MATTHEW LAKIN

Department of Computer Science
Department of Chemical & Biological Engineering
Center for Biomedical Engineering
University of New Mexico
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Research Interests

DNA nanotechnology, synthetic biology, biological modeling languages, formal methods.

Education

- Ph.D. in Computer Science, University of Cambridge, UK, 2010.
  - Thesis title: *"An executable meta-language for inductive definitions with binders."*
  - Advisor: Prof. Andrew M. Pitts.
- M.A. (Cantab), University of Cambridge, UK, 2009.
- B.A. (Hons) in Computer Science, University of Cambridge, UK, 2005.

Positions

- 2020–present. Assistant Professor (by courtesy), Department of Chemical & Biological Engineering, University of New Mexico.
- 2017–present. Assistant Professor, Department of Computer Science, University of New Mexico.
- 2014–present. Member, Center for Biomedical Engineering, University of New Mexico.
- 2015–2017. Research Assistant Professor, Department of Chemical & Biological Engineering, University of New Mexico.
- 2015–2017. Research Assistant Professor, Department of Computer Science, University of New Mexico.
- 2011–2015. Postdoctoral Scholar, Department of Computer Science, University of New Mexico. Advisor: Prof. Darko Stefanovic.
- 2009–2011. Postdoctoral Researcher, Biological Computation Group, Microsoft Research, Cambridge, UK. Advisor: Dr. Andrew Phillips.

Awards

- 2021–present. NSF CAREER award.
- 2021. UNM School of Engineering Junior Faculty Research Excellence award.
- 2020. STC.UNM Innovation Award.
- 2013–2015. Postdoctoral Training Fellowship, New Mexico Cancer Nanotechnology Training Center.
- 2007–2008. Queens' College Munro Studentship. (Awarded for teaching excellence.)
- 2004. Queens' College Foundation Scholarship. (Awarded for first class honors in Tripos examinations.)
- 2003. Queens' College Exhibition. (Awarded for first class honors in Tripos examinations.)

Current Grant Support

G8: Co-Principal Investigator, National Science Foundation award 2202396, *"Student and Postdoc Travel Support for DNA28."*

- Total award amount: $20,000.
- Award period: 03/01/2022–02/28/2023.
- PI: Darko Stefanovic (UNM); Co-PIs: Matthew Lakin.

G7: Co-Principal Investigator, National Science Foundation award 2124308, *"Collaborative Research: Toward lifelike synthetic cells via engineered control of DNA replication."*

- Total award amount: $1,095,798. UNM portion: $414,071.
- Award period: 08/15/2021–07/31/2024.
- PI: James Chappell (Rice); Co-PIs: Matthew Lakin, Peter Davenport (UNM), Emma Frow (ASU).

G6: Co-Principal Investigator, National Science Foundation award 2123465, *"Synthetic P-bodies: Coupling gene expression and ribonucleoprotein granules in synthetic cell vesicles for sensing and response."*

- Total award amount: $992,280.
- Award period: 08/01/2021–07/31/2024.
- PI: Gabriel Lopez (UNM); Co-PIs: Matthew Lakin, Kate Adamala (University of Minnesota), William Gannon (UNM).

G5: Principal Investigator, National Science Foundation award 2044838, *"CAREER: Robust heterochiral molecular computing in mammalian cells."*

- **Total award amount: $650,000.**
- **Award period: 04/01/2021–03/31/2026.**
- **PI: Matthew Lakin (sole investigator).**

G4: Co-Principal Investigator, National Science Foundation award 2031774, *"EAGER: Engineered, Smart, Nucleic Acid-Binding, Intrinsically Disordered Proteins to Enable Ubiquitous Detection of Viral Pathogens and Diagnosis."*

- Total award amount: $300,000.
- Award period: 07/01/2020–06/30/2023.
- PI: Gabriel Lopez (UNM); Co-PIs: Matthew Lakin, Nick Carroll (UNM), David Peabody (UNM).

G3: Co-Principal Investigator, National Science Foundation award 1935087, *"Synthetic cells that can learn without evolution."*

- Total award amount: $1,000,000. UNM portion: $203,171.
- Award period: 09/15/2019–08/31/2023.
- PI: James Carothers (University of Washington); Co-PIs: Matthew Lakin, Irene Chen (UCLA), Pamela Peralta-Yahya (Georgia Tech), Emma Frow (ASU).

G2: Project Investigator, National Institutes of Health NIGMS grant P20GM103451 via NM-INBRE, *"Cell-free design and implementation of CRISPR guide RNA switches."*

- Total award amount: $109,237.
- Award period: 05/01/2019–03/31/2023.
- PI: Matthew Lakin (sole investigator).

G1: Principal Investigator, National Science Foundation award 1814906, *"SHF: Small: Models and design tools for tethered molecular circuits."*

- Total award amount: $450,000.
- Award period: 06/15/2018–05/31/2023.
- PI: Matthew Lakin (sole investigator).

Completed Grant Support

F4: Co-Principal Investigator, National Science Foundation award 1763718, *"SHF: Collaborative Research: Biocompatible I/O interfaces for robust bioorthogonal molecular computing."*

- Total award amount: $300,000. UNM portion: $200,000.
- Award period: 10/01/2018–09/30/2022.
- PI: Darko Stefanovic (UNM); Co-PIs: Matthew Lakin, Milan Stojanovic (Columbia University).

F3: Co-Principal Investigator, National Science Foundation award 1518861, *"AF: Large: Collaborative Research: Molecular computing for the real world."*

- Total award amount: $2,000,000. UNM portion: $934,358.
- Award period: 09/01/2015–08/31/2022.

- PI: Darko Stefanovic (UNM); Co-PIs: Matthew Lakin, Steven Graves (UNM), Lydia Tapia (UNM), Milan Stojanovic (Columbia University), Sergei Rudchenko (Hospital for Special Surgery), Christof Teuscher (Portland State University).

F2: Co-Principal Investigator, National Science Foundation award 1843958, *"RoL: EAGER: DESYN-C^3: Programmable control of metabolism in synthetic cells using intrinsically disordered proteins."*

- Total award amount: $299,986.
- Award period: 10/01/2018–09/30/2021.
- PI: Nick Carroll (UNM); Co-PI: Matthew Lakin.

F1: Principal Investigator, National Science Foundation award 1525553, *"AF: SHF: Small: Adaptive molecular computation using buffered strand displacement networks."*

- Total award amount: $449,999.
- Award period: 09/01/2015–08/31/2020.
- PI: Matthew Lakin; Co-PIs: Darko Stefanovic (UNM), Steven Graves (UNM).

Patents

P5: M. R. Lakin, T. L. Mallette, and D. Stefanovic, *Heterochiral translators and molecular circuits*, US provisional patent application, 2021

P4: M. R. Lakin, C. W. Brown III, D. Stefanovic, and S. W. Graves, *Signal propagation biomolecules, devices and methods*, US patent number 10,221,446, 2019

P3: M. R. Lakin and N. J. Carroll, *Programmable control of metabolism in synthetic cells using intrinsically disordered proteins*, US provisional patent application, 2018

P2: M. R. Lakin and P. W. Davenport, *Engineering stimulus-responsive effectors for cell-specific control of gene expression*, US provisional patent application, 2018

P1: M. R. Lakin and A. Phillips, *Stochastic simulation of multi-language concurrent systems*, US patent application number 13/091,950, patent pending, 2011

Edited Volumes

V1: M. R. Lakin and P. Šulc, Eds., *27th International Conference on DNA Computing and Molecular Programming (DNA 27)*, vol. 205, Leibniz International Proceedings in Informatics (LIPIcs), Schloss Dagstuhl – Leibniz-Zentrum für Informatik, 2021, ISBN: 978-3-95977-205-1. DOI: 10.4230/LIPIcs.DNA.27

Book Chapters

B3: M. R. Lakin, D. Stefanovic, and M. N. Stojanovic, "Diverse applications of DNAzymes in computing and nanotechnology," in *Ribozymes*, S. Müller, B. Masquida, and W. Winkler, Eds., Wiley, 2021, ch. 25, pp. 633–660. DOI: 10.1002/9783527814527.ch25

B2: D. Arredondo, M. R. Lakin, D. Stefanovic, and M. N. Stojanovic, "Development and application of catalytic DNA in nanoscale robotics," in *DNA- and RNA-Based Computing Systems*, E. Katz, Ed., Wiley, 2021, ch. 15, pp. 293–306. DOI: 10.1002/9783527825424.ch15

B1: M. R. Lakin, M. N. Stojanovic, and D. Stefanovic, "Implementing molecular logic gates, circuits, and cascades using DNAzymes," in *Advances in Unconventional Computing Volume 2: Prototypes, Models and Algorithms*, ser. Emergence, Complexity, and Computation, A. Adamatzky, Ed., vol. 23, Springer International Publishing, 2017, ch. 1, pp. 1–28. DOI: 10.1007/978-3-319-33921-4_1

Journal Publications

J29: T. L. Mallette and M. R. Lakin, "Protecting heterochiral DNA nanostructures against exonuclease-mediated degradation," *ACS Synthetic Biology*, vol. 11, no. 7, pp. 2222–2228, 2022. DOI: 10.1021/acssynbio.2c00105

J28: D. Arredondo and M. R. Lakin, "Supervised learning in a multilayer, nonlinear chemical neural network," *IEEE Transactions on Neural Networks and Learning Systems*, 2022, Published online ahead of print. DOI: 10.1109/TNNLS.2022.3146057

J27: D. Arredondo and M. R. Lakin, "Robust finite automata in stochastic chemical reaction networks," *Royal Society Open Science*, vol. 8, no. 12, p. 211 310, 2021. DOI: 10.1098/rsos.211310

J26: O. Staufer, J. A. D. Lora, E. Bailoni, A. Bazrafshan, A. S. Benk, K. Jahnke, Z. A. Manzer, L. Otrin, T. D. Pérez, J. Sharon, J. Steinkühler, K. P. Adamala, B. Jacobson, M. Dogterom, K. Göpfrich, D. Stefanovic, S. R. Atlas, M. Grunze, M. R. Lakin, A. P. Shreve, J. P. Spatz, and G. P. López, "Building a community to engineer synthetic cells and organelles from the bottom-up," *eLife*, vol. 10, e73556, 2021. DOI: 10.7554/eLife.73556

J25: S. Kumar, J. M. Weisburd, and M. R. Lakin, "Structure sampling for computational estimation of localized DNA interaction rates," *Scientific Reports*, vol. 11, p. 12 730, 2021. DOI: 10.1038/s41598-021-92145-8

J24: M. R. Lakin and A. Phillips, "Domain-specific programming languages for computational nucleic acid systems," *ACS Synthetic Biology*, vol. 9, no. 7, pp. 1499–1513, 2020. DOI: 10.1021/acssynbio.0c00050

J23: T. L. Mallette, M. N. Stojanovic, D. Stefanovic, and M. R. Lakin, "Robust heterochiral strand displacement using leakless translators," *ACS Synthetic Biology*, vol. 9, no. 7, pp. 1907–1910, 2020. DOI: 10.1021/acssynbio.0c00131

J22: C. Spaccasassi, M. R. Lakin, and A. Phillips, "A logic programming language for computational nucleic acid devices," *ACS Synthetic Biology*, vol. 8, no. 7, pp. 1530–1547, 2019. DOI: 10.1021/acssynbio.8b00229

J21: A. Fabry-Wood, M. E. Fetrow, A. Oloyede, K.-A. Yang, M. N. Stojanovic, D. Stefanovic, S. W. Graves, N. J. Carroll, and M. R. Lakin, "Microcompartments for protection and isolation of nanoscale DNA computing elements," *ACS Applied Materials and Interfaces*, vol. 11, no. 12, pp. 11 262–11 269, 2019. DOI: 10.1021/acsami.9b03143

J20: M. R. Lakin and A. Phillips, "Automated analysis of tethered DNA nanostructures using constraint solving," *Natural Computing*, vol. 17, no. 4, pp. 709–722, 2018. DOI: 10.1007/s11047-018-9693-y

J19: S. Pallikkuth, C. Martin, F. Farzam, J. S. Edwards, M. R. Lakin, D. S. Lidke, and K. A. Lidke, "Sequential super-resolution imaging using DNA strand displacement," *PLOS ONE*, vol. 13, no. 8, e0203291, 2018. DOI: 10.1371/journal.pone.0203291

J18: A. Fabry-Wood, M. E. Fetrow, C. W. Brown III, N. A. Baker, N. F. Oropeza, A. P. Shreve, G. A. Montaño, D. Stefanovic, M. R. Lakin, and S. W. Graves, "A microsphere-supported lipid bilayer platform for DNA reactions on a fluid surface," *ACS Applied Materials and Interfaces*, vol. 9, no. 35, pp. 30 185–30 195, 2017. DOI: 10.1021/acsami.7b11046

J17: M. R. Lakin and D. Stefanovic, "Supervised learning in adaptive DNA strand displacement networks," *ACS Synthetic Biology*, vol. 5, no. 8, pp. 885–897, 2016. DOI: 10.1021/acssynbio.6b00009

J16: D. Mo, M. R. Lakin, and D. Stefanovic, "Logic circuits based on molecular spider systems," *BioSystems*, vol. 146, pp. 10–25, 2016. DOI: 10.1016/j.biosystems.2016.03.008

J15: M. R. Lakin, D. Stefanovic, and A. Phillips, "Modular verification of chemical reaction network encodings via serializability analysis," *Theoretical Computer Science*, vol. 632, pp. 21–42, 2016. DOI: 10.1016/j.tcs.2015.06.033

J14: R. L. Petersen, M. R. Lakin, and A. Phillips, "A strand graph semantics for DNA-based computation," *Theoretical Computer Science*, vol. 632, pp. 43–73, 2016. DOI: 10.1016/j.tcs.2015.07.041

J13: C. W. Brown III, M. R. Lakin, A. Fabry-Wood, E. K. Horwitz, N. A. Baker, D. Stefanovic, and S. W. Graves, "A unified sensor architecture for isothermal detection of double-stranded DNA, oligonucleotides, and small molecules," *ChemBioChem*, vol. 16, no. 5, pp. 725–730, 2015. DOI: 10.1002/cbic.201402615

J12: M. R. Lakin, C. W. Brown III, E. K. Horwitz, M. L. Fanning, H. E. West, D. Stefanovic, and S. W. Graves, "Biophysically inspired rational design of structured chimeric substrates for DNAzyme cascade engineering," *PLOS ONE*, vol. 9, no. 10, e110986, 2014. DOI: 10.1371/journal.pone.0110986

J11: C. W. Brown III, M. R. Lakin, E. K. Horwitz, M. L. Fanning, H. E. West, D. Stefanovic, and S. W. Graves, "Signal propagation in multi-layer DNAzyme cascades using structured chimeric substrates," *Angewandte Chemie International Edition*, vol. 53, no. 28, pp. 7183–7187, 2014. DOI: 10.1002/anie.201402691

J10: M. R. Lakin, A. Minnich, T. Lane, and D. Stefanovic, "Design of a biochemical circuit motif for learning linear functions," *Journal of the Royal Society Interface*, vol. 11, no. 101, p. 20 140 902, 2014. DOI: 10.1098/rsif.2014.0902

J9: C. W. Brown III, M. R. Lakin, D. Stefanovic, and S. W. Graves, "Catalytic molecular logic devices by DNAzyme displacement," *ChemBioChem*, vol. 15, no. 7, pp. 950–954, 2014. DOI: 10.1002/cbic.201400047

J8: M. R. Lakin and A. M. Pitts, "Contextual equivalence for inductive definitions with binders in higher-order typed functional programming," *Journal of Functional Programming*, vol. 23, no. 6, pp. 658–700, 2013. DOI: 10.1017/S0956796813000245

J7: P. Banda, C. Teuscher, and M. R. Lakin, "Online learning in a chemical perceptron," *Artificial Life*, vol. 19, no. 2, pp. 195–219, 2013. DOI: 10.1162/ARTL_a_00105

J6: M. R. Lakin, D. Parker, L. Cardelli, M. Kwiatkowska, and A. Phillips, "Design and analysis of DNA strand displacement devices using probabilistic model checking," *Journal of the Royal Society Interface*, vol. 9, no. 72, pp. 1470–1485, 2012. DOI: 10.1098/rsif.2011.0800

J5: M. R. Lakin, L. Paulevé, and A. Phillips, "Stochastic simulation of multiple process calculi for biology," *Theoretical Computer Science*, vol. 431, pp. 181–206, 2012. DOI: 10.1016/j.tcs.2011.12.057

J4: M. R. Lakin, S. Youssef, L. Cardelli, and A. Phillips, "Abstractions for DNA circuit design," *Journal of the Royal Society Interface*, vol. 9, no. 68, pp. 460–486, 2012. DOI: 10.1098/rsif.2011.0343

J3: M. R. Lakin, S. Youssef, F. Polo, S. Emmott, and A. Phillips, "Visual DSD: A design and analysis tool for DNA strand displacement systems," *Bioinformatics*, vol. 27, no. 22, pp. 3211–3213, 2011. DOI: 10.1093/bioinformatics/btr543

J2: M. R. Lakin and A. M. Pitts, "Encoding abstract syntax without fresh names," *Journal of Automated Reasoning*, vol. 49, no. 2, pp. 115–140, 2012. DOI: 10.1007/s10817-011-9220-7

J1: M. R. Lakin, "Constraint solving in non-permutative nominal abstract syntax," *Logical Methods in Computer Science*, vol. 7, no. 3:06, pp. 1–31, 2011. DOI: 10.2168/LMCS-7(3:6)2011

Conference Publications

C17: M. R. Lakin and A. Phillips, "Automated, constraint-based analysis of tethered DNA nanostructures," in *Proceedings of the 23rd International Conference on DNA Computing and Molecular Programming*, R. Brijder and L. Qian, Eds., ser. Lecture Notes in Computer Science, vol. 10467, Springer, Cham, 2017, pp. 1–16. DOI: 10.1007/978-3-319-66799-7_1

C16: M. R. Lakin and D. Stefanovic, "Towards temporal logic computation using DNA strand displacement reactions," in *Unconventional Computation and Natural Computation 2017*, M. J. Patitz and M. Stannett, Eds., ser. Lecture Notes in Computer Science, vol. 10240, Springer, Cham, 2017, pp. 41–55. DOI: 10.1007/978-3-319-58187-3_4

C15: M. R. Lakin and D. Stefanovic, "Supervised learning in an adaptive DNA strand displacement circuit," in *Proceedings of the 21st International Conference on DNA Computing and Molecular Programming*, A. Phillips and P. Yin, Eds., ser. Lecture Notes in Computer Science, vol. 9211, Springer International Publishing, 2015, pp. 154–167. DOI: 10.1007/978-3-319-21999-8_10

C14: D. Mo, M. R. Lakin, and D. Stefanovic, "Scalable design of logic circuits using an active molecular spider system," in *Proceedings of the 10th International Conference on Information*

Processing in Cells and Tissues, M. Lones, A. Tyrrell, S. Smith, and G. Fogel, Eds., ser. Lecture Notes in Computer Science, vol. 9303, Springer International Publishing, 2015, pp. 13–28. DOI: 10.1007/978-3-319-23108-2_2

C13: M. R. Lakin, R. Petersen, K. E. Gray, and A. Phillips, "Abstract modelling of tethered DNA circuits," in *Proceedings of the 20th International Conference on DNA Computing and Molecular Programming*, S. Murata and S. Kobayashi, Eds., ser. Lecture Notes in Computer Science, vol. 8727, Springer International Publishing, 2014, pp. 132–147. DOI: 10.1007/978-3-319-11295-4_9

C12: M. R. Lakin and D. Stefanovic, "Pattern formation by spatially organized approximate majority reactions," in *Unconventional Computation and Natural Computation 2014*, O. H. Ibarra, L. Kari, and S. Kopecki, Eds., ser. Lecture Notes in Computer Science, vol. 8553, Springer International Publishing, 2014, pp. 254–266. DOI: 10.1007/978-3-319-08123-6_21

C11: M. R. Lakin and A. Phillips, "Compiling DNA strand displacement reactions using a functional programming language," in *Proceedings of Practical Aspects of Declarative Languages 2014*, M. Flatt and H.-F. Guo, Eds., ser. Lecture Notes in Computer Science, vol. 8324, Springer International Publishing Switzerland, 2014, pp. 81–86. DOI: 10.1007/978-3-319-04132-2_6

C10: A. Goudarzi, M. R. Lakin, D. Stefanovic, and C. Teuscher, "A model for variation- and fault-tolerant digital logic using self-assembled nanowire architectures," in *Proceedings of the 2014 IEEE/ACM International Symposium on Nanoscale Architectures (NANOARCH)*, IEEE Press, 2014, pp. 116–121. DOI: 10.1109/NANOARCH.2014.6880504

C9: A. Goudarzi, M. R. Lakin, and D. Stefanovic, "Reservoir computing approach to robust computation using unreliable nanoscale networks," in *Unconventional Computation and Natural Computation 2014*, O. H. Ibarra, L. Kari, and S. Kopecki, Eds., ser. Lecture Notes in Computer Science, vol. 8553, Springer International Publishing, 2014, pp. 164–176. DOI: 10.1007/978-3-319-08123-6_14

C8: M. R. Lakin, A. Phillips, and D. Stefanovic, "Modular verification of DNA strand displacement networks via serializability analysis," in *Proceedings of the 19th International Conference on DNA Computing and Molecular Programming*, D. Soloveichik and B. Yurke, Eds., ser. Lecture Notes in Computer Science, vol. 8141, Springer-Verlag, 2013, pp. 133–146. DOI: 10.1007/978-3-319-01928-4_10

C7: A. Goudarzi, M. R. Lakin, and D. Stefanovic, "DNA reservoir computing: A novel molecular computing approach," in *Proceedings of the 19th International Conference on DNA Computing and Molecular Programming*, D. Soloveichik and B. Yurke, Eds., ser. Lecture Notes in Computer Science, vol. 8141, Springer-Verlag, 2013, pp. 76–89. DOI: 10.1007/978-3-319-01928-4_6

C6: M. R. Lakin, A. Minnich, T. Lane, and D. Stefanovic, "Towards a biomolecular learning machine," in *Unconventional Computation and Natural Computation 2012*, J. Durand-Lose and N. Jonoska, Eds., ser. Lecture Notes in Computer Science, vol. 7445, Springer-Verlag, 2012, pp. 152–163. DOI: 10.1007/978-3-642-32894-7_15

C5: M. R. Lakin and A. Phillips, "Modelling, simulating and verifying Turing-powerful strand displacement systems," in *Proceedings of the 17th International Conference on DNA Computing and Molecular Programming*, L. Cardelli and W. Shih, Eds., ser. Lecture Notes in Computer Science, vol. 6937, Springer-Verlag, 2011, pp. 130–144. DOI: 10.1007/978-3-642-23638-9_12

C4: A. Phillips, M. R. Lakin, and L. Paulevé, "Stochastic simulation of process calculi for biology," in *Membrane Computing and Biologically Inspired Process Calculi 2010*, G. Ciobanu and M. Koutny, Eds., ser. Electronic Proceedings in Theoretical Computer Science, vol. 40, 2010, pp. 1–5. DOI: 10.4204/EPTCS.40.1

C3: L. Paulevé, S. Youssef, M. R. Lakin, and A. Phillips, "A generic abstract machine for stochastic process calculi," in *CMSB 2010: Proceedings of the 8th International Conference on Computational Methods in Systems Biology, Trento, Italy*, ACM, 2010, pp. 43–54. DOI: 10.1145/1839764.1839771

C2: M. R. Lakin and A. M. Pitts, "Resolving inductive definitions with binders in higher-order typed functional programming," in *18th European Symposium on Programming (ESOP '09)*, G. Castagna, Ed., ser. Lecture Notes in Computer Science, vol. 5502, Springer, 2009, pp. 47–61. DOI: 10.1007/978-3-642-00590-9_4

C1: M. R. Lakin and A. M. Pitts, "A metalanguage for structural operational semantics," in *Trends in Functional Programming, Volume 8*, M. T. Morazán, Ed., Intellect, 2008, pp. 19–35

Media Coverage

- 2022. "Faculty highlight" on UNM School of Engineering website:
  - https://ess.unm.edu/resources/highlights/index.html
- 2021. "Computer science professor offers a new twist on DNA in NSF CAREER project" article on UNM Newsroom website:
  - https://news.unm.edu/news/computer-science-professor-offers-a-new-twist-on-dna-in-nsf-career-project
- 2019. "Research team receives NSF award to develop 'smart' synthetic cell systems" article on University of Washington Molecular Engineering & Sciences Institute website:
  - https://www.moles.washington.edu/research-team-receives-nsf-award-to-develop-smart-synthetic-cell-systems/
- 2015. "Molecular computing at UNM" article on UNM Newsroom website:
  - http://news.unm.edu/news/molecular-computing-at-unm
- 2014. "Computational chemicals" article on Royal Society of Chemistry's Chemistry World website:
  - http://www.rsc.org/chemistryworld/2014/02/computational-chemicals-learning-network-turing

Teaching

- 2016–present. Instructor, University of New Mexico. Multiple courses (15 total):
  - Fall 2022: Computer Science postgraduate course CS 558: "Software Foundations."
  - Spring 2022: Computer Science undergraduate / postgraduate course CS 468 / CS 568: "Computational Modeling for Bioengineering." This course was cross-listed as CS 468, CS 568, and BME 568.
  - Fall 2021: Computer Science postgraduate course CS 558: "Software Foundations."
  - Spring 2021: Biomedical Engineering postgraduate course BME 556: "Protein and Nucleic Acid Engineering." This course was cross-listed as BME 556, CBE 499, CBE 515, CS 491, and CS 591.
  - Fall 2020: Computer Science postgraduate course CS 558: "Software Foundations."
  - Spring 2020: Computer Science undergraduate / postgraduate course CS 365: "Introduction to Scientific Modeling." This course was cross-listed as CS 365, CS 491, CS 591, and BME 598.
  - Fall 2019: Computer Science postgraduate course CS 558: "Software Foundations."
  - Fall 2019: Computer Science postgraduate course CS 592: "Colloquium."
  - Spring 2019: Computer Science undergraduate course CS 251: "Intermediate Programming."
  - Spring 2019: Biomedical Engineering postgraduate course BME 556: "Protein and Nucleic Acid Engineering." This course was cross-listed as BME 556, CBE 499, CBE 515, and CS 591.
  - Fall 2018: Computer Science postgraduate course CS 558: "Software Foundations."
  - Spring 2018: Computer Science undergraduate course CS 365: "Introduction to Scientific Modeling."
  - Fall 2017: Computer Science postgraduate course CS 558: "Software Foundations."
  - Spring 2017: Computer Science undergraduate course CS 293: "Social and Ethical Issues in Computing."
  - Fall 2016: Computer Science postgraduate course CS 558: "Software Foundations."
- 2012–2015. Guest lecturer, University of New Mexico. Multiple courses (5 total):
  - Computer Science postgraduate course CS 558: "Software Foundations."
  - Biomedical Engineering postgraduate course BME 556: "Protein and Nucleic Acid Engineering."
  - Nanoscience and Microsystems Engineering postgraduate course NSMS 518: "Synthesis of Nanostructures."
  - Chemical Engineering undergraduate course CHNE 361: "Biomolecular Engineering."
  - Chemical Engineering undergraduate CBE 417 / Biomedical Engineering postgraduate course BME 517: "Applied Biology for Biomedical Engineers."
- 2005–2011. Computer Science supervisor, University of Cambridge. Served as teaching assistant for multiple courses (10 total):

- Programming in Java, Databases, Discrete Mathematics, Specification and Verification, Logic and Proof, Semantics of Programming Languages, Computation Theory, Types, Topics in Concurrency, Natural Language Processing.

- 2007–2009. Computer Science introductory programming laboratory supervisor, University of Cambridge.

Advising

- Research faculty advisor, University of New Mexico. Research professors mentored (1 total):
  - Dr. Peter Davenport (2020–present).
- Postdoctoral scholar advisor, University of New Mexico. Postdocs mentored (1 total):
  - Dr. Peter Davenport (2018–2020).
- Graduate student advisor, University of New Mexico. Students mentored (6 total):
  - Kaitlin Eversole (Biomedical Engineering Ph.D. student, 2020–present).
  - Randi Smith (Biomedical Engineering Ph.D. student, 2019–present).
  - Sarika Kumar (Computer Science Ph.D. student, 2018–present).
  - Tracy Mallette (Biomedical Engineering Ph.D. student, 2017–present).
  - David Arredondo (Nanoscience and Microsystems Engineering Ph.D. student, 2017–2022).
    - Ph.D. thesis adviser, graduated Fall 2022.
    - Thesis title: *"Control Mechanisms for Nanoscale Devices."*
    - Also mentored as a post-baccalaureate student, 2016–2017.
  - James C. Boney (Biomedical Engineering M.S. student, 2018).
    - Currently a lab scientist at New Mexico Department of Health.
- Undergraduate student advisor, University of New Mexico. Students mentored (7 total):
  - Sameen Jawadi (Biology student, 2021–present).
  - Jacob McCullough (Computer Science student, 2020–present).
  - Luis Paez Beltran (Biochemistry student, 2019–present).
  - Kelsie Herzer (Chemical Engineering student, 2018–2020).
  - Christopher Fetrow (Chemistry / Physics undergraduate student, 2016–2020).
  - Danielsen Moreno (General Engineering undergraduate student, Central New Mexico Community College, 2018).
  - Julian Weisburd (Computer Science undergraduate student, 2017).
- Technical staff advisor, University of New Mexico. Technical staff members mentored (1 total):
  - Dr. Caroline Rempe (part-time faculty member, Central New Mexico Community College, 2021–present).

Mentoring

- Graduate student mentor, University of New Mexico. Students mentored (13 total):
  - Sajjad Khan (Nanoscience and Microsystems Engineering Ph.D. student, 2021–present).
    — Candidacy exam committee member.
  - Andisheh Dadashi (Computer Science Ph.D. student, 2021–present).
    — Ph.D. dissertation committee member.
  - Amy Overstreet (Chemistry Ph.D. student, 2020–present).
    — Ph.D. dissertation committee member.
  - Tongtong Li (Chemistry Ph.D. student, 2020–present).
    — Ph.D. dissertation committee member.
  - Adán Myers y Gutiérrez (Nanoscience and Microsystems Engineering Ph.D. student, 2013–2019).
    — Ph.D. dissertation committee member.
    — Thesis title: *"Diagnostic Sequence Detection Against a Complex Background using a DNA Molecular Computation Framework."*
    — Currently a postdoctoral researcher at Los Alamos National Laboratory.
  - Aurora Fabry-Wood (Biomedical Engineering Ph.D. student, 2013–2018).
    — Co-adviser, Ph.D. thesis committee member.
    — Thesis title: *"Compartmentalization of DNA-Based Molecular Computing Elements Using Lipid Bilayers."*
    — M.S. committee member.
    — Currently a field application scientist at Berkeley Lights.
  - Qing Sun (Biomedical Engineering M.S. student, 2018).
    — M.S. committee member.
  - Dandan Mo (Computer Science Ph.D. student, 2013–2016).
    — Ph.D. dissertation committee member.
    — Thesis title: *"Molecular Circuits based on Molecular Spider System."*
  - Alireza Goudarzi (Computer Science Ph.D. student, 2013–2016).
    — Subsequently a postdoctoral researcher at the RIKEN Brain Science Institute, Wakō, Japan.
  - Carl W. Brown, III (Biomedical Sciences Ph.D. student, 2011–2015).
    — Graduated with a Ph.D. with distinction in June 2014.
    — Subsequently a postdoctoral researcher at the Naval Research Laboratory, Washington, DC and a staff scientist at the Wyss Institute, Harvard Medical School, Boston, MA.
    — Now at Sherlock Biosciences.
  - David Mohr (Computer Science Ph.D. student, 2013–2015).
    — Ph.D. thesis committee member.
    — Thesis title: *"Stella: A Python-based Domain-Specific Language for Simulations."*
    — Subsequently at Google, Boulder, CO.
  - Amanda Minnich (Computer Science Ph.D. student, 2011–2014).

  - — Now at Lawrence Livermore National Laboratory, Livermore, CA.
  - Geoffrey Reedy (Computer Science M.S. student, 2013).
    - — M.S. thesis committee member.
    - — Thesis title: *"Design and Implementation of a Scala Compiler Backend Targeting the Low Level Virtual Machine."*

- Undergraduate student mentor, University of New Mexico. Students mentored (8 total):
  - Madalyn Fetrow (Chemistry undergraduate student, summer 2014–2018).
  - Mische Hubbard (Chemical Engineering undergraduate student, 2016–2017).
  - Nicholas A. Baker (Chemical Engineering undergraduate student, 2014–2016).
  - Dominic Medina (Biochemistry undergraduate student, summer 2015).
  - Cameron Degani (Chemical Engineering undergraduate student, summer 2015).
  - Erin Sosebee (Computer Science undergraduate student, summer 2013).
  - Eli K. Horwitz (Chemical Engineering undergraduate student, 2012–2014).
  - Hannah E. West (Chemical Engineering undergraduate student, 2011).
- High school intern mentor, University of New Mexico. Students mentored (7 total):
  - Christian Poncho (Fall 2018–Spring 2019) Adittyo Paul (Summer 2018), Priyanka Jain (Summer 2015), Holly Liu (Summer 2015), Rebecca DeLand (Summer 2014), Katherine Jordan (Summer 2013), Megan Willams (Summer 2013).
- Mentor for student team in postgraduate course BME 598: "Biodesign", University of New Mexico. Students mentored (7 total):
  - Fall 2018: Amanda Sanchez, Neema Naeemi, Rohan Choraghe, Christopher Buksa, Marshall Klee, Daniel Sikora, Ushnik Ghosh. My team won $50,000 in funding from the UNM School of Engineering and the UNM Clinical & Translational Science Center to develop their invention, a wheelchair attachment for stroke patients.

External Service

- 2021. Reviewer for Natural Sciences and Engineering Research Council of Canada (NSERC) Discovery Grant program.
- 2020–present. Program committee co-chair, 27th International Conference on DNA Computing and Molecular Programming (DNA27), Oxford, UK, September 2021.
- 2019–present. Organizing committee co-chair, 27th International Conference on DNA Computing and Molecular Programming (DNA28), Albuquerque, NM, August 2022.
- 2018–present. Organizing committee member, programm committee member, virtual technology committee member, International Conference on Engineering Synthetic Cells and Organelles, Santa Fe, NM, May 2020.
- 2018–present. Program committee member, 24th and 25th International Conferences on DNA Computing and Molecular Programming (DNA24, DNA25).

- 2017–2018. Program committee member, 9th and 10th International Workshops on Biodesign Automation (IWBDA 2017, 2018).
- 2017. Reviewer, British Computer Society Distinguished Dissertation award.
- 2017. Poster and oral presentation judge, UNM STEM Research Symposium.
- 2015–present. Ad hoc reviewer for National Science Foundation.
- 2014–2021. Review editorial board member, Frontiers in Computational Intelligence (a specialty of Frontiers in Robotics and AI).
- 2014. Session chair, Workshop on Computing with Biomolecules: From Network Motifs to Complex and Adaptive Systems (satellite workshop of ALife 2014 conference).
- 2014–2015. Program committee member, 1st and 2nd International Workshops on Verification of Engineered Molecular Devices and Programs (VEMDP 2014, 2015).
- 2008–present. Invited peer reviewer for multiple journals (42 total):
  - Nature; Nature Nanotechnology; Proceedings of the National Academy of Sciences of the USA; Nature Communications; Journal of the American Chemical Society; ACS Synthetic Biology; Bioinformatics; Nucleic Acids Research; ACS Nano; Nano Letters; Angewandte Chemie International Edition; Advanced Functional Materials; Theoretical Computer Science; Journal of the Royal Society Interface; Chemical Science; Interface Focus; Royal Society Open Science; RSC Advances; BMC Bioinformatics; Information & Computation; Advanced Biology; IEEE/ACM Transactions on Computational Biology and Bioinformatics; IEEE Transactions on Neural Networks and Learning Systems; IEEE Transactions on NanoBioscience; IEEE Transactions on Nanotechnology; IEEE Transactions on Emerging Topics in Computational Intelligence; IEEE Life Sciences Letters; IEEE Access; IEEE Design & Test; Proceedings of the Royal Society A; WIREs Nanomedicine & Nanobiotechnology; Artificial Intelligence in Medicine; Computational and Structural Biotechnology Journal; Natural Computing; BioSystems; Molecules; Analytical Methods; Journal of Symbolic Computation; Theory of Computing Systems; Interdiscplinary Sciences—Computational Life Sciences; International Journal of Parallel, Emergent, and Distributed Systems; International Journal of Molecular Sciences.
- 2008–present. Invited peer reviewer for multiple conferences (7 total):
  - International Conference on DNA Computing and Molecular Programming (DNA); International Conference on Unconventional Computation and Natural Computation (UCNC); International Conference on Functional Programming (ICFP); International Colloquium on Automata, Languages, and Programming (ICALP); European Symposium on Programming (ESOP); IEEE International Symposium on Logic in Computer Science (LICS); International Workshop on Biodesign Automation (IWBDA).

University Service

- 2021–present. Chair, Graduate admissions and recruitment committee, Department of Computer Science, University of New Mexico.

- 2018–present. Member, Graduate program committee, Department of Computer Science, University of New Mexico.
- 2018–2021. Member, Graduate admissions and recruitment committee, Department of Computer Science, University of New Mexico.
- 2018–2020. Member, Faculty hiring committee, Department of Computer Science, University of New Mexico.

Professional Society Memberships

- 2018–present. Member, American Association for the Advancement of Science (AAAS).
- 2018–present. Member, American Chemical Society (ACS).
- 2016–present. Member, Institute of Electrical and Electronics Engineers (IEEE).
- 2014–present. Member, Association for Computing Machinery (ACM).
- 2011–present. Member, International Society for Nanoscale Science, Computation and Engineering (ISNSCE).

Selected Invited Talks

- *"Engineering molecules and cells for programmable biology."* Invited speaker as part of University of Minnesota ECE colloquium talk series, February 2022.
- *"Information processing in synthetic cells."* Invited speaker as part of the Build-A-Cell virtual seminar series, August 2021.
- *"Information processing in synthetic cells."* Invited speaker at the Synthetic Approaches to Biology and Artificial Intelligence (SB-AI) workshop, a satellite workshop of the 2021 ALIFE conference, held virtually, July 2021.
- *"Information processing in synthetic cells."* Invited speaker at the 2021 International Conference on Engineering Synthetic Cells and Organelles (SynCell 2021), held virtually, May 2021.
- *"Programming life using cell-free synthetic beiology."* Invited speaker at Biology Seminar, Northern New Mexico College, Española, New Mexico, September 2019.
- *"Modular verification of chemical reaction networks via serializability analysis."* Invited keynote speaker, 2nd International Workshop on Verification of Engineered Molecular Devices and Programs (VEMDP 2015), San Francisco, California, July 2015.
- *"Theory and practice of molecular computing."* Invited speaker at Biochemistry & Molecular Biology Seminar, University of New Mexico School of Medicine, Albuquerque, New Mexico, March 2015.

Selected Contributed Talks

- *"Protecting heterochiral DNA nanostructures against exonuclease-mediated degradation."* Presented by graduate student Tracy Mallette at the 28th International Conference on DNA Computing and Molecular Programming (DNA28), Albuquerque, New Mexico, August 2022.
- *"Robust heterochiral strand displacement using leakless translators."* Presented by graduate student Tracy Mallette at the 26th International Conference on DNA Computing and Molecular Programming (DNA26), held virtually, September 2020.
- *"Supervised learning in a multi-layer, non-linear chemical neural network."* Presented by graduate student David Arredondo at the 26th International Conference on DNA Computing and Molecular Programming (DNA26), held virtually, September 2020.
- *"Automated, constraint-based analysis of tethered DNA nanostructures."* 23rd International Conference on DNA Computing and Molecular Programming (DNA23), Austin, Texas, September 2017.
- *"Towards temporal logic computation using DNA strand displacement reactions."* International Conference on Unconventional Computation and Natural Computation, Fayetteville, Arkansas, June 2017.
- *"Supervised learning in an adaptive DNA strand displacement circuit."* 21st International Conference on DNA Computing and Molecular Programming (DNA21), Boston, Massachusetts, August 2015.
- *"Abstract modelling of tethered DNA circuits."* 20th International Conference on DNA Computing and Molecular Programming (DNA20), Kyoto, Japan, September 2014.
- *"Pattern formation by spatially organized approximate majority reactions."* International Conference on Unconventional Computation and Natural Computation, London, Ontario, July 2014.
- *"Compiling DNA strand displacement reactions using a functional programming language."* International Symposium on Practical Aspects of Declarative Languages, San Diego, California, January 2014.
- *"Modular verification of DNA strand displacement networks via serializability analysis."* 19th International Conference on DNA Computing and Molecular Programming (DNA19), Tempe, Arizona, September 2013.
- *"Towards a biomolecular learning machine."* International Conference on Unconventional Computation and Natural Computation, Orléans, France, September 2012.
- *"Modelling, simulating and verifying Turing-powerful strand displacement systems."* 17th International Conference on DNA Computing and Molecular Programming (DNA17), Pasadena, California, September 2011.
- *"Resolving inductive definitions with binders in higher-order typed functional programming."* European Symposium on Programming, York, United Kingdom, March 2009.

Selected Poster Presentations

- David Arredondo and Matthew Lakin. *"Operant conditioning of stochastic chemical reaction networks."* 28th International Conference on DNA Computing and Molecular Programming (DNA28), Albuquerque, New Mexico, August 2022.
- Sarika Kumar and Matthew Lakin. *"A geometric framework for reaction enumeration in computational nucleic acid devices."* 28th International Conference on DNA Computing and Molecular Programming (DNA28), Albuquerque, New Mexico, August 2022.
- David Arredondo and Matthew Lakin. *"Supervised learning in a multi-layer, non-linear chemical neural network."* 26th International Conference on DNA Computing and Molecular Programming (DNA26), held virtually, September 2020. This poster was also nominated for a short oral presentation.
- Matthew Lakin, Julian M. Weisburd, and Sarika Kumar. *"Structure sampling for rate estimation in tethered molecular circuits."* 25th International Conference on DNA Computing and Molecular Programming (DNA25), Seattle, Washington, August 2019.
- Carlo Spaccasassi, Matthew Lakin, and Andrew Phillips. *"A logic programming language for computational nucleic acid devices."* International Workshop on Biodesign Automation, Cambridge, UK, July 2019.
- Aurora Fabry-Wood, Madalyn E. Fetrow, Carl W. Brown, III1, Nicholas A. Baker, Nadia Fernandez Oropeza, Andrew P. Shreve, Gabriel A. Montaño, Darko Stefanovic, Matthew Lakin, and Steven W. Graves. *"Monitoring DNA Reactions on a Fluid Microsphere Supported Lipid Bilayer Surface with Flow Cytometry."* 23rd International Conference on DNA Computing and Molecular Programming (DNA23), Austin, Texas, September 2017.
- Keith Lidke, Diane Lidke, Cheyenne Martin, Farzin Farzam, Jeremy Edwards, Matthew Lakin. *"Multi-structure super-resolution imaging using sequential imaging and DNA strand displacement."* 2018 Conference on Quantitative BioImaging in Göttingen, Germany, January 2018.