CURRICULUM VITAE : SIDDHARTHA GADGIL

Citizenship. : Indian

Date of Birth. : 11 July 1974.

Education. :
- California Institute of Technology, 1995–1999
    - *Ph. D.* received in June 1999.
      Thesis title: *On the geometric simple-connectivity of 4-manifolds.*
      Advisor: David Gabai
    - *M.S.* received in June 1998
- Indian Statistical Institute, Calcutta, 1992–1995
    Bachelor of Statistics (Honours) received in 1995

Positions Held. :
- *Professor* at the Indian Institute of Science 2012–
- *Associate Professor* at the Indian Institute of Science 2006–2012.
- *Associate Professor* at the Indian Statistical Institute, Bangalore, 2002–2006.
- *Simons Instructor* at the State University of New York, Stony Brook, 1999–2002
- *Graduate Teaching Assistant*, California Institute of Technology, 1995–98.

Research interests. :
- *Low-dimensional topology* including 3-manifold topology and geometric topology of smooth 4-manifolds.
- *Geometric Group theory* in particular connections with and applications of topology.
- *Automated Theorem Proving* and *Formal Mathematics*, primarily working with the Lean Theorem Prover.

Software

I have been developing software for mathematics and AI, all of which is open source. From about April 2021, I have focussed on working with Lean Prover 4, using it as a programming language and a theorem prover working together seamlessly. Some of my projects with these are the following:
- **LeanAide**: AI tools to work with the Lean Theorem Prover for autoformalization as well as attempts at proof discovery.
- **Saturn**: A SAT solver-prover in lean 4, i.e., a DPLL SAT solver returning solutions with proofs of correctness. This is not high performance, but is one of the larger proved programs in Lean 4.
- **Polylean**: containing Gardam's disproof of Kaplansky's conjecture (with Anand Rao Tadipatri) as well as lean replication of the PolyMath code.

- **LeanSearchClient**: Provides Lean syntax to use the APIs of Moogle, Loogle, and Mathlib search. This is a small amount of code, but has the distinction of being one of very few Mathlib dependencies, and is widely used.

My main automated theorem proving activity before switching to Lean 4 is open sourced at **ProvingGround**, consisting mainly of scala code. This was an implementation of a dependent type-theory based Automated theorem prover in scala. It was a prototype, without the performance or interfaces of a full-fledged ITP.

Industry Collaborations

- Consulted for *Blue Raven, Singapore* on AI related to mathematics. Specifically, my role was to provide Lean metaprogramming expertise to their team. June – August 20234 (three months for 20 hours per month).
- Orgranized and lectured in training on Type Theory and Logic for Formal methods for *Alstom, Bangalore.* This was over the course of two months.

Honours and Awards. :

- Accelerating Foundation Models Research Award from Microsoft Research, 2023.
- *NASI-Scopus Young Scientist Award* from Elsevier, 2010.
- *Platinum Jubilee medal for Young Scientist*, National Academy of Sciences India, 2008.
- *Indian National Science Academy medal for Young Scientists*, 2008.
- *Ganesh Prasad Memorial Award lecture* at the Indian Mathematical Society, 2007.
- *Associate of the Indian Academy of Sciences*, 2003-2008.
- *Sloan dissertation fellowship* in Mathematics, 1998-99.

Grants received.

- *Accelerating Foundation Models Research Award*, Microsoft Research, 2023. Azure credits worth $20,000.
- Research credits from *Google* for using their cloud services, 2022 (worth about $5000).
- *Homotopy Type theory and Natural language processing for Computer-Assisted Mathematics*, SERB extra-mural grant, 2018-2021.

Publications

Research Publications.

(1) Das, Sumanta, and Gadgil, Siddhartha, and Nair, Ajay Kumar, *The Goldman bracket characterizes homeomorphisms between non-compact surfaces*, Algebr. Geom. Topol. (to appear), online at `https://arxiv.org/abs/2307.02769`.

(2) Gadgil, Siddhartha, and Anand Rao Tadipatri., *Formalizing Giles Gardam's Disproof of Kaplansky's Unit Conjecture.* , Proceedings of the 13th ACM SIGPLAN International Conference on Certified Programs and Proofs , (2024), 177-189.

(3) Das, Sumanta and Gadgil, Siddhartha, *Surfaces of infinite-type are non-Hopfian* , C. R. Math. Acad. Sci. Paris , **361** (2023), 1349-1356. (`https://doi.org/10.5802/crmath.504`) (`https://doi.org/10.5802/crmath.504`)

(4) Gadgil, Siddhartha and Krishnapur, Manjunath, *Random words in free groups, non-crossing matchings and RNA secondary structures* , Indian J. Pure Appl. Math. , **54** (2023), 146-158. (`https://doi.org/10.1007/s13226-022-00240-x`) (`https://doi.org/10.1007/s13226-022-00240-x`)

(5) Gadgil, Siddhartha, *Homogeneous Length Functions on Groups: Intertwined Computer and Human Proofs* , J. Automat. Reason. , **64** (2020), 677-688. (`https://doi.org/10.1007/s10817-019-09523-1`) (`https://doi.org/10.1007/s10817-019-09523-1`)

(6) Sanki, Bidyut and Gadgil, Siddhartha, *Graphs of systoles on hyperbolic surfaces* , J. Topol. Anal. , **11** (2019), 1-20. (`https://doi.org/10.1142/S1793525319500018`) (`https://doi.org/10.1142/S1793525319500018`)

(7) Fritz, Tobias and Gadgil, Siddhartha and Khare, Apoorva and Nielsen, Pace P. and Silberman, Lior and Tao, Terence, *Homogeneous length functions on groups* , Algebra Number Theory , **12** (2018), 1773-1786. (`https://doi.org/10.2140/ant.2018.12.1773`) (`https://doi.org/10.2140/ant.2018.12.1773`)

(8) Chas, Moira and Gadgil, Siddhartha, *The extended Goldman bracket determines intersection numbers for surfaces and orbifolds* , Algebr. Geom. Topol. , **16** (2016), 2813-2838. (`https://doi.org/10.2140/agt.2016.16.2813`) (`https://doi.org/10.2140/agt.2016.16.2813`)

(9) Gadgil, Siddhartha and Kulkarni, Dheeraj, *Relative symplectic caps, 4-genus and fibered knots* , Proc. Indian Acad. Sci. Math. Sci. , **126** (2016), 261-275. (`https://doi.org/10.1007/s12044-016-0278-3`) (`https://doi.org/10.1007/s12044-016-0278-3`)

(10) Gadgil, Siddhartha, *The projective plane, J-holomorphic curves and Desargues theorem* , C. R. Math. Acad. Sci. Paris , **351** (2013), 915-920. (`http://dx.doi.org/10.1016/j.crma.2013.10.022`) (`https://doi.org/10.1016/j.crma.2013.10.022`)

(11) Gadgil, Siddhartha and Kalelkar, Tejas, *A chain complex and quadrilaterals for normal surfaces* , Rocky Mountain J. Math. , **43** (2013), 479-487. (`http://dx.doi.org/10.1216/RMJ-2013-43-2-479`) (`https://doi.org/10.1216/RMJ-2013-43-2-479`)

(12) Gadgil, Siddhartha and Krishnapur, Manjunath, *Lipschitz correspondence between metric measure spaces and random distance matrices* , Int. Math. Res. Not. IMRN , (2013), 5623-5644.

(13) Gadgil, Siddhartha and Pandit, Suhas, *Geosphere laminations in free groups* , Geom. Dedicata , **158** (2012), 211-234. (`http://dx.doi.org/10.1007/s10711-011-9629-5`) (`https://doi.org/10.1007/s10711-011-9629-5`)

(14) Gadgil, Siddhartha, *Conjugacy invariant pseudo-norms, representability and RNA secondary structures* , Indian J. Pure Appl. Math. , **42** (2011), 225-237. (`http://dx.doi.org/10.1007/s13226-011-0015-7`) (`https://doi.org/10.1007/s13226-011-0015-7`)

(15) Gadgil, Siddhartha, *The Goldman bracket characterizes homeomorphisms* , C. R. Math. Acad. Sci. Paris , **349** (2011), 1269-1272. (`http://dx.`

doi.org/10.1016/j.crma.2011.11.005) (`https://doi.org/10.1016/j.crma.2011.11.005`)

(16) Gadgil, Siddhartha and Seshadri, Harish, *Surfaces of bounded mean curvature in Riemannian manifolds*, Trans. Amer. Math. Soc. , **363** (2011), 3977-4005. (`http://dx.doi.org/10.1090/S0002-9947-2011-05190-1`) (`https://doi.org/10.1090/S0002-9947-2011-05190-1`)

(17) Biswas, Indranil and Gadgil, Siddhartha, *Real theta characteristics and automorphisms of a real curve*, J. Aust. Math. Soc. , **88** (2010), 29-42. (`http://dx.doi.org/10.1017/S1446788709000305`) (`https://doi.org/10.1017/S1446788709000305`)

(18) Gadgil, Siddhartha, *Open manifolds, Ozsváth-Szabó; invariants and exotic $\mathbb{R}^4$'s*, Expo. Math. , **28** (2010), 254-261. (`http://dx.doi.org/10.1016/j.exmath.2009.09.002`) (`https://doi.org/10.1016/j.exmath.2009.09.002`)

(19) Gadgil, Siddhartha and Pandit, Suhas, *Splittings of free groups, normal forms and partitions of ends*, Proc. Indian Acad. Sci. Math. Sci. , **120** (2010), 217-241. (`http://dx.doi.org/10.1007/s12044-010-0020-5`) (`https://doi.org/10.1007/s12044-010-0020-5`)

(20) Gadgil, Siddhartha, *Watson-Crick pairing, the Heisenberg group and Milnor invariants*, J. Math. Biol. , **59** (2009), 123-142. (`http://dx.doi.org/10.1007/s00285-008-0223-x`) (`https://doi.org/10.1007/s00285-008-0223-x`)

(21) Gadgil, Siddhartha and Kachari, Geetanjali, *Cup products for groups and commutators*, J. Group Theory , **12** (2009), 895-900. (`http://dx.doi.org/10.1515/JGT.2009.021`) (`https://doi.org/10.1515/JGT.2009.021`)

(22) Gadgil, Siddhartha and Pandit, Suhas, *Algebraic and geometric intersection numbers for free groups*, Topology Appl. , **156** (2009), 1615-1619. (`http://dx.doi.org/10.1016/j.topol.2008.12.039`) (`https://doi.org/10.1016/j.topol.2008.12.039`)

(23) Gadgil, Siddhartha, *Orders on manifolds and surgery*, Math. Student , **77** (2008), 145-159 (2009).

(24) Gadgil, Siddhartha, *Incompressibility and least-area surfaces*, Expo. Math. , **26** (2008), 93-98. (`http://dx.doi.org/10.1016/j.exmath.2007.10.005`) (`https://doi.org/10.1016/j.exmath.2007.10.005`)

(25) Gadgil, Siddhartha and Pancholi, Dishant, *Non-orientable Seifert surfaces and a Thom-Pontrjagin type construction*, J. Ramanujan Math. Soc. , **23** (2008), 143-149.

(26) Biswas, Indranil and Gadgil, Siddhartha and Sankaran, Parameswaran, *On theta characteristics of a compact Riemann surface*, Bull. Sci. Math. , **131** (2007), 493-499. (`http://dx.doi.org/10.1016/j.bulsci.2007.02.001`) (`https://doi.org/10.1016/j.bulsci.2007.02.001`)

(27) Gadgil, Siddhartha, *On the proof of the Poincaré; conjecture*, J. Indian Inst. Sci. , **87** (2007), 451-456.

(28) Gadgil, Siddhartha, *Degree-one maps, surgery and four-manifolds*, Bull. Lond. Math. Soc. , **39** (2007), 419-424. (`http://dx.doi.org/10.1112/blms/bdm019`) (`https://doi.org/10.1112/blms/bdm019`)

(29) Gadgil, Siddhartha and Seshadri, Harish, *Ricci flow and the Poincaré; conjecture*, Math. Intelligencer , **29** (2007), 34-43. (`http://dx.doi.org/10.1007/BF02986174`) (`https://doi.org/10.1007/BF02986174`)

(30) Gadgil, Siddhartha, *Embedded spheres in $S^2 \times S^1 \# ... \# S^2 \times S^1$*, Topology Appl. 153 (2006), no. 7, 1141–1151.

(31) Gadgil, Siddhartha, *Homology and homeomorphisms of non-orientable surfaces* (joint with Dishant Pancholi), Proc. Indian Acad. Sci. Math. Sci. 115 (2005), no. 3, 251–257.

(32) Gadgil, Siddhartha, and Ng, Lenny *The Chord algebra and fundamental groups*, Appendix to Knot and braid invariants from contact homology II by Lenny Ng, Geom. Topol. 4 (2005), 1603-1637.

(33) Gadgil, Siddhartha, *Limits of functions and elliptic operators.* Proc. Indian Acad. Sci. Math. Sci. 114 (2004), no. 2, 153–158.

(34) Sulochana Gadgil, P.N. Vinaychandran, P.A. Francis, and Gadgil, Siddhartha, *Extremes of the Indian summer monsoon*, Geophysical Research letters, Volume 31, Issue 12, 2004.

(35) Gadgil, Siddhartha, *Contact Structures on elliptic 3-manifolds*, Proc. Amer. Math Soc.132 (2004), no. 12, 3705–3714.

(36) Funar, Louis, and Gadgil, Siddhartha, *On the Geometric simple-connectivity of open manifolds*, Int. Math. Res. Not. 2004, no. 24, 1193–1248.

(37) Gadgil, Siddhartha, *Equivariant framings, lens spaces and contact structures*, Pacific Journal of Mathematics **1** (2003), 73–84.

(38) Funar, Louis, and Gadgil, Siddhartha, *Topological geodesics and virtual rigidity*, Algebr. Geom. Topol. **1** (2001), 369–380.

(39) Gadgil, Siddhartha, *The pq-condition for 3-manifold groups*, Proc. Amer. Math. Soc. **129** (2001), no. 6, 1873–1875.

(40) Gadgil, Siddhartha, *Cobordisms and Reidemeister torsions of homotopy lens spaces*, Geom. Topol. **5** (2001), 109–125.

Expository articles.

(1) *On the proof of the Poincaré conjecture*, J. Indian Inst. Sci. 87 (2007), 451–456.

(2) *Orders on manifolds and surgery*, Math. Student **77** (2008), 145–159 (2009).

(3) *Ricci flow and Perelman's proof of the Poincaré conjecture* (joint with Harish Seshadri), Current Science 91 (2007), 1326–1334.

(4) *Ricci flow and the Poincaré conjecture.*(joint with Harish Seshadri) Math. Intelligencer 29 (2007), no. 4, 34–43.

(5) *A topological characterisation of hyperbolic groups (following Bowditch)*, Proceedings of the Workshop on Topological methods in Group theory, I.M.Sc., Chennai, 2002.

(6) *Dynamics on the circle*, Resonance, November 2003.

(7) *Chern and total curvature*, Resonance, April 2005.

Invited lectures

- *The future of Automated and Interactive Theorem Proving and its possible impact on industry*, Industry-Academia conclave, IIT Palakkad, India, September 2024.

- *Autoformalization and Friends: Interactive Theorem Provers and Artificial Intelligence*, Workshop on AI and Mathematics, Chalmers University, Gothenburg, Sweden, August 2024.

- *Programs with Proofs and Meta-Programming in Lean*, Workshop on Formal Proofs and Lean, National University of Singapore, April 2024.
- *Towards Autoformalization and Mathematical Reasoning using language models*, seminar on Formalisation of mathematics with interactive theorem provers, University of Cambridge, UK, January 2024.
- *Lengths on Free groups*, TIFR, Mumbai, January 2020.
- *Lengths on Free groups*, Conference on Geometric Topology Indian Institute of Science Education and Research and Bhaskaracharya Pratishthana, Pune.
- *Free groups, Lengths and Computer Proofs*, IISER Thiruvanathapuram, November 2019.
- *Homogeneous length functions on Groups: A polymath adventure*, Ashoka University, April 2018
- *String Topology and the Geometric decomposition of three-dimensional manifolds*, East Asian Conference on Algebraic Topology, December 2017.
- *Automating Mathematics?*, IISER, Tirupathi, September 2017.
- *Triangulating Moduli spaces of Surfaces*, Conference on Topolgy and Geometry, IISER Bhopal, December 2015.
- *Metric Measure spaces and Random matrices*, Young Topologists Conference, Chennai, December 2013.
- *Topology of Manifolds : Constructing, Describing and Distinguishing spaces*, T.I.F.R. Young Indian Scientists Colloquium, September 2009.
- *Embedded spheres, intersection numbers and free groups*, International Conference on Surface mapping class groups, North-Eastern Hill University, Shillong 2008.
- *Heegaard Floer theory, Open manifolds and Teichmuller spaces*, Geometric Topology Conference, Peking University, Beijing, 2007.
- *Degree-one maps, surgery and low-dimensional topology*, North-Eastern Hill University, Shillong, October 2006.
- *The Quest for the best metric*, Conference on *Relativity and its impact on Mathematics*, Belgaum, September 2005.
- *Automorphisms of surfaces*, H.R.I., Allahabad, June-July 2005 (4 lectures).
- *Exotic $\mathbb{R}^4$'s and Ozsvath-Szabo invariants*, I.I.Sc. Mathematics Colloquium, 2005.
- *Symmetries of spheres*, Indian Academy of Sciences Annual Meeting, Varanasi, 2004.
- *Topological spherical space forms*, AMS-India meeting, Bangalore, 2003.
- *On the Andrew-Curtis conjecture and Algorithms from topology*, Frankfurt-Bocham group theory seminar, Frankfurt, 2003.
- *Topological spherical space forms*, Institut Fourier, Grenoble, 2003 (3 lectures).
- *Topological geodesics in 3-manifolds*, Colloquium, T.I.F.R., Mumbai, 2003.
- *Topological geodesics in 3-manifolds*, Colloquium, Chennai Mathematical institute, 2002.
- *Contact structures on 3-manifolds*, Colloquium, T.I.F.R., Bangalore, 2002.
- *A topological characterisation of hyperbolic groups (following Bowditch)*, Workshop on Topological methods in Group theory, I.M.Sc., Chennai, 2002 (3 lectures).

- *Random walks and Contact geometry*, Groupes et leurs applications en géométrie et topologie, Institut Fourier, Grenoble, 2002.
- *Equivariant framings, Space forms and Contact structures*, Groupes et leurs applications en géomtrie et topologie, Institut Fourier, Grenoble, 2002.
- *On the Andrews-Curtis conjecture and Algorithms from Topology*, Groupes et leurs applications en géomtrie et topologie, Institut Fourier, Grenoble, 2002.
- *On the Andrew-Curtis conjecture and Algorithms from topology*, Special session in Computational topology, American Mathematical Society National meeting, San Diego, January 2002.
- *On the Andrew-Curtis conjecture and Algorithms from topology*, Topology Seminar, University of Melbourne, August 2001.
- *Topological Geodesics in 3-manifolds*, Topology seminar, University of Melbourne, August 2001
- *Equivariant framings of 3-manifolds*, Seminar, T.I.F.R., Mumbai, June 2001
- *Cobordisms and Reidemeister torsions of homotopy lens spaces*, Seminar, T.I.F.R., Mumbai, January 2001
- *Introductory lectures (five lectures) on 3-manifolds*, Instructional Conference in low-dimensional topology, Allahabad, December 2000.
- *Finite groups that act on S^3 without fixed points*, Colloquium, I.I.Sc., Bangalore, June 2000
- *On the Andrew-Curtis conjecture and Algorithms from topology*, West Coast topology colloquium, Stanford University, April 1999

Courses Taught

I have taught many of these courses more than once.

- Proofs and Programs (new course).
- UM 102: Analysis and Linear Algebra II (IISc core course).
- Introduction to Homotopy type theory (new course).
- Introduction to Algebraic Topology.
- Algebraic Topology.
- Topology.
- Logic, Types and Spaces (new course).
- Basic Analysis.
- Elementary Algebra and Number Theory.
- Algebra I.
- Symplectic Topology(new course).
- Mathematical Logic (new course).
- Cohomology of Manifolds and Groups (new course).
- Topology and Geometry.

Other activities

- Member of Committee for making the Artificial Intelligence policy for the Indian Institute of Science, 2023.
- Member of the Senate Curriculum Committee, I.I.Sc., 2013-2015.

- Member of the UGC review committee for Chennai Mathematical Institute, 2018.
- Member selection committees for the faculty of IISER Bhopal, IISER Tirupathi and IIT, Hyderabad.
- Member of the UGC advisory committee for the Department of Mathematics, NEHU, Shillong, 2016-2021.
- Co-organiser of the ICM Satellite Conference on *Geometric Topology and Riemannian Geometry*, June 2010.
- Co-organiser of the International Conference *Geometric method in low-dimensional topology*, IISc, Bangalore, June 2006.
- Member, Programme Committee, International Center for Theoretical Science, 2010–2012.
- Co-organiser of the conference 'Low-dimensional manifolds and Groups', ISI, Bangalore June 2004.
- Co-organiser of the Geometry/Topology seminar at Stony Brook, 1999-2002
- Member, Graduate committee, Department of Mathematics, Stony Brook, 2001-2002
- Colloquium chair, I.S.I. Bangalore, 2005-2006
- Seminar-in-charge, IISc, Bangalore, 2006-2009
- Member, Research fellows advisory committee, I.S.I. Bangalore, 2005-2006
- Convener, computer committee, I.S.I. Bangalore, 2004-2006