title: *Towards the Graceful Tree Conjecture*.

Babak Farzad, DCS, UofT. Sept 1999 - Jan 2001. Masters awarded Jan 2001. Thesis title: When the Chromatic Number is Close to the Maximum Degree.